THE UNIVERSITY OF TENNESSEE
CHATTANOOGA

THEC ACADEMIC PROGRAM REVIEW

Computational Science Graduate Program

Self-Study for the Ph.D. in Computational Science Program

Academic Years 2015-2020

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INTRODUCTION

During the current review cycle, the Computational Science Ph.D. program at the University of Tennessee Chattanooga has seen substantial changes. These changes were necessary in order to grow enrollment as well as to establish a financially sustainable doctoral program. This self-study report presents the history, rationale, and transition of the Computational Engineering Ph.D. program to the Computational Science Ph.D. program. Additionally, this report describes the efforts taken to redefine the mission of the SimCenter in becoming a campus-wide multidisciplinary research accelerator and core facility for high-performance computing, and the creation of the Center for Urban Informatics and Progress. These Centers allow for an integrated research and educational environment and act as a catalyst for campus-wide computational-based research. The self-study report assesses the overall program with regards to achieving the established student learning outcomes, enrollment and graduation, demographics, employment, faculty, support and resources, and budget.

HISTORY AND BACKGROUND

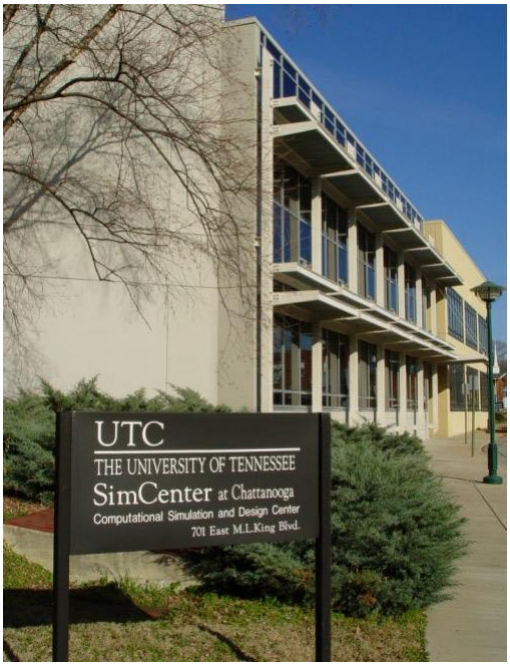
A. History of the University of Tennessee at Chattanooga

The University of Tennessee at Chattanooga, a metropolitan university since 1969, has historical roots in two private institutions: The University of Chattanooga (UC) and a junior college, Chattanooga City College (CCC). UC was founded by an agency of the Methodist Episcopal Church in 1886, later consolidated with Grant University and Tennessee Wesleyan University in 1889, and renamed The University of Chattanooga in 1907. CCC, with a predominantly African-American student population, was created in 1964 as a non-sectarian successor to Zion College, which had been established as a junior college in 1949.

The University of Chattanooga and Chattanooga City College merged in 1969 with The University of Tennessee System, one of the oldest land-grant institutions in the nation, to form The University of Tennessee at Chattanooga (UTC). The UT System currently has four primary campuses located in Knoxville, Martin, Memphis, and Chattanooga. Governance is provided through a UT System President, Chancellors on each campus, and a UT Board of Trustees.

UTC earned the Carnegie Community Engagement classification in both Curricular Engagement and Outreach and Partnerships areas in 2008. The University's wide diversity of degree programs has attracted a current 2019-2020 enrollment of over 11,000 students representing 88 Tennessee counties, 40 states, and 46 foreign countries. UTC currently offers 24 Master, one Educational Specialist, and six Doctorate degrees, which accounts for approximately 11.5% of student enrollment headcount.

B. History of the Computational Engineering Program



The University of Tennessee SimCenter at Chattanooga and the UTC Graduate School of Computational Engineering were both established in late 2002. This was the result of a shared vision to form an engineering research center in Chattanooga, to begin UTC's first Ph.D. program, and to initiate external engagement activities that would ultimately support technology innovation and economic development in Chattanooga. These initiatives were enabled in part by large grants from the Lupton Foundation and UC Foundation and by contributions of time and resources from many other people and institutions. Starting in November 2003, the SimCenter occupied a 31,000 sq. ft. research and education facility adjacent to campus. The UC Foundation renovated this formerly unoccupied building, which had been donated by the City of Chattanooga.

The Computational Engineering program received approval in April 2003 to offer a concentration in Computational Engineering within the existing M.S. in Engineering degree at UTC. During the academic year following the last self-study (Academic Years 2010 – 2015), the M.S. in Engineering: Computational Engineering concentration was discontinued, and the remaining students were allowed to complete their degrees. From Fall 2003 to August 2016, the M.S. in Engineering: Computational Engineering concentration conferred 43 degrees.

Approval from the Tennessee Higher Education Commission (THEC) was received in January 2004 to offer the Ph.D. in Computational Engineering. UTC received approval from the Southern Association of Colleges and Schools Commission on Colleges (SACSCOC) in April 2004 for a substantive change in status to a Ph.D. granting institution. The Computational Engineering Ph.D. program officially commenced operation in the fall semester of 2004. The Department of Computational Engineering grew rapidly over its first few years and continued at a rapid growth rate until the onset of the economic downturn that began in late 2008. From Fall 2004 through the completion of the previous self-study report (Fall 2014), the Ph.D. in Computational Engineering had cumulatively conferred 19 doctoral degrees.

Due to the aforementioned downturn, and the prolonged effects that were felt in the traditional funding sources of the SimCenter, no new students were admitted into the program from Spring 2014 through the Spring 2016 semester. This moratorium was deemed necessary to address lingering problems with developing a sustainable funding

model for the program. One of the steps taken in these regards was the transition from Computational Engineering to a more diverse Computational Science program.

C. Transition of the Ph.D. Program to Computational Science

The Department of Computational Engineering administered the Ph.D. degree program as well as the M.S. in Engineering: Computational Engineering concentration. At its highest point, the 2012-2013 academic year, the Department was comprised of eight academic tenure/tenure-track faculty including the Department Head, 13 research faculty, and two research associates. Due to the economic downturn, and a moratorium on new student admissions, many faculty left the program to pursue industry, academic, and government positions. At the time of the last THEC Academic Program Review, the Department and SimCenter consisted of a Department Head (who also served as Interim Director of the SimCenter), two academic tenured professors, and nine research faculty. The Department Head and one of the academic tenured professors retired in June 2015. Six of the nine research faculty left the program during the 2015-2016 academic year. In order to stabilize the program, as well as to create a more sustainable funding model, the Ph.D. program transitioned to Computational Science. This transition was accomplished based on the scope of the Computational Engineering degree.

The working definition of Computational Engineering as it appeared in the approved Ph.D. program:

> ***Computational Engineering (CmE)*** *is the development and application of computational models and scientific supercomputing to solve complex physical problems arising in engineering analysis and design. It encompasses the development and application of software tools and systems, including physical, mathematical, and geometric modeling, solution algorithms, computer simulations, and visualization, analysis, interpretation, synthesis, and use of computed results to solve practical problems.*

with the primary educational objective of the Computational Engineering program consisting of:

> *1. Academic preparation in three core areas of computational engineering: a) an engineering/science application area, b) applied computational mathematics, c) applied scientific computing*

Although the scope of the program remained the same, in July 2015 the Classification of Instructional Program (CIP) code and name of the program was changed to Computational Science. From the National Center for Educational Statistics (nces.ed.gov):

Detail for CIP Code 30.3001
Title: *Computational Science.*

Definition: *A program that focuses on the study of scientific computing and its application. Includes instruction in scientific visualization, multi-scale analysis, grid generation, data analysis, applied mathematics, numerical algorithms, high-performance parallel computing, and numerical modeling and simulation with applications in science, engineering, and other disciplines in which computation plays an integral role.*

As can be readily seen, the definitions are essentially identical. However, the definition used in Computational Engineering was simply a working definition as created by the program. The Computational Science definition is universally accepted and, therefore, the CIP code and name change were justified and approved by THEC as the original scope of the program remained the same.

To best address the interdisciplinary nature of the Computational Science Ph.D. program, the departmental structure of the original program was abandoned, and instead, a concentration-based approach was adopted to expand the program across UTC. To this end, Computational Engineering represented the first concentration and encompassed all engineering departments within the College of Engineering and Computer Science (CECS). That is, the Computational Engineering concentration is applicable to all computational-based doctoral engineering research, regardless of the specific engineering discipline. During the Fall 2015 semester, the Department of Computer Science and Engineering created a Computer Science concentration which was approved by UTC Graduate Council during Spring 2016 semester. At this time, the moratorium was lifted and new students were permitted to enroll in the Computational Science Ph.D. program. During the Fall 2017 semester, the Department of Mathematics created a Computational & Applied Mathematics concentration, which was approved during the Spring 2018 semester. Discussions concerning establishing a Computational Biology and Environmental Science concentration have taken place, however, a graduate proposal has yet to be developed. In order to support these concentrations and broaden the research focus, the SimCenter facility was re-envisioned as the Multi-Disciplinary Research Building.

D. Expansion of the SimCenter to the MultiDisciplinary Research Building

As previously discussed, the SimCenter building was established as a research and educational facility supporting the Computational Engineering Ph.D. program. Due to the transition of the Ph.D. program to a more diverse Computational Science degree, the SimCenter was expanded to the MultiDisciplinary Research Building (MDRB). Currently, the MDRB houses the SimCenter and the Center for Urban Informatics and Progress

(CUIP), along with other specialized labs such as the Interdisciplinary Geospatial Technology Lab (IGTLab), the Internet-of-Things Lab (IoT Lab), and the Unmanned Systems Lab. The SimCenter Director manages the MDRB facilities and infrastructure.

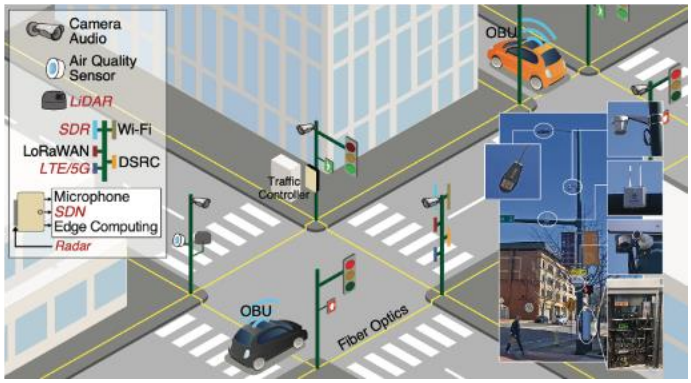
Under the new broader, campus-wide mission, the SimCenter (new.utc.edu/research/simcenter) now serves UTC as a multidisciplinary research accelerator as well as the core facility for High-Performance Computing and Storage. Therefore, the formal mission statement for the SimCenter is to establish, expand, and sustain a cohesive multidisciplinary effort in applied computational sciences through mentoring of students and faculty, seed funding in key thrust areas, and state-of-the-art research computing facilities. Current research thrust areas include Advanced Modeling and Simulation, High-Performance Computing and Algorithms, Cybersecurity and Cyber-Physical Systems, Health and Biological Systems, Digital Twins, and Energy and Environment. To this end, the SimCenter is a THEC-funded Center of Excellence in Applied Computational Science and Engineering (CEACSE) designed to advance modeling- and simulation-based research. Additionally, it is also a member of a new focused investigative Center for Understandable, Performant Exascale Communication Systems (CUP-ECS). This center is part of the Predictive Science Academic Program (PSAAP-III) under the National Nuclear Security Agency (NNSA) of the US Department of Energy. Dr. Anthony Skjellum joined UTC as the Director of the SimCenter in July 2017 and his curriculum vitae may be found in Appendix A.

The Center for Urban Informatics and Progress (CUIP) is a smart city and urbanization research center at UTC (new.utc.edu/research/center-urban-informatics-and-progress). Using the power of big data, artificial intelligence, statistical modeling, machine learning, and more, the center studies how cities can adapt to our generation's challenges to ensure that our future is safer, smarter, and healthier for all. CUIP's applied research efforts pioneer ways to improve traffic flow, reduce vehicle and pedestrian accidents, reduce carbon emissions, optimize healthcare patient outcomes, and more.

The City of Chattanooga has emerged as a pioneer in urban renewal and sustainable development. As part of this renewal, an extraordinary infrastructure has been put in place that includes high-speed, high bandwidth information networks that connect a large number of citizens to the Internet. This infrastructure provides the foundation for the collection and exploitation of large amounts of heterogeneous data intended to improve city services. It allows for more effective transportation systems, energy efficiency, production and delivery, and for improving quality of life in general, including human wellness and health management and care delivery. As a regional partner, CUIP has many ties and collaborations with the City of Chattanooga and plays a major role in the Chattanooga Smart Community Collaborative (www.utccuip.com/cscc).

Chattanooga is uniquely positioned to be the next generation testbed for smart cities. The city has wisely used its unique location and its resources to build the first 10Gbps fiber optic Internet service through the Electric Power Board (EPB) of Chattanooga to 80,000

householders and businesses. This led Chattanooga to be called GigCity because it is the first city in the Western Hemisphere to acquire city-wide fast Internet service.



CUIP has been working collaboratively with the City of Chattanooga, Chattanooga Department of Transportation, EPB of Chattanooga and The Enterprise Center to develop, deploy and publish innovative practices for the smart city of Chattanooga. Central to the work of CUIP is the MLK Smart Corridor, a 1.2-mile stretch of road in downtown Chattanooga capable of giving researchers real-time data about traffic, pedestrians, emissions, and more. Intersections across the corridor are outfitted with cameras, lidar, air quality monitors, and more, to give researchers and city officials unique insights into the inner workings of urban environments. Dr. Mina Sartipi is the founding Director of CUIP and her curriculum vitae may be found in Appendix A.

E. Responses and Actions Taken as a Result of the Previous Self-Study

The last self-study of this program was undertaken during the Spring 2015 semester. The self-study document formed the basis for a formal review conducted by Dr. L.S. “Skip” Fletcher in March 2015. Dr. Fletcher’s comments in his review were overall very complimentary and focused generally on modifications intended to promote a more sustainable program. The summary recommendations contained two sections, the first being an overall impression of the program and the second listing suggested goals and possible paths forward in achieving these goals in the subsequent five years. The following summarizes Dr. Fletcher’s comments (in italics) and provides responses to his suggestions for improvement.

Overall, what are your impressions of the program?

To this question, following a very complimentary paragraph, Dr. Fletcher notes:

> *In terms of weaknesses, the expectation that the SimCenter must provide all of the resources to operate the program without support from the College of Engineering and Computer*

Science limits the chances of offering a successful program. Further, the increasingly difficult research funding environment of both industry and government is an obstacle despite an increase in the number of proposals submitted by the SimCenter faculty. Clearly, new funding sources are needed as the scope of the program is broadened to include other areas.

RESPONSE: This comment reflects the integrated nature of the SimCenter and the Department of Computational Engineering as an organizational structure during the last review cycle. The Department of Computational Engineering, uniquely identified as the Graduate School of Computational Engineering at UTC, received direct state funding for the academic program. This funding covered the academic salaries of tenured/tenure-track faculty within the program. However, the research operation of the SimCenter was completely self-funded (including covering research faculty and support staff, associated personnel benefits, equipment, and other facility costs).

As previously discussed, the Computational Science Ph.D. expanded the capacity of the program via a concentration-based structure that encompassed all Engineering Departments, Computer Science, and the Department of Mathematics. The SimCenter facility was re-envisioned as the MDRB, where the SimCenter serves as a multidisciplinary research incubator and HPC core facility for the campus. A portion of the original state funding for the Ph.D. program was transferred to CECS to support pre-existing faculty lines from Computational Engineering, whereas the remainder serves to cover operational costs associated with the MDRB. Ultimately, these program modifications significantly increased graduate faculty numbers by utilizing existing, as well as leveraging new faculty hires, within the CECS and the College of Arts & Sciences (CAS).

What goals would you suggest the program set for the next five years? How can the program work to achieve these goals over the next five years?

1) Develop a plan for balancing the number of graduate students and research staff commensurate with anticipated funding. Part of this plan should be to review all research staff and determine which staff have the potential for an academic appointment, and which staff might find a better opportunity with industry or government. In this regard, it would mean placing some staff and students on the College of Engineering and Computer Science funding and being very selective in staff and student additions to SimCenter funding. Only add research staff when funding is anticipated and only if absolutely necessary when an advanced PhD student cannot provide the assistance needed. These efforts may require some transition funds from the University, or redefinition of some of the College of Engineering and Computer Science funding through the elimination of small classes and limited enrollment majors.

RESPONSE: As discussed in History and Background Section C, by the end of the 2015-2016 academic year the number of research staff was reduced from nine to three. Two of these research faculty were hired as tenure-track faculty within the CECS in January

2017, the third remained as SimCenter research staff. Student funding comes from a variety of external, and limited internal, sources.

2) Refine the mission and goals for the SimCenter and the PhD program in Computational Engineering, recognizing that there are now many open source simulation tools that are comparable to those developed and used by the SimCenter, and that there are a wider range of computational opportunities for modeling and simulation than when the SimCenter was started.

RESPONSE: Again, the expansion of the original program to Computational Science significantly broadened the range of computational opportunities and the modeling and simulation tools utilized.

3) Carefully review all current graduate students and determine their status and progress towards the PhD, transfer all MS students to the College of Engineering and Computer Science, and set a hard timeline for completion of the PhD for each student and stopping the funding after a fixed period. For MS students, funding should only be provided for actual time devoted to the MS research.

RESPONSE: The MS in Engineering: Computational Engineering concentration was eliminated and all students were permitted to graduate. During the 13 years that this concentration was active, 43 degrees were conferred. Current MS students now work with faculty within the existing MS programs in the CECS and CAS. With regards to setting a hard timeline for completion of the Ph.D., little has been done. However, this issue has been somewhat mitigated via lower student-to-faculty ratios due to the expansion of the program. Again, between Fall 2004 through the completion of the previous self-study report (Fall 2014), the Ph.D. in Computational Engineering had cumulatively conferred 19 doctoral degrees. From Fall 2015 through Fall 2020, the Ph.D. program has conferred 25 doctoral degrees.

4) The SimCenter research staff and faculty must seek funding from non-traditional sources as well as peripheral science areas, providing services utilizing their skills and software to serve industry and the public. Large blocks of funding from the Federal Government are highly unlikely except in very targeted areas. At this point, it appears that funding for the SimCenter and the staff/graduate students must come from industry and royalties/license fees or other SimCenter products. This transition effort may also require some additional funding from the University.

RESPONSE: The expansion of the Ph.D. program, the re-envisioned mission of the SimCenter, and the creation of CUIP address this recommendation.

5) In view of the uniqueness of the SimCenter, its national and international reputation, and the potential for increased research income and intellectual property development, it is recommended that the SimCenter, as a research-driven unit, report to a Vice Chancellor for Research or possibly the Office of the Provost. The Graduate School of Computational Engineering and the academic MS and PhD programs, would appropriately continue to report to the Dean of the College of Engineering and Computer Science.

RESPONSE: Starting in Fall 2014 UTC conducted a national search for a Vice-Chancellor of Research/Dean of the Graduate School. This combined position was to serve UTC in both capacities. Dr. Joanne Romagni was appointed to this position in July 2015. As such, the SimCenter, CUIP, and MDRB staff directly report to the Vice-Chancellor of Research. Additionally, with the elimination of the MS in Engineering: Computational Engineering concentration, and the intent to extend the Ph.D. degree and make it accessible across multiple colleges, the Computational Science program was designated by the Provost to report to the Vice-Chancellor of Research/Dean of the Graduate School.

6) Develop an academic Master Plan which shows course sequence and semester the course is to be offered so as to make efficient use of the student's time while on Campus. Consider offering courses continuously over 12-months with the goal of minimizing time required to satisfy degree requirements and therefore reduce overall cost.

RESPONSE: This recommendation stems from the limited number of academic Computational Engineering faculty and the sparsity of course offerings. The expansion of the Ph.D. program and the significant increase in faculty involvement across CECS and CAS has mitigated this issue.

7) Review the existing Computational Engineering course offerings with an eye towards expanding those offerings to include such elective courses as computational biology, computational chemistry, computational physics or other areas related to computational engineering. Although the number of course offerings at the University of Tennessee at Chattanooga in these areas are few; perhaps the new joint faculty appointees from ORNL could help with identifying qualified individuals (at ORNL or UTK) to provide instruction in these and other areas of interest to the computational engineering program.

RESPONSE: Once again the expansion of the Ph.D. program to Computational Science, and with the increased faculty base and strategic hires within CECS and CAS, significant diversity in course offerings has resulted.

8) Continue pursing partnerships with other institutions that could lead to enhanced educational opportunities for students as well as "enrichment" opportunities for computational engineering faculty that can also lead to external funding. It is important that ongoing efforts aimed at partnering with Volkswagen, ORNL, Purdue, UTSI, Toledo, and Auburn be continued and supported by the university.

RESPONSE: The SimCenter, CUIP, and many faculty involved in the Computational Science Ph.D. program have established numerous collaborative partnerships with the aforementioned entities as well as many others.

9) Consider establishing an on-line only non-thesis MS program in computational engineering where students would pay their own way, thereby associating MS students with attracting revenue rather than expending it.

RESPONSE: This recommendation somewhat contradicts the third recommendation. As previously noted, the MS in Engineering: Computational Engineering concentration was

eliminated. However, the CECS has established an online MS in Engineering option in recent years.

PART I – LEARNING OUTCOMES

UTC is committed to institutional effectiveness and continuous improvement. As part of these efforts, outcomes assessment processes have been established. Campus Labs/Anthology is used as a repository for student learning outcomes, service outcomes, assessment results, and strategic plans. By using the information captured in Campus Labs/Anthology, UTC is able to provide evidence of outcomes being assessed and those results being used for continuous improvement. A detailed time-line of the process, tools used for developing outcomes, and how these results are used campus wide for continuous improvement may be found on the Office of Planning, Evaluation, and Institutional Research website (new.utc.edu/academic-affairs/planning-evaluation-and-institutional-research/assessment-and-institutional-effectiveness).

A. Program Learning Outcomes

The goal of the program is to produce graduates who can make contributions to the betterment of our society and our nation. The program has three learning outcomes for outcome assessment:

- ACADEMIC PREPARATION: Students will exhibit competence in the three core areas of Computational Science: a) an engineering/scientific application area, b) applied computational mathematics, c) applied scientific computing

- INDEPENDENT RESEARCH: Students will be able to conduct independent research in a computational science specialty area, typically demonstrated by solving practical problems using computer simulations based on mathematical models

- GRADUATES WITH MARKETABLE SKILLS: Students will have practical, marketable skills to obtain employment relatively soon after graduation (assuming that employment is their immediate goal).

These learning outcomes directly align with the Institutional mission, the College of Engineering and Computer Science mission, as well as the College of Arts and Sciences mission by preparing students to enter into the global community capable of advancing scientific knowledge through research with critical thinking, communication, and complex solving skills.

B. Program Evaluation

1. Academic Preparation

As outlined in greater detail in Part III.B, at the completion of all coursework, students are given a preliminary examination on material from the three core areas of computational

science. The preliminary exam has a written and an oral component. The preliminary exams cover four (4) subject areas. These subject areas include the required core courses in mathematics (1) and computer science (1), as well as the application area of the dissertation research (2). Each student sits for the written exams, followed by an oral exam conducted by the examining committee. Each faculty who administers an exam records the results (for their exam) using a rubric which may be found in Appendix B. Results for both the written and oral portion of the exams are reported to the Computational Science Ph.D. Program and are placed on file. These rubrics form the basis for the assessment of Academic Preparation and are reported annually for SACSCOC outcomes assessment.

During this review cycle, 24 Ph.D. students have taken their preliminary exams. They were evaluated by the examining committee using the following four criteria:

- **Criterion 1:** Answered all questions thoroughly
- **Criterion 2:** Demonstrates knowledge and understanding of examination subject area
- **Criterion 3:** Demonstrates ability to identify correct solution procedure
- **Criterion 4:** Demonstrates ability to articulate/explain solution procedure

Additionally, the exam committee also rated the student's performance on the written (**W**) as well as the oral (**O**) portions of the preliminary exam in addition to providing an overall rating of the students' performance. The ratings ranged from "Needs Significant Improvement" to "Excellent" on a five-point Likert scale. "Needs Significan Improvement" in either the written or oral portions requires that part of the exam to be retaken. Although, a rating of at least "Needs Improvement" in the Overall category is required to pass the preliminary exam, a "Needs Improvement" cannot be obtained in both the written and oral portions. The aggregated scores across the four criteria in addition to the overall scores are shown in Table 1 below. Note that each student is evaluated by the three or four faculty members that form the Examination Committee, therefore the overall number of evaluations is significantly greater than the number of students taking the exams.

As can be seen from in Table 1, most students scored in the Satisfactory to Excellent categories across all criteria. It appears that students struggle more with the oral portion of the exams, as a small number of them scored lower in this category. Potential causes for this lower performance could be related to language barriers for some of our international students in addition to nervousness in facing the exam committee. To this end, students are encouraged to attend the various speaker series offered and utilize academic support service provided by UTC as outlined in Part III.F and G, respectively. Furthermore, students are additionally encouraged to participate in the UTC Research Dialogues and the CECS Technology Symposium. These are annual events that celebrate research, scholarly and creative activities across campus and in the Chattanooga community. In these events, students present their research in a conference-style setting to faculty, staff, community leaders, and their peers.

TABLE 1 – Rubric Results for Academic Preparedness

Rating	Criterion 1		Criterion 2		Criterion 3		Criterion 4		Overall
	W	O	W	O	W	O	W	O	
Excellent	29	17	34	22	35	20	30	16	24
Very Good	45	38	42	38	42	43	44	37	37
Satisfactory	15	23	15	23	13	17	15	21	20
Needs Improvement	3	13	0	9	1	11	3	15	12
Needs Significant Improvement	0	1	1	0	1	1	0	3	0

2. Independent Research

Each candidate for the doctoral degree must conduct research and present a dissertation on that research that 1) demonstrates a mastery of the techniques of research and 2) makes a very distinct contribution to the field of computational science. At the completion of the research, the candidate prepares and submits a draft of the dissertation to each committee member, and in consultation with the major advisor schedules a final defense through the UTC Graduate School. The final defense includes a public presentation of the dissertation followed by a defense of the dissertation before the faculty and dissertation committee. The committee either accepts, accepts provisionally (subject to requirements set by the committee), or does not accept the dissertation for credit toward the degree requirements. The Concentration Coordinator records the outcome of the defense and submits the form to the Graduate School. In addition, the candidate's dissertation committee assesses the quality of research conducted by the student using the rubric in Appendix B for Independent Research. The input from this rubric is reported annually for the SACSCOC outcomes assessment.

During this review cycle, 24 Ph.D. students have successfully defended their dissertations. Note, in section Part III.D, a detailed presentation with regards to enrollment, demographics, and degrees awarded may be found. Additionally, a list of the doctoral dissertations is given in Appendix C. The students were evaluated by the exam committee using the following criteria:

- **Criterion 1:** Problem Definition
- **Criterion 2:** Literature and Previous Work

- **Criterion 3:** Impact of Proposed Research
- **Criterion 4:** Solution Plan
- **Criterion 5:** Results
- **Criterion 6:** Quality of Written (**W**) and Oral (**O**) Communication
- **Criterion 7:** Quality of Responses to Questions
- **Criterion 8:** Critical Thinking
- **Criterion 9:** Broader Impact
- **Criterion 10:** Publications

The specifics of what each criterion entails are available in Appendix B. In addition to these criteria, the dissertation committee also provided an overall rating. The ratings followed the same scale as the preliminary exams with an overall rating of at least "Needs Improvement" required to successfully pass the dissertation defense. Again, "Needs Improvement" cannot be received in both the written and oral categories. Table 2 provides the aggregated scores for the students who defended their dissertations during this review cycle. The data indicates that a significant portion of the students having at least "Satisfactory" performance or better with only a couple of grades in the "Needs Improvement" category. Feedback from this rubric is provided to the faculty advisors and graduate coordinators of the program as informative guidance. As a result, to mitigate potential deficiencies, subsequent students are directed to appropriate campus-provided resources.

TABLE 2 – Rubric Results for Independent Research

Rating	C1	C2	C3	C4	C5	C6		C7	C8	C9	C10	Overall
						W	O					
Excellent	36	39	40	44	38	32	40	39	48	41	41	46
Very Good	40	35	37	31	35	40	33	44	34	39	33	31
Satisfactory	12	13	11	10	15	14	15	6	7	9	13	11
Needs Improvement	1	2	0	1	0	2	0	0	0	0	2	0
Needs Significant Improvement	0	0	0	0	0	0	0	0	0	0	0	0

3. Graduates with Marketable Skills

The interdisciplinary nature of the Computational Science degree, and the acquired knowledge in applied mathematics, computer science, and engineering/science applications, make graduates both marketable and in demand. To this end, all students during this review cycle were employed upon graduation. The placement of these students is given in Table 3 below. Due to FERPA Laws and privacy concerns, student

names will not be given. As can be clearly seen, graduates are currently employed by a variety of industrial, academic, and government agencies.

TABLE 3 – Employment of Graduates

Senior Software Engineer, Abundant Robotics, Inc. Hayward, CA.	Aerodynamics Engineer, Boeing Research & Technology Mukilteo, Washington	Research Scientist, NASA Langley Research Center Hampton, VA	Research Software Engineer, Oak Ridge National Lab Oak Ridge, TN
Computational Engineer, EndoVantage Scotsdale, AZ	Applications Engineer, Pointwise Fort Worth, TX	Surfacing Meshing Software ENGR Siemens PLM, Austin, TX	Assistant Professor, Lipscomb University Nashville, TN
Software Development Engineer, Mentor Graphics/Siemens, Huntsville, AL	Research Assistant Professor, Department of EECS, University of Tennessee Knoxville, Knoxville, TN	Director, Civil Infrastructure Lab & Research, UTC, Civil & Chemical ENGR, Chattanooga, TN	Research Scientist, University of Cincinnati Cincinnati, Ohio
Research Scientist, NASA Langley Research Center Hampton, VA	Research Engineer, Convergent Science Madison, WI	Alfrex LLC, Suwanee, GA	CFD Applications Engineer, Siemens Houston, TX
NIH-National Cancer Institute Fellow, University of Cincinnati Cincinnati, Ohio	Lecturer, University of Tennessee at Chattanooga Chattanooga, TN	Senior Development ENGR-Machine Learning, AMD Austin, TX	Senior Research Engineer Convergent Science Madison, WI
Lead Engineer, WorldQuant Austin, TX	Pilot, United States Air Force	Director of Software Engineering, Branch Technologies Chattanooga, TN	Sr. Data Science Computational Scientist Virginia Tech, Blacksburg, VA

PART II – CURRICULUM

A. Curriculum Review

The curriculum review process is two-fold. First, all departments and colleges have a curriculum review process in place for their graduate courses and programs. These are provided and discussed as part of the THEC review process for their program-specific degrees, and ultimately extend to the Computational Science Ph.D. Secondly, the Computational Science Ph.D. Program Coordinators regularly meet to discuss programmatic needs. These meetings include the appropriate department heads, and subsequently, these discussions then extend to the appropriate faculty for action. The program is not offered through online or distance learning technologies.

B. Curricula Structure

As is standard, courses taken during doctoral studies are utilized to support the dissertation research. Individual programs of study are developed based on each student's background, interests, and research objectives. The courses that support these research objectives are varied and collectively come from the various departments in engineering, mathematics, and computer science. Additionally, graduate courses outside these core areas are permissible when they directly contribute to the scientific application. For example, students performing research in computational biology may have a need for graduate-level courses from biology. Specific program requirements are detailed in PART III.B. The Computational Science Ph.D. program has common core requirements in Computer Science and Mathematics. High-performance computing is an integral part of the Computational Science Ph.D. program, and many of the courses in the curriculum are routinely updated to address the most recent technological innovations. Since high-performance computing is an integral part of the Computational Science Ph.D. program, many of the courses in the curriculum are routinely updated to address the most recent technological innovations to advance student learning. Beyond these core requirements, and as noted above with respect to individual programs of study, students are required to have at a minimum six semester hours at the 7000-level.

Course Requirements:

Computer Science Common Core (6 credit hours)
CPSC 5210 Design and Analysis of Computer Algorithms
CPSC 5260 Introduction to Parallel Algorithms
CPSC 5410 Model Analysis and Simulation

Mathematics Common Core (6 credit hours)
MATH 5210 Linear Algebra and Matrix Theory
MATH 5600 Numerical Analysis I
MATH 5610 Numerical Analysis II

Advanced Study Requirements (minimum 6 credit hours)
CPSC 7210 Parallel Scientific Supercomputing
CPSC 7250 Advanced Data Science
CPSC 7600 Secure Software Engineering
CPSC 7610 Information Security Theory and Practice
CPSC 7910 Special Topics in Computer Science and Engineering
CPSC 7997 Individual Studies

MATH 7160 Computational Statistics
MATH 7180 Probability Theory
MATH 7290 Algebraic Number Theory

MATH 7460 Mathematical Biology
MATH 7560 Asymptotic Analysis
MATH 7580 Discrepancy Theory
MATH 7590 Spectral Theory
MATH 7640 Advance Numerical Linear Algebra
MATH 7910 Special Topics in Computer Science and Engineering
MATH 7997 Individual Studies

ENME 7100 Computational Fluid Dynamics II
ENME 7130 Advanced Topics in the Finite Element Method
ENME 7160 Adaptive and Dynamic Grid Generation
ENME 7310 Computational Design Optimization
ENME 7340 Viscous Flow Computations
ENME 7400 Computational Structural Dynamics II
ENME 7510 Advanced Turbulence Modeling
ENME/ENEE/ENCE/ENCH 7910 Special Topics in Computational Engineering
ENME/ENEE/ENCE/ENCH 7997 Individual Studies

C. Course Scheduling

Course scheduling for all 5000- and 7000-level courses are performed by the respective departments. The core required courses in Computer Science and Mathematics described above are offered each academic year. Doctoral level courses are offered as needed based on demand and graduate enrollment. Occasionally, when student enrollment is low, faculty will engage these courses with the students via the 7997 Individual Studies course option. When advanced material in a topic is desirable, or an exploratory course is being considered, faculty will present this material using the 7910 Special Topics class.

D. Alignment with Learning Outcomes

The interdisciplinary curriculum is directly aligned with the three learning outcomes of the program. Core Computer Science and Mathematics, as well as the application-specific courses, are assessed using the Preliminary Exam and associated rubric, as previously discussed. Within all respective departments, 7998 Doctoral Research and 7999 Dissertation courses exist and are used to assess Independent Research. In either of these courses, a grade of unsatisfactory performance (NP) cannot be counted on the student's program of study. Additionally, a rubric is utilized after the student has completed degree requirements to assess Independent Research. The interdisciplinary curriculum has been adopted in order to provide opportunities for students that broaden their knowledge and backgrounds and thus produce graduates with marketable skills.

PART III – STUDENT EXPERIENCE

The PhD program is unique because it emphasizes interdisciplinary teamwork and is integrated with research centers to prepare graduates to develop and apply advanced modeling, simulation, and optimization software for a broad range of real-world scientific analysis, data-driven discovery, and product design solutions.

The Computational Science curriculum offers broad exposure to applied mathematics, scientific computing, and a science or engineering application area. Due to the wide scope of this interdisciplinary program, various concentration areas are available. These concentration areas allow for flexibility, and may evolve as needed, to address educational and research priorities of national and global interest. With regards to teaching, all classes undergo Course Learning Evaluations (CLE) to provide faculty with feedback to improve quality of instruction as well as course content. Course Learning Evaluations are discussed in greater detail in Part IV.F.

The program offers opportunities for significant interaction with multiple faculty and researchers across the UTC campus. Each individual student's research topic is integrated with the research being carried out in the various academic departments in addition to dedicated research centers such as the SimCenter and CUIP. Students participate in team research focused on real-world problems and are prepared to enter the workforce and make immediate contributions.

The core research of the Computational Science program is intended to establish leadership in critical technology areas affecting sustainable energy, environment, health and biological systems, advanced manufacturing, security, and defense.

A. Admission Requirements

Applicants must meet the following Graduate School and Computational Science admission requirements:

Graduate School Requirements

To be eligible for Degree Regular Admission an applicant must have a baccalaureate degree from a regionally accredited college or university or foreign equivalent and be in good academic standing at the last institution attended. In addition to the previous two requirements, an applicant for regular admission must meet one of the following requirements from a regionally accredited institution or foreign equivalent. All GPAs are based on a 4.0-point scale; the last two years of undergraduate coursework are equivalent to approximately 60-70 semester hours or 90-100 quarter hours. (Updated GPA requirements approved by Graduate Council spring 2011)

- Hold a baccalaureate or master's degree from a regionally accredited college, university, or foreign equivalent;

- Baccalaureate degree holders must have a minimum grade point average (GPA) of 2.7 on a 4.0 scale, or a 3.0 in the senior year; Master's degree holders must have a cumulative GPA of 3.0 on a 4.0 scale for graduate-level coursework;
- Have a minimum 550 (paper-based), or 213 (computer-based), or 79 (internet-based) TOEFL score, or 6.0 on the IELTS for international students, or qualify for a Graduate School exemption from this requirement;
- Submit at least two letters of recommendation from senior managers or professors;
- Submit official transcripts from each institution previously attended;
- Complete the Graduate School application form and pay the non-refundable fee.
- Plus meet additional program-specific requirements.

Computational Science Ph.D. Program Requirements

In addition to regular graduate admission requirements, applicants must receive a positive recommendation by the Computational Science screening committee and submit the following documents:

- Computational Science Application Form
- A one-page statement of purpose
- Three completed recommendation forms
- Scores from the Graduate Record Examination (GRE) are required for international applicants. Successful applicants usually have a score of 700 or better on the quantitative exam. Other applicants are encouraged to submit GRE scores. The GRE may be waived for all applicants (international or domestic) if they have a degree from an accredited US Institution.
- Current scores for the Test of English as a Foreign Language (TOEFL) or International English Testing System (IELTS) for applicants whose native language is not English and who do not meet the conditions outlined in "Admission Examinations" under "Doctoral Degree Programs" to apply for an exemption to the TOEFL/IELTS requirement. A minimum score of 550 (213 on the computer-based test, or 79 on the Internet-based test) on the TOEFL, or a score of 6.0 or higher on the IELTS, is required.

B. Program Requirements

Course Requirements

Doctoral students must complete a minimum of 72 hours beyond the bachelor's degree, exclusive of credit for the master's thesis. These hours must include a minimum of 24 semester hours in Doctoral Research and Dissertation and a minimum of 48 semester hours in other courses. At least 12 of the required 24 research and dissertation hours must be in Dissertation from an established concentration area. The courses must include:

- A minimum of 24 semester hours of graduate coursework in courses numbered 5000 and above, with at least 12 of these related to the student's dissertation topic. A minimum of 6 semester hours of courses is required at the 7000 level. These are exclusive of thesis or dissertation credit. The student's supervisory committee can approve a student's petition to replace one 7000-level course with one or more 5000-level course(s) that are more appropriate.
- A minimum of 6 semester hours of coursework in mathematics selected from the list of approved core courses (currently MATH 5210: Linear Algebra and Matrix Theory, MATH 5600: Numerical Analysis I, and MATH 5610: Numerical Analysis II) and exclusive of a first course in ordinary differential equations.
- A minimum of 6 semester hours of coursework in computer science selected from the list of approved core courses (currently CPSC 5210: Design and Analysis of Computer Algorithms, CPSC 5260: Introduction to Parallel Algorithms, and CPSC 5410: Model Analysis and Simulation).
- There are multiple pathways toward accumulating the required coursework: a) all coursework may be performed at UTC, b) credit may be earned through coursework performed within the University of Tennessee system, up to the maximum allowed by the University, c) credit is normally granted for up to 24 semester hours of program-relevant coursework credited toward a master's degree at another university, and d) transfer credit may be granted for courses applicable to the program of study and accepted for graduate credit at another university.

Core Requirements

The program of study must adequately address the following core requirements, with appropriate course content in each of three primary areas that are essential to computational science: 1) an engineering or science application area, 2) scientific supercomputing, and 3) mathematics of computation, as determined by the student's supervisory committee and the Graduate Program Coordinator. Courses completed at the master's level can be included to satisfy the core requirements. Courses in the program of study can vary, based on each student's background and goals. It is the responsibility of the student's supervisory committee, with the approval of the Graduate Program Coordinator, to ensure the student's adequate exposure to each area, which may involve completion of some undergraduate prerequisite courses.

Major Advisor and Supervisory Committee

Full-time students are encouraged to select a major advisor and form a committee during the second semester of coursework (or before completing 12 hours of coursework for part-time students). Each student's major advisor normally serves as the student's research or project director.

The supervisory committee is made up of four or five members of the Graduate Faculty and selected by the student in consultation with the major advisor. The supervisory committee must be comprised of members who collectively have expertise in the core

areas: 1) a computational science or engineering application area, 2) scientific supercomputing, and 3) mathematics of computation. Upon establishing a committee, each student should complete a Dissertation Committee Approval Form, obtain signatures of committee members and Graduate Program Coordinator, and submit the form to the UTC Graduate School.

Standards of Academic Performance: Continued Enrollment

Continued enrollment in the doctoral program is dependent upon satisfactory performance in the courses, in research, and progress toward completion of the degree. To achieve satisfactory performance, a student must maintain a "B" average on all undergraduate prerequisite courses, all graduate courses completed, and all graduate courses included in the student's Program of Study. Students must also maintain a grade of "Satisfactory Progress" (SP) in all dissertation research hours that are counted toward satisfying degree requirements.

Students must conform to all general regulations of the UTC Graduate School. A student must maintain a 3.0 grade point average (GPA) on all courses taken for graduate credit. A grade less than C is included in the GPA but cannot be counted for credit toward the degree. In the event the student fails to meet this standard, one of the following actions will be taken.

Probation

A student will be placed on probation whenever the grade point average falls below a 3.0 on courses taken for graduate credit or a grade of "No Progress" (NP) on the doctoral dissertation.

Dismissal

Decisions regarding continuation will be made by the Dean of the Graduate School based on the recommendation of the Computational Science Graduate Faculty. Graduate students will be placed on academic probation when their institutional cumulative GPA falls below 3.0. By the end of the next two terms of enrollment (counting the entire summer session as one term), students must raise their institutional cumulative GPA to 3.0 or higher. Students will be academically dismissed if they fail to achieve this institutional cumulative GPA within the two-semester probation or if they fail to achieve a 3.0 or higher for either probationary semester. A student is automatically academically dismissed upon receiving a third grade of "C," upon receiving more than one grade less than "C," or upon receiving a second grade of "No Progress" (NP) on the doctoral dissertation.

Dismissed students may appeal to the Graduate Council for readmission. Upon readmission, students may resume graduate study on probation with the same continuation standards.

Continuous Enrollment

Once admitted into the program, all active students are expected to remain enrolled until graduating. This requirement can be satisfied by registering for at least one credit-hour of

Doctoral Dissertation or Doctoral Research each semester within the student's respective concentration area. Note that once a student registers for Doctoral Dissertation, the student must continuously register for Doctoral Dissertation until graduating. This is not true for Doctoral Research, which allows students to engage in doctoral-level research that may or may not lead to a dissertation. A maximum of 12 credit hours of Doctoral Research can be counted toward satisfying research/dissertation degree requirements.

Residency Requirement

Students must be in residence at UTC for a period of at least two semesters during the period in which doctoral studies are performed. If the Program of Study includes coursework completed within the University of Tennessee System, then residency on these campuses associated with this coursework will be counted toward this residency requirement.

Admission to Candidacy

A doctoral student is admitted to candidacy upon successful completion of all courses included in his or her Program of Study, acceptance of a research topic by his or her committee, successful completion of the preliminary examination, submission of the Application for Admission to Candidacy form to the UTC Graduate School by the student's major advisor, and approval by the UTC Graduate School.

Candidacy Time Limits

There is an eight-year limit for completing all degree requirements for the Ph.D. in Computational Science. All doctoral course work and the successful defense of the dissertation must be completed in an eight-year time frame that begins with the earliest course applied to the doctoral program of study. The earliest course in the doctoral program of study excludes any courses credited from a previously awarded master's degree or transferred from another educational institution.

Research Topic Approval

For the purposes of candidacy, a student can gain approval for his or her research topic in two ways: 1) by submitting a concise and focused (one or two-page) abstract of the intended research topic to committee members; or 2) by submitting the full dissertation research proposal to committee members (see the section below on dissertation proposal). The major advisor should ensure that all committee members find the research acceptable.

Preliminary Examination

Students must pass a preliminary examination on coursework in the Program of Study covering each of the three primary areas in the core requirements. The preliminary exam is given at the completion of all coursework. The preliminary exam is scheduled in consultation with the student's major advisor and committee and must be completed no less than six months in advance of the anticipated date of graduation.

The preliminary examination has two parts: 1) a written part including four exams from the Computational Science examination committee, and 2) an oral examination of the student by the committee. One exam comes from the Computer Science required core courses, one from the Mathematics required core courses, and the other two are from courses related to the student's primary area of research. The student receives the questions from the committee, submits the answers to the respective committee members, and then stands for an oral examination by the committee. The student's major advisor will be responsible for scheduling the examination and reporting the results to the UTC Graduate School.

Research

Each candidate for the doctoral degree must conduct research and present a dissertation on that research that 1) demonstrates a mastery of the techniques of research and 2) makes a very distinct contribution to the field of computational science. Each candidate must present a proposal of the dissertation research for approval by the supervisory committee and defend the research before the committee when the dissertation has been completed.

Dissertation Proposal

Each candidate must present to his or her committee a formal written proposal of the research to be included in the dissertation. The proposal should be concise, focused, and contain the following: 1) sufficient background information for the committee members, 2) a clear statement of the topic to be addressed by the research, 3) a review of pertinent work by others related to this topic, 4) the precise research questions and issues to be addressed by this research, and 5) the justification for the research. Also, the candidate must attach a tentative outline of the final dissertation document. The proposal must be presented in the manner requested by the committee. Acceptance of the proposal and the dissertation outline by all members of the committee is the responsibility of the major advisor.

Dissertation

Upon completion of the research, the candidate submits a draft of his or her dissertation to each committee member one to two weeks prior to the scheduled final defense. The dissertation must be a contribution to knowledge and conform to the policies of the UTC Graduate School. Dissertations will be submitted to UMI Dissertations Services for its on-line and paper-based bibliographic reference collection. At the discretion of the Dean of the Graduate School in consultation with the student's major advisor, dissertations containing material of a classified or sensitive nature may be restricted from public dissemination for a specified time.

Final Defense

In consultation with his or her major advisor, the candidate files a request for a final defense at least two weeks in advance of the intended date of the examination. The final

defense will have two parts: (1) a public presentation of the dissertation followed by (2) a defense of the dissertation before the student's committee and other UTC faculty members. At the discretion of the candidate's committee, the dissertation defense may be closed to include only the student, the committee, and a representative of the UTC Graduate School. This option is to facilitate defenses in which proprietary or ITAR restricted information may potentially be discussed.

Programs of Study

As mentioned above, for those students entering the program with a B.S. but whose ultimate goal is the Ph.D. degree, the Computational Science Graduate Faculty strongly encourages these students to first complete an M.S. degree within an appropriate program. The reasoning behind this recommendation is twofold: first, the student must complete a minimum of 48 credit hours of coursework for the Ph.D., and therefore the thesis is the only remaining requirement to complete the M.S. Second, the faculty believe that completing an M.S. thesis is extremely valuable because (a) this is often a student's first exposure to conducting research, and (b) learning how to function as a member of a team and communicating research results via an M.S. thesis is an experience that ultimately carries over to the needs of the student's doctoral program.

A student's program of study will depend on his or her academic background and undergraduate major, as well as on the selected concentration area. However, the program of study establishes a primary applications focus, with additional coursework in both scientific supercomputing and mathematics of computation that logically relates to the application focus. A Program of Study Form must be signed by the student, the student's major advisor, and the Graduate Program Coordinator and then submitted to the UTC Graduate School for final approval. The student should file the Program of Study Form during the second semester of coursework (or before completing 12 hours of coursework for part-time students). Sample programs of study are given in each of the Computational Science Ph.D. Concentration descriptions.

C. Recruitment

Many students have been recruited as a result of student responses gained through the SimCenter and the Computational Science program website. Additional students have been recruited directly by faculty on various professional sites, contacts, and referrals from faculty at other universities, as well as referrals from our own students and alumni. Some students have been recruited through occasional recruiting visits to other Tennessee universities. Currently, a plethora of highly qualified students apply and are accepted to the various concentrations in the Computational Science Ph.D. program. However, as is typical, the limiting factor in the size of doctoral programs is the ability to financially support these students. Only those that receive financial support will usually enroll.

D. Enrollment, Demographics, and Degrees Awarded

Enrollment, demographics and degrees awarded are shown in Table 4 below for the year preceding this review cycle, the current review cycle as denoted, and the academic year starting the subsequent cycle. This is intended to give an improved picture of where the program was, performance during this cycle, and a potential future perspective. The table does not include the additional six MS in Engineering: Computational Engineering students that graduated prior to the elimination of this concentration in August 2016. During this review cycle alone, 24 doctoral degrees were conferred. This is compared to 19 Ph.D. students graduating from the program over the previous 10 years (Fall 2004 – Fall 2014). Again, these improvements can be attributed to implementing many of the recommendations offered by the external reviewer from the last review cycle. The total enrollment appears to fluctuate over the 7 years shown, with significant growth during the last year of this review cycle and the beginning of the next cycle. However, by further examination of the data, the program indeed has seen nearly continuous growth. Recall, from Spring 2014 – Spring 2016 a moratorium was in place, and no new students were allowed into the Ph.D. program. The moratorium facilitated the previously discussed transition to Computational Science, as well as the approval and launching of the Computer Science concentration. Observe, in the 2015-2016 academic year, the enrollment was at 25 students with five students graduating. However, with 29 enrolled during the 2016-2017 academic year, nine additional students were added to the program. In the 2016-2017 and 2017-2018 academic years, 12 and 4 doctoral degrees were conferred, respectively. The excessive number of graduates over this time frame was compensated by new student enrollment. As of the 2019-2020 academic year, all students within the program prior to the moratorium have graduated, and the overall enrollment grew to 30 doctoral students. Furthermore, the enrollment starting the next review cycle stands at 40 students during the Spring 2021 semester. The accelerated growth in enrollment is directly attributed to the launching of the Computer Science and the Computational & Applied Mathematics concentrations.

Additionally shown in the table are the demographics of the student population. As is typical with most STEM doctoral degrees, the number of males and international students tend to be much higher than female and US Citizens. With regards to females, the average enrollment over this review cycle is 16.3%, with declining numbers in years four and five. However, looking forward the percentage of female Ph.D. students has rebounded to 17.5%. Furthermore, five of the 24 graduates during this period were female, giving an overall percentage of 20.83%. Using the middle of the review cycle as a reference point, data from the National Center for Education Statistics[1] for academic years 2017-2018 indicates that approximately 20% of Computational Science Ph.D.

[1] National Center for Educational Statistics, “Table 318.30: Bachelor’s, Master’s, and Doctor’s Degrees Conferred by Postsecondary Institutions, By Sex of Student and Division: 2017-2018,” *Digest of Educational Statistics*: 2019 Tables and Figures (2019).

degrees were conferred to female students. Therefore, our graduation rates appear to match published trends. It should be noted, the NCES data additionally includes many related degree programs that appear with various names and have relation to the concentrations within the Computational Science Ph.D. Examples include separate data for Computational Mathematics as well as Computational and Applied Mathematics. To this end, greater attention will be given to benchmarking demographics with respect to published data during the next review cycle, and how this data can be better correlated with similar interdisciplinary degree disciplines.

The last row in Table 4 represents the THEC metric for Ph.D. programs whereby an adequately performing program produces an average of three graduates per year over a rolling five-year period. As can be seen, in the year prior to this review cycle and in the first year of the current cycle, the THEC benchmark was not met. Many of the recommendations previously discussed and implemented mitigated this deficiency. In particular, for a graduate program, the student to academic faculty ratio in the Department of Computational Engineering was exceedingly high. This problem was exacerbated by also attempting to advise/graduate a large number of MS in Engineering: Computational Engineering students. Of the 43 MS in Engineering: Computational Engineering graduates, only seven were non-thesis students. The elimination of the MS in Engineering: Computational Engineering concentration and the increased faculty numbers afforded by the expansion of the Computational Science Ph.D. provided for more advising and greater monitoring of the existing students. To this end, the program has exceeded the THEC benchmark for all remaining years in this review cycle.

TABLE 4 – Student Demographics

Category	2014-15[1]	2015-16	2016-17[2]	2017-18	2018-19[3]	2019-20	2020-21[4]
Total	26	25	29	23	23	30	40
Citizens	9	8	15	12	10	14	15
International	17	17	14	11	13	16	25
Female	6	6	5	4	3	3	7
Male	20	19	24	19	20	27	33
% Citizens	34.62%	32.00%	51.72%	52.17%	43.48%	46.67%	37.50%
% International	65.38%	68.00%	48.28%	47.83%	56.52%	53.33%	62.50%
% Female	23.08%	24.00%	17.24%	17.39%	13.04%	10.00%	17.50%
% Male	76.92%	76.00%	82.76%	82.61%	86.96%	90.00%	82.50%
Graduates	2	5	12	4	0	3	1
THEC 5-Year Average	1.8	2.4	4.4	5.2	4.6	4.8	

1 AY Prior to Current Cycle (Spring 2015)

2 AY 2016-2017 Computer Science Concentration Launched

3 AY 2018-2019 Computational & Applied Mathematics Concentration Launched

4 Current Spring 2021 Data for AY Beginning Next Cycle

E. Professional Development Opportunities

Within the Computational Engineering, Computer Science, and Computational & Applied Mathematics concentrations, professional development opportunities are most notably realized through membership in professional societies. Typical societies that represent these concentrations include, among others, the American Institute of Aeronautics and Astronautics (AIAA), American Society of Mechanical Engineers (ASME), American Institute of Chemical Engineers (AIChE), Institute of Electrical and Electronics Engineers (IEEE), Association of Computing Machinery (ASM), the American Mathematics Society (AMS), and the Society of Industrial and Applied Mathematics (SIAM). Activities with regards to these professional societies include conference attendance, presentations, and publications. Furthermore, students are involved with the Graduate Student Association (GSA). At UTC, the GSA is a student organization that governs and advocates for professional and graduate students. The Graduate School and the GSA additionally provide travel awards for students to attend conferences and professional activities when other external or internal monies are unavailable.

F. Enrichment Opportunities

Adequate enrichment opportunities are provided via professionals that take part in numerous speaker series coordinated by constituents of the program. These include the College of Engineering and Computer Science Speaker Series, the SimCenter Seminar Series, and the Mathematics Colloquium Series. Additionally, the faculty work closely with numerous local industries and visits to facilities, as well as interaction with professionals, routinely take place.

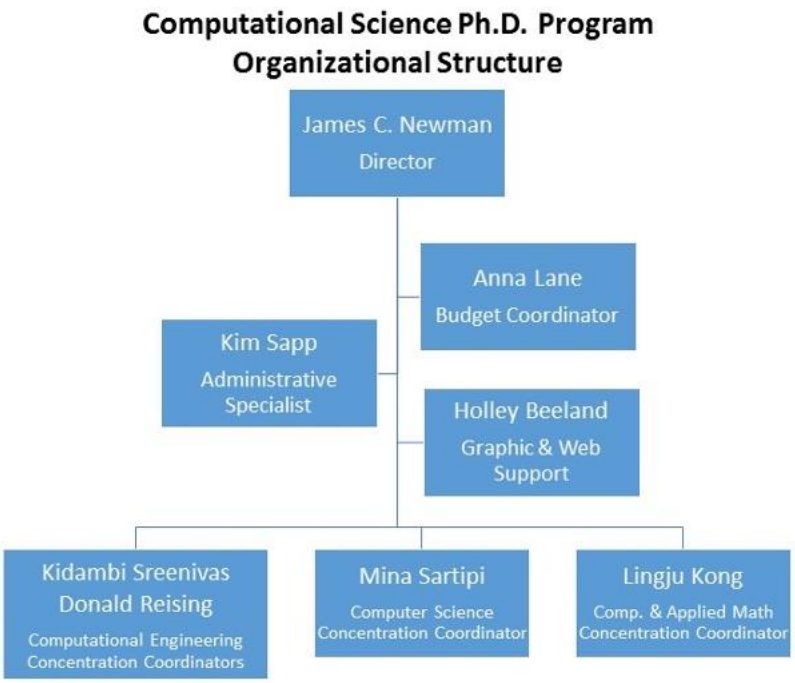
G. Academic Support

Many academic support services are provided to graduate students at UTC. Among others, these include a Thesis/Dissertation Writing Workshop hosted by the Graduate School at the beginning of each semester, a Writing and Communication Center which assists students one-on-one with all forms of written or oral communication projects and a multitude of workshops provided by the UTC Library. A very short list of workshops conducted each semester: How to Email Your Professor; Excel Basics; PowerPoint Basics; Word Basics; EndNote Desktop; Copyright for Newbies; How to Read a Scholarly Article; Overcoming Writer’s Block; Avoiding Plagiarism; Get a Job Part 1- Find Job Ads; and Get a Job Part 2- Your Resume & Cover Letter.

PART IV – FACULTY

A. Computational Science Organizational Structure

As previously discussed in the History and Background section, in July 2015 Dr. James Newman was appointed as Interim Department Head of Computational Engineering and tasked with eliminating the departmental structure of the program. This was to facilitate the transition to a campus-wide interdisciplinary Computational Science program. Additionally, in response to actions taken as a result of the previous self-study (recommendation 5), with the planned elimination of the MS in Engineering: Computational Engineering concentration, and the intent to extend the Ph.D. degree and make it accessible across multiple colleges, the Computational Science program was designated by the Provost to report to the Vice-Chancellor of Research/Dean of the Graduate School. The Vice-Chancellor of Research reports directly to the Chancellor. The Chancellor reports to the Univerity of Tennessee (UT) System president who in turn reports to the UT Board of Trustees. Therefore, no traditional departmental structure exists, and the organizational structure is comprised of a director and concentration coordinators as shown in the chart. The credentials of the coordinators are given in Appendix D. The Computational Science Ph.D. program is supported via administrative staff that includes an Administrative Specialist, Budget Coordinator, and Graphics & Web Support personnel.



B. Faculty Credentials

All faculty who teach graduate-level courses and/or advise graduate students must first obtain Graduate Faculty Status at UTC. This policy is in support of continuing high-quality graduate education and in recognition of expected SACSCOC accreditation standards. The criteria for membership in the Graduate Faculty are designed to advance the specific programs and are consistent with the mission of the University. Periodically, graduate

programs, the Graduate Council, and the Graduate School review and update the selection criteria. Criteria for membership includes: Evidence of Appropriate Degree, Evidence of Ongoing Scholarly and Professional Work, Documented Commitment to Graduate Education, and a Commitment to Professional and Ethical Behavior at All Times. Approval is required by the Academic Department Head, the College Dean, the Dean of the Graduate School, and the SACSCOC Liaison. A process has been developed and implemented to ensure all appropriate approvals are received. The Graduate Faculty Application form may be found in Appendix E.

C. Faculty Workload

Based on the interdisciplinary nature and structure of the Computational Science Ph.D. program, faculty span all departments in the College of Engineering and Computer Science as well as the Department of Mathematics in the College of Arts and Sciences. Faculty workloads with regards to teaching, research, and service are designated by the departments and under the auspices of their respective colleges. In all cases, course release time is provided for faculty engaged in research, which includes advising doctoral students.

D. Faculty Professional Development

Professional development for faculty conducting doctoral-level research is typically manifested in attendance at conferences, seminars, and workshops that are sponsored by various professional organizations. In most cases, faculty fund this travel from external grants and contracts; however, departmental budgets provide for professional development activities as well. Furthermore, there are numerous other internal funding opportunities that support professional development such as the Walker Center for Teaching and Learning Faculty Travel Grants for activities that contribute to scholarly works of UTC faculty, and the Office of Research and Sponsored Programs Faculty Pre-Tenure Enhancement Program (PREP). Moreover, for all tenure-track faculty, a Faculty Mentor is assigned to provide guidance and feedback with regards to their activity. The Faculty Mentor Plan document used in the College of Engineering and Computer Science may be found in Appendix F.

E. Improvement Process

Within the Computational Science Ph.D. program, the improvement process is realized in two manners. First, with regards to course development, the constituent departments that are represented within the concentrations continuously review their offerings to ensure quality and relevance. New or modifications to existing courses are finalized in the

department, these are then reviewed and require approval from the relevant College Course and Curriculum Committee. The course proposals are then submitted to the University Graduate Council for subsequent review and approval. Secondly, the Computational Science Director, Concentration Coordinators, Vice-Chancellor of Research/Dean of the Graduate School, Associate Dean of the Graduate School, and Computational Science Staff meet numerous times each semester to discuss initiatives, address concerns, and review programmatic issues. In these regards, when involving specific concentrations or faculty, the relevant department heads of these units participate in these meetings.

F. Faculty Evaluation

Faculty evaluation is conducted annually using the Evaluation and Development by Objectives (EDO) process as detailed in the UTC Faculty Handbook (www.new.utc.edu/adacemic-affairs/faculty-senate/faculty-handbook). The EDO evaluation is conducted by the Department Head of the unit and subsequently reviewed and approved by the Dean of the College. The objectives and goals are established between the department head and the faculty member prior to the start of the academic year. Reporting of performance near the completion of the academic year by the faculty member must then detail their activities and accomplishments in teaching, research, scholarly activity, and service as they pertain to the predetermined objectives and goals. With regards to teaching, all classes undergo Course Learning Evaluations (CLE) to provide faculty with feedback to improve quality of instruction. The Office of Planning, Evaluation, and Institutional Research (OPEIR) administers the course evaluations using online survey software. Students are asked to respond honestly and openly to 15 questions, most using a seven-point Likert scale and some open-ended. The questions are related to course learning outcomes, student contributions to learning, course content and delivery, and course instruction. These items were deemed by the Course Learning Evaluation committee to be indicators of student learning. Open-ended student responses are available to the Department Head, but are used primarily by instructors to help them improve their class in future semesters.

G. Faculty Diversity

Again, due to the interdisciplinary nature of the Computational Science Ph.D. program, faculty diversity is reflected by the diversity within the various departments. However, the level of diversity within the Computational Science Ph.D. program may be evaluated by analyzing the faculty that have been or currently are the major advisor, or served as a committee member, for a doctoral student during this review cycle. Note, the following list

only includes UTC Faculty, not external committee members from industry and government, that were employed by the university during the review cycle.

Engineering Faculty: Drs. Raga Ahmed, Abdollah Arabshahi, Michael Danquah, Vahid Disfani, Bradley Harris, James Hiestand, Bruce Hilbert, Sagar Kapadia, Abdelrahman Karrar, Mohammad Mahtabi, James Newman, Abdul Ofoli, Osama Osman, Joseph Owino, Daniel Pack, Soubantika Palchoudhury, Donald Reising, Kidambi Sreenivas, Li Wang, Robert Webster

Computer Science Faculty: Drs. Joseph Dumas, Farah Kandah, Joseph Kizza, Yu Liang, Mina Sartipi, Anthony Skjellum, Craig Tanis, Hong Qin, Yingfeng Wang, Dalei Wu, Mengjun Xie, Li Yang

Mathematics Faculty: Drs. Boris Belinskiy, Sumith Gunasekera, Lingju Kong, Andrew Ledoan, John Matthews, Roger Nichols, Eleni Panagiotou, Jin Wang

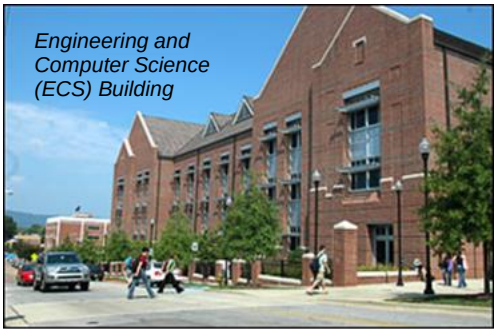
The larger number of faculty involved in the Computational Science Ph.D. program is attributed to the Computer Science and Computational & Applied Mathematics concentrations starting in academic years 2016-2017 and 2018-2019, respectively. In the above lists of 40 faculty, six, or 15%, are female. On the additional breakdown of the data, within the list of 20 engineering faculty only three, or 15%, are female, whereas the national average[2] is 17.4%. Of the 12 Computer Science faculty, two or 16.7% are female which compares to the national average[3] of 15%. Finally, from mathematics, of the eight faculty listed one, or 12.5%, are female and the national average[4] is 16.8%. With the exception of Computer Science, the gender diversity within the Computational Science Ph.D. program is below the national average, indicating that increased efforts in these regards are warranted. To this end, the Office of Human Resources and the Office of Equity and Inclusion have specific processes that must be followed to ensure a sufficiently diverse candidate pool during faculty searches.

[2] Roy, J. (2019), *Engineering by the numbers*, American Society of Engineering Education.
[3] S. F. Way, D. B. Larremore, A. Clauset, "Gender, productivity, and prestige in computer science faculty hiring networks" in Proceedings of the 25th International Conference on World Wide Web (International World Wide Web Conferences Steering Committee, 2016), pp. 1169–1179.
[4] Golbeck AL, Barr TH, and Rose CA. (invited paper). Fall 2017 Departmental Profile Report. Notices of the American Mathematical Society 66(10):1721-1730, 2019.

PART V – LEARNING ENVIRONMENT

A. Equipment and Facilities

Computational Science Ph.D. students are afforded outstanding facilities and computational resources in which to conduct research. The 31,000 sq. ft. MultiDisciplinary Research Building (MDRB) facility includes faculty offices, student cubicles, a 1,500 sq. ft. computer room, a conference/meeting room accommodating 25 people, an 80-seat auditorium, two secure expandable suites of rooms dedicated to proprietary and/or classified research, a research library, and other workspaces. The interior layout is designed to facilitate extensive cross-disciplinary interactions among faculty and students, with student cubicles in large open spaces adjacent to faculty offices. All doctoral students are provided cubicle or office space within the MDRB, desktop computers, and access to the SimCenter computational resources. The computer science and engineering faculty have office space in the Engineering and Computer Science (ECS) Building, formally the Engineering, Mathematics, and Computer Science (EMCS) Building, at UTC. This building, a 203,000 square-foot facility equipped with advanced classroom technology available to all majors, opened in Fall 2003. Many classrooms feature tiered design and include flexible workstations to accommodate hands-on "studio" instruction. Most classrooms include podiums housing state-of-the-art audio and video projection. In August 2020, the Department of Mathematics relocated to into newly renovated Lupton Hall. This state-of-the-art building was designed to promote interaction between faculty, staff, and students. Both ECS and Lupton Hall have additional space allocated for graduate students.



Engineering and Computer Science (ECS) Building

Lupton Hall

The SimCenter computational resources are as follows:

Computational Clusters (Open access)

- ***EPYC*** – 2176 core (128 cores/node; 17 nodes) AMD EPYC 7662
  - 512 GB of RAM/node
  - InfiniBand EDR interconnect (100GbE)
- ***Firefly*** – 400 cores (80 cores/node; 5 nodes) Xeon 6148 CPU cluster
  - head node 3TB RAM
  - 192 GB of RAM
  - 4x Tesla V100 SXM2 32GB GPUs per node
  - Dual 10G Gigabit Ethernet bonded to 20G of interconnect
- ***Lookout*** – 160 core/640 thread (6 nodes) IBM Power9 (AC922) cluster
  - Dual Power9 20 core/80 thread CPUs (2.4GHz, 3.0 GHz turbo)
  - 4 Nvidia Volta GPUs with 16 GB GPU memory; NVLink provides up to 300GB/s of bi-directional bandwidth GPU-GPU and CPU-GPU
  - 256 GB RAM
  - InfiniBand EDR interconnect (100GbE)
- ***Research as a Service (RaaS) cluster*** – 224Core/448Thread OpenStack local cloud
  - One user/admin facing management server that provides web-based user dashboards for on-demand research computing
  - Three back-end OpenStack management servers are used to facilitate VM provisioning, management, storage I/O, etc.
  - Four high-end CPU/GPU Dell R740 compute servers where VMs/containers run
    - Each with dual Intel Xeon Platinum 8176 28C/56T CPUs
    - 384GB RAM
    - One NVIDIA Tesla P100 12GB GPU
    - One NVIDIA Tesla T4 16GB GPU
  - Three Dell 740XD storage servers for local RaaS storage
    - Each with 192GB RAM
    - 168GB raw disk space; usable space half this using 2-factor replication
  - This RaaS implements a 100GbE network fabric throughout with the compute and storage servers having dual 100GbE links to facilitate extra network performance for the VMs/containers as well as all storage traffic. This network connects back to the SimCenter core at 100GbE as well.
- ***Tennessine*** – 924 CPU core/59,136 GPU core (33 node) diskless cluster (Dell)
  - Two 14-core Intel Xeon E5-2680 v4 processors
  - 128 GB RAM per node
  - EDR InfiniBand (100 Gb/s) interconnect
  - One Nvidia P100 GPU (16 GB) with 1792 double-precision cores
  - 400 GB SSD per node for local application caching (pending installation)
  - Theoretical peak performance of ~1TFLOPs (CPU only) or ~5.7TFLOPs (CPU and GPU)
- ***Qbert*** – 192 core (12 nodes) cluster (Dell)
  - Two 8-core Intel Xeon E5-2650v2 processors
  - 32 GB RAM per node

    - 10 Gigabit Ethernet interconnect
    - 216 TB reconfigurable 10 Gigabit iSCSI storage
    - Head node has 256 GB RAM, an NVIDIA K20 and Xeon Phi 5110P co-processors
    - Currently configurable for data analytics type (hadoop) applications

Computational Clusters (Restricted access; ITAR compliant)

- ***Cerberus*** – 32 core compute server (Dell)
    - Four 8-core Intel Xeon X7560 2.27 GHz processors
    - 256 GB RAM
- ***Papertape*** – 512 core (32 nodes) diskless cluster (Dell)
    - Two 8-core Intel Xeon E5-2670 processors
    - 32 GB RAM per node
    - FDR InfiniBand interconnect (2:1 blocking)
    - ~25TB of local storage (BeeGFS)
- ***Papertape_v2*** – 512 core (4 nodes) AMD EPYC 7702
    - Two 64-core AMD EPYC 7702 processors
    - 512 GB RAM per node
    - EDR Infiniband interconnect

Infrastructure

- 20 GbE network backbone
- New air conditioning units.
- Brand new server room network infrastructure capable of up to 100GbE
- Dell R730 VMWARE cluster which runs all system critical services
    - Three node cluster
    - Highly redundant hardware
    - Important services configured “highly available” so they never crash
    - Dynamic load balancing

Data Storage

- Highly scalable DDN 14KX GPFS storage system
    - 113 TB (10K SAS) of high speed, tier 1 storage
    - 1 PB of high capacity, lower tier storage
    - Connects to the HPC infrastructure at EDR InfiniBand speeds (100 Gb/s)
    - Scalable up to over 1700 hard drives and 60 GB/s bandwidth
    - Available (via NFS) to all desktops in the SimCenter
- Backup system based on ZFS
    - 800TB maximum capacity
    - Primary target in MRDB Data Center with a secondary target in Hunter Hall.
    - ZFS replication between primary and secondary targets.
- Expandable Dell PowerVault LTO7 tape backup system
    - LTO7 tape media can store between 6 and 15 TB (based on compression)
    - Can backup/archive between 240 and 600 TB of data without expansion

B. Support Staff

The MDRB support staff provides administrative support to the Computational Science PhD program as well as to the SimCenter, CUIP, IGTLab, and the IoT Lab. Support staff includes Ms. Holley Beeland, Graphics and Web Support; Ms. Anna Lane, Budget Coordinator; and Ms. Kim Sapp, Administrative Specialist. Additionally, the support staff additionally work closely with their counterparts in the Office of the Vice-Chancellor for Research, the Office of Research and Sponsored Programs, and the Graduate School. Information technology support is provided by Dr. Michael Ward, HPC/HTC Administrator, and Advanced Infrastructure Facilitator; and Mr. Christopher Dowell, HPC Administrator. Furthermore, the MDRB has several student workers each semester that assist the support staff in routine functions. Currently, given the integrated team efforts of multiple offices, the support staff is sufficient to meet the Computational Science Ph.D. program needs and to promote research and scholarly activities.

C. Learning and Informational Resources

The mission of the UTC Library is to contribute to the intellectual endeavors of the UTC community by assisting in the discovery of information and providing the infrastructure and resources for learning. The UTC Library services all UTC students, faculty, staff, and alumni, as well as the local community. The UTC Library is well equipped to support the research and scholarship needs of the UTC community with an operating budget of over 4.1 million dollars, a dynamic and engaged faculty and staff, a new library building that opened in January 2015, and a broad collection of diverse materials including 600,000 print and eBooks, over 30,000 digital journals available, 150+ indexes and databases, and more. Moreover, the UTC Library conducts a number of workshops each semester, some of which were previously presented in PART III.G Academic Support. Additional information with regards to the UTC Library may be found at http://www.utc.edu/library.

PART VI – SUPPORT

A. Operating Budget

The Operating Budget during the current review cycle is given in Table 5. As is clearly seen, many budgetary changes took place while the Ph.D. program transitioned to Computational Science. As previously discussed in Part IV.A, in July 2015 (FY16), the program still retained the combined integrated budget of the Department of Computational Engineering and the SimCenter, which continued through the 2016-2017 academic year (FY17). Shown is the breakdown by category of budgeted amounts and cumulative actuals for the fiscal years. During the first fiscal year shown (FY16), the budget was in deficit by $89,138. After examining the budgetary categories, graduate

student expenditures were determined to contribute to the majority of this deficit. However, in FY17 the Academic Salaries, including both faculty and graduate student support, fell significantly below budgeted amounts resulting in an end-of-year surplus of $461,541. Beginning in the academic year 2017-2018 (FY18), the SimCenter/MDRB funding was decoupled from the Computational Science Ph.D. program. Graduate student support and one Additional Duties Assignment (ADA) for the director of $9,600/per year was subsequently reallocated and dispersed via the Office of the Vice-Chancellor for Research and the Graduate School. Note, limited graduate student support for all MS degree programs on campus is provided by the Graduate School in a similar manner. Moreover, four academic faculty salary lines remained under the SimCenter account. In the 2018-2019 academic year (FY19) funding for the four academic positions, totaling $422,496 was reallocated from the SimCenter account to the College of Engineering and Computer Science. At this point, the transition to the new Computational Science Ph.D. program was complete, and all faculty reside in appropriate academic departments. Funding specific to the program consists only of graduate student support and one ADA.

TABLE 5 - Budget and Expenditures During Review Cycle

Budget Item	Category	2015-2016[1]	2016-2017[1]	2017-2018[2]	2018-2019[3]	2019-2020
Academic Salaries	Faculty	B: 783,560 A: 637,560	B: 802,009 A: 441,520	A: 9,600	A: 9,600	A: 9,600
	Graduate Students	B: 0 A: 194,899	B: 151,038 A: 118,385	A: 165,457	A: 155,959	A: 171,116
Non-Academic Salaries	Professional	B: 104,055 A: 79,731	B: 142,309 A: 64,807			
	Clerical (all)	B: 28,767 A: 43,231	B: 77,559 A: 75,130			
Student Emp.	All	B: 0 A: 791	B: 0 A: 180			
Travel	All	B: 350 A: 0	B: 0 A: 12,964			
Media	All	B: 0 A: 68	B: 0 A: 973			
Communication	All	B: 0 A: 8,532	B: 6,703 A: 6,932			
Supplies	All	B: 0 A: 58	B: 61,462 A: 366			
Awards	Student Aid	B: 0 A: 62,283	B: 0 A: 18,690-			
Other Services	All	B: 46,680 A: 23	B: 56,056 A: 55,056			
Operating		B: 47,030 A: 70,964	B: 124,221 A: 100,691			
Revenues		25,375	14,882			
Total Budget		963,412	1,297,136			
Cumulative Actuals		1,052,550	835,595	175,057	165,559	180,716
Variance		-89,138	461,541			

B: Budgeted; A: Cumulative Actuals

1 Graduate School of Computational Engineering Main Account

2 SimCenter/MDRB Funding Separated from Computational Science Ph.D. Graduate Student Funding from the Graduate School.

3 Remaining Faculty Positions Moved to Respective Departments (10/16/2018)

B. Enrollment and Effectiveness

As previously discussed in various sections, during this review cycle the Ph.D. program at UTC has been re-envisioned in order to expand enrollment and to become exceedingly cost-effective. This included the expansion of the Ph.D. program to Computational Science that ultimately allowed faculty from all departments within the College of Engineering and Computer Science, the Department of Mathematics, as well as faculty in additional departments across campus the ability to have doctoral students. In doing so, the faculty-base was significantly expanded while taking advantage of the financial resources that are already provided to these departments in delivering their undergraduate and MS degree programs. That is, these faculty exist and are financially

justified in their departments by their respective enrollments and credit hour productions. As for costs associated with Ph.D. (7000-level) courses, these very often have a significant number of MS students enrolled; therefore, essentially not creating additional costs. Depending on the nature of the funded research, and student-level required to pursue such research, faculty may now use this support for doctoral students in Computational Science when appropriate. This is in direct contrast to the organizational structure of the Ph.D. program prior to this review cycle wherein a unique Department of Computational Engineering offered the degree. That department did not offer an undergraduate degree, nor received credit for the MS in Engineering: Computational Engineering concentration degrees. Therefore, due to the limited capacity and credit hour production compared with the expense of the faculty, the original program was not cost-effective nor sustainable at UTC. The organizational structure and efforts taken during this review cycle have established an exceedingly cost-effective means of delivering this program. The only associated costs are due to one ADA and a limited number of graduate assistantships provided by the Graduate School. Again, the Graduates School provides assistantships to all Colleges on campus for their graduate programs. Hence, providing this limited funding for the Computational Science Ph.D. program is consistent with campus procedures. Furthermore, as presented in Part I.B.3 Graduates with Marketable Skills, and in Part III.D Enrollment, Demographics, and Degrees Awarded, data is collected and systematically reviewed to ensure the effectiveness of the program. In this review cycle, 100% of all graduates were immediately employed at the time their degrees were conferred. As is evident from Table 3, all students have been placed in positions that are appropriate for their Computational Science Ph.D. degree. Furthermore, based on the industrial, academic, and governmental positions that these graduates have filled, the program is fulfilling workforce-development needs at the local, state, and national levels.

C. Alignment with Institutional Policies

Policies and procedures with respect to scope and program requirements are reviewed by the Computational Science coordinators. Beyond the program, all other policies and procedures are reviewed to ensure consistency by constituent colleges and departments. Furthermore, the Office of Research and Sponsored Programs monitors and enforces all institutional, state, and federal policies with regards to funded research. The Graduate School ensures that all academic policies and procedures of UTC, UT System and the state are followed.

APPENDIX

A. Credentials of Center Directors

a) Curriculum Vitae of SimCenter Director, Dr. Anthony Skjellum

Curriculum Vitae[1]

ANTHONY SKJELLUM, PhD
skjellum@gmail.com

Expertise

High Performance Computing, Systems Software, and Scalable Simulation
Systems Engineering and Cyber Security
Development, Advancement, and Management of Entrepreneurial and Academic Entities

Education

PhD: Chemical Engineering, Minor in Computer Science, California Institute of Technology, June 1990
Dissertation: *Concurrent Dynamic Simulation: Multicomputer Algorithms Research Applied to Ordinary Differential-Algebraic Process Systems in Chemical Engineering*

M.S.: Chemical Engineering, California Institute of Technology, June 1985
B.S. (Honors): Physics, California Institute of Technology, June 1984

Employment

University of Tennessee, Chattanooga
Professor of Computer Science (Tenured) and Chair of Excellence, August 2017–present
Director, SimCenter – Center of Excellence in Applied Computational Science and Engineering, August 2017–present

Auburn University, Department of Computer Science and Software Engineering
- Professor of Computer Science and Software Engineering (Tenured), June 2014 – August 2017.
- McCrary Eminent Scholar Endowed Chair, August 2016 – August 2017.
- Director of the Charles D. McCrary Institute for Critical Infrastructure Protection and Cyber Systems, August 2016 – August 2017.
- COLSA Corporation Cyber Security and Information Assurance Endowed Professorship, July 2014 – August 2016.
- Auburn Lead Scientist for Cyber Research, July 2014 – August 2017.
- Director of the Auburn Cyber Research Center, July 2014 – August 2017.

University of Alabama at Birmingham, Department of Computer and Information Sciences
- Professor and Chair, August 2003 – June 2014
- Director of UAB University-wide Research Center – CIA|JFR, 2011 – June 2014

Mississippi State University, Dept. of Computer Science, January 1993 – July 2003
- Director, NSF ERC High Performance Computing Laboratory, January 1997-July 2003
- Tenured Associate Professor, 1997
- Associate Professor, 1996
- Assistant Professor (Tenure earning), 1993

Lawrence Livermore National Laboratory, 1990-1993
- Computer Scientist (Q-cleared fulltime employee)

[1] 4-August-2019 update

Entrepreneurial efforts have included these additional outside activities:

- President, MPI Software Technology, Inc, 1996-2002 (Spin-off from Mississippi State)
- Chief Technology Officer, MPI Software Technology, Inc, 2002-2004
- Chief Software Architect, Verari Systems Software (Formerly MPI Software Tech.), 2004-2009. Verari closed it doors in 2009 during the "Great Recession."
- Co-Founder, CTO of RunTime Computing Solutions, LLC, 2009-present. RunTime Computing acquired key software assets from Verari in 2009; it is a successful Birmingham, AL embedded software, consulting, and services company.

Professional Activities

Editorial Board, *Parallel Computing*, March 1992-December 1995
Editorial Board, *The International Journal of Supercomputer Applications and High Performance Computing*, November 1993-2000
Editorial Board, *Concurrency & Communication: Practice & Experience*, 1994-present
Working Group Chair, "Persistence," MPI-4 Standard, MPI Forum, 2013-present.
Working Group Co-chair, "Collective," MPI-4 Standard, MPI Forum, 2017-present.
Sub-committee Chair, Message Processing Interface (MPI) Standards Committee III, 2010-2013 (Persistent Communications Working Group),
Co-Chair, Real-Time Message Passing Interface (MPI/RT) Forum, 1997-2005.
Sub-committee Chair, BLAS Technical Forum (Lite BLAS/ BLAIS), 1995-98
Sub-committee Chair, Message Processing Interface (MPI) Standards Committee II, 1995-96 (Collective Chapter), 1995-97 (Real-Time), Persistence (2012-2019), Collective (2017-2019)
Sub-committee Chair, Message Processing Interface (MPI) Standards Committee, 1993-94
Newsletter Co-Editor (with Andrew Lumsdaine), Society of Industrial and Applied Mathematics (SIAM) Supercomputing Activity Group
Chair, MPIDC '99, Atlanta, GA, March 9-12, 1999
Organizing Committee of MPIDC '95 and MPIDC '96, Notre Dame, IN
Chair, 1997 Gordon Conference on HPC/II, Plymouth, NH, July 1997
Co-Chair, (Daniel Reed, Chair) 1995 Gordon Conference on HPC/II, Plymouth, NH, July 1995
Co-Chair, (Jack Dongarra, Chair; Co-Chair: David Walker), 1992 Gordon Conference on HPC/II (Previous name Software Tools and Libraries for HPC), Plymouth, NH, July 1992
Program Director, SIAM Supercomputing Activity Group, January 1994-December 1996
Editor, *Proceedings of MPIDC '99*, March 1999
Editor, *Proceedings of the Scalable Libraries Conference*, October 1994
Editor, *Proceedings of the Scalable Libraries Conference*, October 1993
Invited participant, Second Pasadena Workshop on System Software and Tools for High-Performance Computing Environments (Pasadena II), January 1995

Awards and Honors

ACM Senior Member, 2014
IEEE Senior Member, 2013
Mississippi Business Journal, "Top 40 Under 40 Award," January 21, 2002
2001 Tibbetts Award Winner (MPI Software Technology, Inc) – excellence in SBIR commercialization (National Award – State of Mississippi Winner)
College of Engineering Hearin Eminent Scholar, 2001-03
1999 College of Engineering Outstanding Engineering Research Award
MSU Alumni Association Research Award, May 1998
College of Engineering Hearin-Hess Distinguished Professor, 1996-97 and 1997-98
MSU ACM Student Chapter Computer Scientist of the Year Award, May 1994

Best Student Paper in Operating Systems Area (First Prize) “Zipcode: A Portable Multicomputer Communications Library atop the Reactive Kernel,” Fifth Distributed Memory Computing Conference, Charleston, South Carolina, April 1990

Runner-Up Student Paper in Applications Area, A: LU Factorization of Sparse, Unsymmetric Jacobian Matrices on Multicomputers, Fifth Distributed Memory Computing Conference, Charleston, SC, April 1990.

IBM Tau Beta Pi Award (California Institute of Technology), writing competition, 1981

Selected Administrative Achievements as UAB Chair of Computer and Information Sciences

1) Led successful ABET Accreditation for the Bachelor of Science Program (October 2005). Re-visit October 2012 (renewed as of September 2013).
2) Recruited, hired, and retained at total of seven professors during past ten years. Total faculty size was thirteen FTEs as of June 30, 2014, including one professor who started in August 2013.
3) Recruited two women assistant professors (among those seven mentioned), one is already tenured, the second is Hispanic. The tenured professor was promoted to full professor at UAB as of May, 2015.
4) Two of my assistant professor hires (T. Solorio, R. Hasan were awarded NSF EARLY CAREER funding (notified in December 2013, effective 2014). I later nominated one of these professors (T. Solorio) for the Denise Denton Award, which she won and received recognition in 2014.
5) Graduated a PhD student who is an African American Woman in 2010 (Dr. Vetria Byrd). She is currently working as an assistant professor on tenure track at Purdue University.
6) Recruited and hired Mr. Gary Warner, internationally renowned cybercrime expert in 2006. He is now the Director of the CIA|JFR that I inaugurated at UAB (see below).
7) Remodeled research labs and infrastructure, including winning three MRI grants (serving as PI) to enable CIS and HPC research.
8) Oversaw the regrowth in undergraduate population, and growth in PhD student graduations in the past nine years.
9) Obtained approval for the Master of Science in Computer Forensics and Security Management, program. Commenced operation in Fall 2011.
10) Introduced several types of continuous improvement processes for undergraduate and graduate education
11) Introduced supplemental instruction in CIS (tutoring for key undergraduate courses).
12) Designed and Introduced the Senior Capstone course (both for ABET and QEP requirements).
13) Introduced requirement for public speaking class for all computer science majors; Introduced public speaking requirements into the senior-level software engineering class as well as senior capstone.
14) Added ethics components to the software engineering and senior capstone classes.
15) I currently serve as founding chair of the “Research Capacity Building Committee,” a faculty-led effort I proposed in 2009 for expanding research opportunities and improving efficiency (from a faculty viewpoint) of all aspects of funded R&D. Supported directly by UAB VP of Research.
16) Grew research space for CIS and other faculty significantly with a new laboratory space in February 2010. This was based on a $500,000 investment from our administration and Deans.
17) Approval of the Bachelor Science in Bioinformatics Degree at the University level. This has also been approved at the state level at the pre-proposal stage (NISP). We started developing the full proposal as of February 2014.

Selected Administrative Achievements as UAB Director of CIA|JFR UWIRC

1) Won approval for an Interdisciplinary Center for Forensics at UAB – CIA|JFR. Still only one of three non-medical UWIRCs at UAB as of June 30, 2014.
2) Successfully developed the Center for Information Assurance and Joint Forensics Research (CIA|JFR) from its 2011 approval to its current status with 45 members across UAB and a high level of activity.
3) With Development, obtained $250,000 gift in 2012 from Facebook for the CIA|JFR completion and leveraged that into a $900,000 upgrade on the 4th Floor of UBOB with a state-of-the-art facility. This was completed February 2013, providing our UWIRC center with a permanent home. It currently houses additional faculty from CIS, Justice Sciences, and one faculty member from Anthropology, as well as upwards of 60 student/postdoc researchers at peak usage.
4) In 2012, recruited Dr. John Grimes from his previous role in Justice Sciences to the Center into a new position, a research professor working almost exclusively on the Center mission and business development as well as his area of pedagogy.
5) Developed and chaired a successful conference series – Cyber Summit, first held at UAB in 2012 and at the BJCC (conference center) in 2013, and again at UAB in February 2014.
6) Launched the UAB Big Data Conference Series, the first of which was held in May 2013, co-sponsored by Intel, Data Direct Networks, and Cray Computer. This conference, which is co-sponsored with CIS, brought big-data science visibility to UAB for the first time and include life sciences, business, and forensics areas.
7) Supported the successful spin-off of the first commercial entity from the CIA|JFR, *Malcovery*, in 2012. Housed in *Innovation Depot*, it recently its hired first CIS graduate as an early employee.
8) In 2013 and 2014, served as Co-PI and co-lead on developing the proposal with two professors at UAH and USA on a $20M NSF EPSCOR Track-1 Proposal unifying over 40 Cyber-related scientists in the state. NSF EPSCOR Track-1 first had to win approval from the state committee. EPSCOR Track-1 is applicable in states with historically lower federal funding (26 of 50 states qualify). In 2014, we resubmitted. (This effort was completed while Center Director at Auburn.)
9) In 2013, joined with Auburn University leaders, UAB colleagues and other colleagues from around the state to create the Alabama Cyber Research Consortium (ALCRC.ORG), which is now an effective, statewide collaborative forum for building capacity in cyber R&D.

Selected Administrative Achievements as Auburn Cyber Center Director (July 1, 2014-August 2017):

1) Established a new research laboratory in “Internet of Things” and “Industrial Control Systems”
2) Recruited and supported a new group of 11 students (including 2 minority students and 1 female student) in cyber. Additionally, we have 7 undergraduate students involved as of Fall 2015.
3) Obtained significant new DOD-related cyber funding in Huntsville, AL (a major hub of DOD R&D) during my first year on faculty at Auburn for work on Cyber R&D ($91K as PI, $273K as co-PI); the majority of this funding continues in FY16.
4) Worked with Auburn development on closing a $250,000 (+$250,000 deferred) donation for the “Lt General Ronald Burgess, Jr, USA, Retired Cyber Research Laboratory,” which is the new home of the Cyber Center. Occupancy was in November 2016.
5) Created a visible, viable Cyber Center, with internal University and growing external visibility.
6) Led efforts to ramp up funded R&D with over 10 proposals submitted in the first year in which I was either the PI or a co-PI. 17 awarded grants/contracts since starting at Auburn on July 1, 2014 with approximately $3M of total funding (either as PI or co-PI).
7) Promoted to Inaugural Director of the *Charles D. McCrary Institute for Critical Infrastructure Protection and Cyber Systems* (starting 8/16/16). Currently building a new, campus-wide

institute with endowed funding in CIP and Cyber security, systems engineering. Responsible for managing an annual base budget of approximately $350,000 and deploying annual income from the $10M endowment for the Institute.

Selected Administrative Achievements as SimCenter Director (August 2017-present):

1) Led upgrade of the high-performance computing and storage systems and established SimCenter as UTC's "Research Computing Core Facility"
2) Organized and supported a new, research network capacity to support smart cities, IoT, and related R&D
3) Began "rebranding" of SimCenter as a holistic part of the UTC's research and experiential learning cores
4) Engaged over a dozen new faculty in SimCenter from multiple colleges across UTC
5) Established new "Swim lanes" (concentration areas) in Cyber and High-Performance Computing
6) Held two retreats (December 2017, January 2019) for team building and establishing trust and new collaborations.
7) Hired new positions: Grants Administrator and Graphic Artist/Web designer – to support SimCenter's support and outreach to campus faculty.
8) Fired probationary employee and rehired a superior Budget Coordinator (2018)
9) Converted temporary system administrator to fulltime position to provide long-term continuity and better support to students and professors working on high performance computing.
10) Upgraded and enhanced the research pilot award programs (CEACSE/THEC awards)—improved processes, improved peer review, and broader engagement of faculty across the UTC campus
11) Established strong working relationships with key Deans, chairs, and stakeholders to enhance faculty and student involvement in SimCenter programs and facilities
12) Began process of enhanced community engagement of SimCenter with Chattanooga.
13) Began process to engage regularly with Oak Ridge National Laboratory (ORNL)
14) Began the process of establishing meaningful international collaborations with University of Edinburgh and University of Cadiz.
15) Supported the submission of over 70 proposals in Fiscal Year 2018.
16) Obtained $64,000 of NSF grant supplements to support undergraduate research in 2018.
17) PI on $250,000 ReVV Economic Development funding to Support IMSA (A Chattanooga Startup)
18) PI at UTC for joint Boston University-UTC NSF Funding ($450K is UTC portion) in 2019.
19) PI of NSF CC*Compute Grant (approx. $393K)—New Cluster Computing Facility (2019).
20) Co-PI on NSF CC*Network Grant (approximately $500K)---New Research Network for Campus. 2019.
21) PI on UTC/TTU EHR: PEER proposal for total of $100K for workshops on workforce development in Digital Twins.
22) Took lead role in development and submission of key infrastructure proposal in 2019 – NSF Major Research Instrumentation --- Private Virtual Cloud Computing (pending).
23) Took lead role in development and submission of a large-scale, Department of Energy High-Performance Center Proposal (continuing in Calendar 2019) with the University of Alabama at Birmingham, and University of New Mexico (Albuquerque)---PSAAP III---pending.
24) Mentored more than 10 faculty on research capacity building and career strategy in 2018 and 2019.
25) Introduced "Digital Twin" Swim Lane (Emphasis area) for SimCenter as of July 1, 2019.

Grants and Contracts

"NSF Collaborative Research: Software Engineering Workforce Development in High Performance Computing for Digital Twins." A. Skjellum (PI) with two UTC co-PIs and two TTU co-PIs. UTC portion: $57,635.

"NSF HDR DSC: Collaborative Research: Transforming Data Science Education through a Portable and Sustainable Anthropocentric Data Analytics for Community Enrichment Program." Yu Liang (Overall PI), A. Skjellum (co-PI), with three other co-PIs at UTC. $723,644 (UTC portion). 2019

"NSF SPX: Collaborative Research: Intelligent Communication Fabrics to Facilitate Extreme Scale Computing," Boston University PI: Martin Herbordt; UTC PI: A. Skjellum, with C. Tanis (co-PI). $450,097 (UTC portion). 2019.

ReVV Grant (IMSA), A. Skjellum (PI), with two UTC co-PIs. $250,000. May 5, 2019 November 5, 2020.

"NSF CC* Compute: A Cost-Effective, 2,048 Core InfiniBand Cluster at UTC for Campus Research and Education," Skjellum (PI), with 4 co-PIs at UTC. $392,235. 2019.

"NSF CC* Networking Infrastructure: Advancing High-speed Networking at UTC for Research and Education," F. Kandah (PI), A. Skjellum (co-PI), with 3 other co-PIs at UTC - $499,663. 2019.

Sandia - MPI R&D– $100K. A. Skjellum, PI, C. Tanis, co-PI. 2019-2020 (split funding over 2 fiscal years).

NSF CICI: Data Provenance: Collaborative Research: Provenance Assurance Using Currency Primitives (Supplement), A. Skjellum, PI, R. Brooks (Clemson), co-PI, $39,000 (UTC Portion), January 1, 2016-December 31, 2019. [Supplement.]; Additional $34,866 supplement to UTC only in 2019.

LLNL/LLNS - MPI R&D for Fault Tolerance – $59K. Skjellum, PI, 2018.

IBM Faculty Award (Philanthropic Grant for R&D in Distributed Grid). A. Skjellum, $20,000 (no indirect). 2018.

IBM Faculty Award (Philanthropic Grant for R&D in Machine Learning for Malware). A. Skjellum, $40,000 (no indirect). 2016.

NSF-ACI-1642083 - CICI - SE Scientific Cybersecurity For University Research – Clemson, UAH, Auburn, Vorhees, JSU. Skjellum PI for Auburn. $80,964 (Auburn budget). 10/1/16-9/30/18. [Transferred to UTC.]

NSF-ACI-1642133-CSSE – CICI - Data Integrity Assurance &Privacy Protection Solutions For Secure Interoperability Of Cloud Resources – Ku (PI), Skjellum (co-PI), $467,028 (UAB has a separate budget in addition to this). 10/1/16 - 9/30/19.

SIT-2102659-01-TO65-RT165 - Cybersecurity For System Of Systems Architectures – Umphress (PI), Skjellum (co-PI), $174,813.. 8/9/16-8/8/17.

PROGENY-PSC-0342 –COTS Approach To Information Security – STTR subcontract – Umphress (PI), Skjellum (co-PI), $120,000. exp. 11/9/16-6/27/18.

LLNL/LLNS - MPI R&D for Fault Tolerance – $54,000. Skjellum, PI. 10/1/16- 9/30/17.

NSF SHF: Medium: Collaborative Research: Next-Generation Message Passing for Parallel Programming: Resiliency, Time-to-Solution, Scalability, and QoS. Collaborative with UAB. Auburn Portion proposed $736,557. Funded at $602,000. Total budget of approximately $1M between the institutions. 6/1/16-5/31/20. [Transferred to UTC.]

NSF SHF: Small: Collaborative Research: Coupling computation and communication in FPGA-enhanced Clouds and Clusters. Joint with Boston University. $249,063 (Auburn portion). Funded at $225,000. 9/1/16-8/31/19. [Transferred to UTC.]

NSF CICI: Data Provenance: Collaborative Research: Provenance Assurance Using Currency Primitives, A. Skjellum, PI, R. Brooks (Clemson), co-PI, $248,755 (Auburn portion), January 1, 2016-December 31, 2019. [Transferred to UTC.]

DOD/NSA: Using Data Mining to Detect Malware in the Internet of Things. A. Skjellum, PI, $74,683, August 1, 2015-August 31, 2016.

NSF EAGER Cyber Manufacturing- Novel Process Data Analytics Framework For Iot-Enabled Cybermanufacturing, J. Wang, PI, A. Skjellum, Co-PI, $244,942, September 1, 2015-August 31, 2018..

Ephemeral Security Overlay For GPS, SBIR, Integrated Solutions For Systems: Af-FA9453-15-M-0473, $5,000, July 10, 2015-April 10, 2016 (co-PI with Drs. Alvin Lim and David Bevly).

BAE Subcontract from US Army (“Cyber Risk,” “Kestrel Eye”), R. Summers, PI, A. Skjellum, Co-PI, $273,870, September 29, 2014 – September 28, 2015 (with renewals in ~$100K FY16 and TBD for FY17).

COLSA Professional Engineering Services (for AMDREC), subcontract to US Army, A. Skjellum PI, $91,507, February 15, 2015 – September 23, 2015. (with no cost extension in 2016).

Sandia Funding for Exascale Storage System Research, A. Skjellum, PI, $161,000, October 1-September 30, 2015. (with renewal year in FY16 at $85,000).

Sandia Funding for Exascale Fault Tolerant MPI, A. Skjellum, PI, $30,000, July 1-September 30, 2014.

Sandia Funding for Exascale Storage System Research, A. Skjellum, PI, $64,000, July 1-September 30, 2014.

Sandia Funding for Exascale Storage System Research, A. Skjellum, PI, $41,000, March 2014-June 30, 2014.

Sandia Funding for Exascale Fault Tolerant System Research, A. Skjellum, PI, $100,000, March 2013.

"Alabama Innovation Fund," supported by Governor Bentley, A. Skjellum, PI, $250,000 plus UAB match. 2012. This award recognizes and supports CIS and Center commercialization efforts, notably *Malcovery*, plus is partially supporting two postdoctoral fellows at CIS in 2013.

Sandia Funding for Exascale File System Research (Sirocco), A. Skjellum, PI, $250,000, February 2013 (for October 1, 2012 start). Total funding yielded was nearly $1M over time.

"EAGER Grant, Research in Fault Tolerant MPI," A. Skjellum, PI; $100,000. National Science Foundation, 2012, no-cost extended through May 31, 2014.

"MRI: Development of a GPU-Enabled, Petascale Active Storage Architecture for Data-Intensive Applications in HPC and Cloud Environments," A. Skjellum PI: $300,000 plus $128,000 UAB Matching, National Science Foundation, 2012. [Switched to co-PI on move to Auburn in 2014.]

Sandia Funding for Exascale File System Research (Sirocco), A. Skjellum, PI, $245,000, December 2011. Renewable for 4 more years – total expected support over $1.2M. Renewals shown above at UAB and then at Auburn starting in 2014.

"NSF EAGER Grant, Research in Peer File System," A. Skjellum, PI; also joint funding with Clemson University, 2010-2011. UAB funding is $67,000. Led to Sandia follow-on support.

Funding from Sandia National Laboratories for Work on Peer File System Research, 2009-2010 (on-going). Initial funding level: $80,000. A. Skjellum, PI at UAB. Also funded are Clemson University and University of Minnesota on separate contracts.

"Cybercrime and Security: A Model State Partnership," United States Department of Justice, Bureau of Justice Assistance. ($500K over 1 year). John J. Sloan, III and Anthony Skjellum (Co-Principal Investigators). Grant #2010-DD-BX-0603, 2010.

"UAB Anti-Cybercrime Computational Operation," Edward J. Byrne Memorial State and Local Justice Assistance Grant ($447K over three years). John J. Sloan III and Anthony Skjellum (Co-Principal Investigators). Grant #2008-DD-BX-0407, 2008.

"Support for UAB Computer Forensics Laboratories Project," United States Department of Justice, Office of Community Oriented Policing Service (COPS), COPS Technology Grant. FY 2006 ($987K over 3 years). John J. Sloan, III and Anthony Skjellum (Co-Principal Investigators). Grant #2006-CKWX-0582, 2006.

"MRI: Development of a GPU-Enabled Integrated Storage Computation Architecture and System," $300,000 plus $128,000 UAB Matching, National Science Foundation, 2008-12.

"MRI: Computer and Information Sciences Grid Node Research Facility," National Science Foundation, August 15, 2004-July 31, 2007. This is a $250,000 equipment grant, with $107,000 of matching to create the CIS Department's "Grid Node" or "Grid Cluster." Role: PI, with six co-PIs.

"Collaborative Research: A Systematic Approach to the Derivation, Representation, Analysis, and Correctness of Dense and Banded Linear Algebra Algorithms for HPC Architectures,"

National Science Foundation, July 1, 2003-June 30, 2006 [extended to June 30, 2007]. This project seeks to advance the understanding of how to gain more performance, predictability, and correctness from scalable and cache-memory oriented algorithms key to many scientific applications. Role: PI (at UAB), co-PI of the overall proposal.

"ALGORITHMS: Collaborative Research: New Contributions to the Theory and Practice of Programming Linear Algebra Libraries," National Science Foundation. August 1, 2002-July 31, 2003, Role: PI at MSU, Co-PI of overall proposal.

"NGS: Computational Vortals for Next-Generation Scalable Computing," National Science Foundation, December 1, 2001 – December 1, 2004, This grant addresses the use of grid computing and portal-based computing in order to advance scientific problem solving environments. Role: Co-Principal Investigator

"Integration of Fuzzy Data Mining with High Performance Scalable Computing: Intrusion Detection, Fault Detection, and Performance Monitoring," BMDO (DEPSCoR), $623,963, April 2001 - March 2004 (Other PIs: Rayford Vaughn and Susan Bridges).

"A QOS-Based Approach to Clustering and Interclustering with a Unified Methodology for Scalability, Security, Performance, Fault-Handling, and Co-Scheduling," National Science Foundation, $220,000, September 1, 2000 – August 31, 2002, (other PI: Rayford Vaughn).

"A Gigabit/s, VIA-Enabled Cluster Architecture for Research in High Performance Systems Software, Scalable Knowledge Discovery, Visualization, and Parallel Planning Under Uncertainty" National Science Foundation CISE Instrumentation Program, $214,939, July 1, 1999 - June 30, 2002 (Other PIs: Julia Hodges, Lois Boggess, Susan Bridges, Donna Reese, Raghu Machiraju, and Eric Hansen).

"Distributed Intrusion Detection Using Fuzzy Data Mining Applied to High Performance Cluster Computation," U.S. Department of Army Research Laboratory, $153,983, September 2000-September 2002 (Other PIs: Rayford Vaughn and Susan Bridges).

"Parallelizing a FORTRAN90 SWAFS Code with MPI," Mississippi Research Consortium, $42,500, October 1, 1998 - February 28, 1999.

"The Scalable Knowledge Discovery Initiative," Hearin Foundation, $49,000, May 16, 1998 - May 15, 1999 (Other PIs: Julia Hodges, Susan Bridges, and Raghu Machiraju).

"Parallelizing a FORTRAN90 SWAFS Code for CRAY T3E with MPI," Lockheed-Stennis, $14,000, December 1, 1997 - February 28, 1998 (PI; co-PIs: Ioana Banicescu and Raghu Machiraju).

"Heterogeneous Embedded Real-Time Systems Environment," Integrated Sensors, Inc. [DARPA BAA 9706 subcontract], $400,000, July 1, 1997 - June 30, 2000.

"Parallel Mathematical Libraries Project II," DOE/USIC/LLNL, $80,000, January 1, 1998 - December 31, 1998.

"MPICH Technology and Optimizations for the Cray T3E," CEWES MSRC focused effort, $20,000, December 1, 1997 - June 30, 1998.

"Support for Scalable CFD and MPI," CEWES MSRC focused effort, $60,000, April 1, 1997 - March 30, 1998 (PI; Co-PI: Puri Bangalore).

“Technical Computing on Intel Platforms and Scalable Interface for Evolving, Mass-Market PC Applications (supplement),” Intel Software Technology Laboratory, Amount: $45,076, December 1, 1996.

“Myrinet 4.1 Memory-Mapped Device Driver Development for Windows NT Systems,” Myricom, Inc, $10,000, December 1, 1996 - January 31, 1997.

“Intel Software Grant,” Intel, $18,000, October 1996.

“Development of MPI and Myrinet Technologies for a Secure, Heterogeneous Application Runtime Environment for High Performance Computing (SHARE-HPSC),” Sanders (Lockheed-Martin), subcontract of DARPA contract, $208,523, September 1995 - November 1997.

“Revolutionary Advances in Ubiquitous, Realtime, Multicomputers and Runtime Environments,” DARPA/US Air Force Rome Laboratory, $1,250,000, October 1996 - June 1999 (joint project with University of Maryland).

“Tactical Advanced Signal Processor Effort (TASP),” U.S. Navy, $125,000, 1999.

“Tactical Advanced Signal Processor Effort (TASP),” U.S. Navy, $95,000, 1997.

“Parallel Mathematical Libraries Project,” DOE/USIC/LLNL, $60,000, July 11, 1996 - December 31, 1997.

“Intel Paragon MPI and ATM Research,” Intel, $230,000, July 1996.

“ATM-based Heterogeneous MPI for the P6 Paragon Multicomputer and 4-Way P6 Multiprocessor,” Intel, $31,000, January 1, 1996 - December 31, 1998.

“Embedded Message Passing Interface (eMPI) for the Advanced Common Processor,” Sanders (Lockheed-Martin, Hudson, NH), $33,000, August 1, 1996 - December 20, 1996.

“The Multicomputer Toolbox,” Lawrence Livermore National Laboratory, $670,000, 1991-92.

“Dynamic Process Simulation on Computers with Parallel Architectures,” National Science Foundation, $11,000, 1995-1996 (no cost extension of original grant).

“The Parallel Mathematical Libraries Project,” United States Industry Coalition, Inc. (USIC; collaboration among LLNL (Dept. of Energy), the Russian Federal Nuclear Center, Arzamas-16 (VNIIEF/Sarov), Intel, and MSU), $35,000, September 1995.

“Technical Computing on Intel Platforms; Scalable Interfaces for Evolving, Mass-Market PC Applications,” Intel, Inc., $76,000 (approximate), September 1995.

“A Multi-Faceted Study of Scalable Parallelism for Computational Science and Engineering,” Skjellum and Lumsdaine (Notre Dame), National Science Foundation, Co-PIs, period of performance: September 15, 1995-August 14, 1998, MSU part of budget: $180,000, ND part of budget $180,000 (both over three years). (Funded unsolicited proposal to CISE ASC Directorate).

"Innovative High Performance Distributed Computing Research and Education: Parallel Algorithms, Libraries, Computational Models, and Distributed Services," National Science Foundation **EARLY CAREER** Award, $124,800, September 1, 1995 - August 31, 1998.

"High Performance Research and Technology for Parallel Programming based on Embedded and Real-time Extensions of the Message Passing Interface (MPI) and MsgWay Protocol," DARPA, $1,386,847, September 1, 1995 - June 30, 1998.

"Collaborative Research and Development of MPI and Myrinet Technologies for Embedded High Performance Computing," Martin-Marietta Laboratories, $57,656, March-December, 1995.

"National High Performance Distributed Computing Consortium," U.S. Army Corps of Engineers Waterways Experiment Station, $75,000, September 1, 1995 - April 30, 1998.

"Parallel Solution, Grid Generation, and Visualization of Turbo-Machinery Grand Challenge Problems," Department of Energy, $254,598, October 1, 1994 - September 30, 1996, in cooperation with Sandia National Laboratories (co-PIs: D. Reese, E. Luke, and D. Barnette).

Publications

Refereed Journal Papers

Nawrin Sultana, Martin Ruefenacht, Anthony Skjellum, Ignacio Laguna, Kathryn Mohror, *Failure recovery for bulk synchronous applications with MPI Stages,* Parallel Computing, 84, pp 1—14, 2019.

Daniel J. Holmes, Bradley Morgan, Anthony Skjellum and Purushotham V. Bangalore and Srinivas Sridharan: *Planning for performance: Enhancing achievable performance for {MPI} through persistent collective operations*, Parallel Computing, Volume 81, pp 32-57, 2019.

Mark Yampolskiy, Wayne E. King, Jacob Gatlin, Sofia Belikovetsky, Adam Brown, Anthony Skjellum and Yuval Elovici: *Security of Additive Manufacturing: Attack Taxonomy and Survey,* Additive Manufacturing, https://doi.org/10.1016/j.addma.2018.03.015, 2018.

Mark Yampolskiy, Anthony Skjellum, Michael Kretzschmar, Ruel A. Overfelt, Kenneth R. Sloan, Alec Yasinsac, "Using 3D printers as weapons," International Journal of Critical Infrastructure Protection (IJCIP), Volume 14, pp. 58-71. http://dx.doi.org/10.1016-/j.ijcip.2015.12.004; impact factor 1.351.

Zekai Demirezen, Murat M. Tanik, Mehmet Aksit, and Anthony Skjellum, An Information-Theory-based Representation of Software Design, *Integrated Computer-Aided Engineering Journal (ICAE)*, Volume 21, Number 3, 2014, pp. 235-247, impact factor 3.370.

Joel P Tully, Aubrey E Hill, Hadia M Ahmed, Ryan Whitley, Anthony Skjellum and M Shahid Mukhtar. Expression-based network biology identifies immune-related functional modules involved in plant defense. BMC Genomics 2014, 15:421 doi:10.1186/1471-2164-15-421, impact factor 4.40.

Zhiwei Sun, Anthony Skjellum, Lee Ward, and Matthew L. Curry. 2014. A Lightweight Data Location Service for Nondeterministic Exascale Storage Systems. *Trans. Storage* 10, 3, Article 12 (August 2014), 22 pages. DOI=10.1145/2629451 http://doi.acm.org/10.1145/2629451 .

Matthew L. Curry, Anthony Skjellum, H. Lee Ward, and Ron Brightwell*, "*Gibraltar: A Library for RAID-Like Reed-Solomon Coding on Programmable Graphics Processors,*"* Concurrency and Communication: Practice and Experience, December 2011, 23(18): 2477-2495.

Wardman, Bradley, Warner, Gary, McCalley, Heather, Turner, Sarah, Skjellum, Anthony "Reeling in Big Phish with a Deep MD5 Net," Journal of Digital Forensics, Security and Law. 5(3), 2010.

Wei, Chun; Sprague, Alan; Warner, Gary; Skjellum, Anthony. The Journal of Digital Forensics, Security and Law : JDFSL 5.1 (2010): 21-47.

Suman Roychoudhury, Jeff Gray, Jing Zhang, Purushotham Bangalore, Anthony Skjellum: "A Program Transformation Technique to Support AOP within C++ Template." Journal of Object Technology 9(1): 143-160, 2010.

Zekai Demirezen, Barrett Bryant, Anthony Skjellum, and Murat M. Tanik, "Design Space Analysis in Model-Driven Engineering," Journal of Integrated Design & Process Science, Volume 14, Number 1, March 2010, pp. 1-15.

Chun Wei, Alan Sprague, Gary Warner, Anthony Skjellum: Mining spam email to identify common origins for forensic application. SAC 2008: 1433-1437

Zhijie Guan, Francisco Hernández, Purushotham Bangalore, Jeffrey G. Gray, Anthony Skjellum, Vijay Velusamy, Yin Liu: Grid-Flow: a Grid-enabled scientific workflow system with a Petri-net-based interface. Concurrency and Computation: Practice and Experience 18(10): 1115-1140 (2006). [86 citations per Google Scholar as of June, 2015].

Florez, G., Liu, Z, Bridges, S., Skjellum, A., and Vaughn, R. "Lightweight Monitoring of MPI Programs in Real-time," *Concurrency and Computation: Practice & Experience*, 2005.

Vijay P. Shah, Nicolas H. Younan, Torey Alford, Anthony Skjellum: A spectral estimation toolkit for Java applications. Sci. Comput. Program. 54(1): 125-142 (2005)

Skjellum, A., A. Kanevsky, Y. Dandass, et al, "The MPI/RT 1.0 Real-Time Message Passing Standard," *Concurrency and Computation Practice and Experience 16*(S1): 0-322 (2004), pp. 0-322, December 2004*.*

Florez, G., Liu, Z, Bridges, S., Skjellum, A., and Vaughn, R., "Detecting Anomalies in High-Performance Parallel Programs" The Journal of Digital Information Management, vol 2, no 2, June 2004, pp. 44-47.

Rajanikanth Batchu Yoginder S. Dandass, Anthony Skjellum, Murali Beddhu: MPI/FT: A Model-Based Approach to Low-Overhead Fault Tolerant Message-Passing Middleware. Cluster Computing 7(4): 303-315 (2004). [100 citations per Google Scholar as of January 2019].

Valsalam, V, and A. Skjellum, "A Framework for High-Performance Matrix Multiplication Based on Hierarchical Abstractions, Algorithms and Optimized Low-level Kernels*,*" *Concurrency and*

Computation: Practice & Experience, Vol 14(10), pp. 805-839. [60 citations on Google Scholar as of January 2019].

Skjellum, A, R. Dimitrov, S. Angaluri, D. Lifka, G. Coulouris, P. Uthayopas, S. Scott, R. Eskicioglu, *Cluster Computing White Paper, "Operating Systems" paper, Mark Baker, ed, Spring 2001 issue of Int. Journal of High Performance Computing Applications.*

Protopopov, B., and A. Skjellum, "A Multithreaded Message Passing Interface (MPI) Architecture: Performance and Program Issues," *Journal of Parallel and Distributed Computing*, Vol. 61, No. 4, April 2001, pp. 449-466. [52 citations on Google Scholar as of January 2019].

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Protopopov, B., and A. Skjellum, "Shared-Memory Communication Approaches for an MPI Message-Passing Library," *Concurrency: Practice & Experience*, Vol.12, No. 9, 2000, pp. 799-820.

Carpenter, B., V. Getov, G. Judd, A. Skjellum, and G. Fox, "MPI-Like Message Passing for Java," *Concurrency: Practice & Experience,* Vol. 12, No. 11, 2000, pp. 1019-1038. [170 citations per Google Scholar as of June, 2015].

Skjellum, A., and others, "MPI 2: A Message-Passing Interface Standard," *International Journal of Supercomputer Applications and High Performance Computing,* Vol. 12, No. 1/2, 1998, pp. 139-157.

Li, J., A. Skjellum, R.D. Falgout, "A Poly-Algorithm for Parallel Dense Matrix Multiplication on Two-Dimensional Process Grid Topologies," *Concurrency: Practice and Experience,* Vol. 9, No. 3, 1997. [53 citations per Google Scholar as of January 2019].

Gropp, W., E. Lusk, N. Doss, and A. Skjellum, "A High-Performance, Portable Implementation of the MPI Message-Passing Interface Standard," *Parallel Computing,* Vol. 22(6), September 1996, pp. 789-828. [2,856 citations on Google Scholar as of January 2019.]

Skjellum, A., E. Lusk, and W. Gropp, "Early Applications in the Message-Passing Interface," *International Journal of Supercomputing Applications,* June 1995 (invited paper).

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Qingqing Xiong, Rushi Patel, Chen Yang, Tong Geng, Anthony Skjellum, Martin C. Herbordt: *GhostSZ: A Transparent FPGA-Accelerated Lossy Compression Framework.* FCCM 2019: 258-266

Walker Haddock, Purushotham V. Bangalore, Matthew L. Curry, Anthony Skjellum: *High Performance Erasure Coding for Very Large Stripe Sizes*. SpringSim 2019: 1-12

Ryan E. Grant, Matthew G. F. Dosanjh, Michael J. Levenhagen, Ron Brightwell, Anthony Skjellum: Finepoints: Partitioned Multithreaded MPI Communication. ISC 2019: 330-350

Qingqing Xiong, Anthony Skjellum, Martin C. Herbordt: *Accelerating MPI Message Matching through FPGA Offload.* FPL 2018: 191-195

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Ujjwal Guin, Pinchen Cui, and Anthony Skjellum, *Ensuring Proof-of-Authenticity of IoT edge devices using Blockchain technology,* 2018, accepted for IEEE Blockchain 2018, Halifax, Canada.

Carl Worley and Anthony Skjellum, *Opportunities, Challenges, and Future Extensions for Smart-Contract Design Patterns,* under review for 1st Workshop on Blockchain and Smart Contract Technologies, BIS (Workshops) 2018: 264-276, Berlin.

U. Guin, A. D. Singh, M. Alam, J. Canedo, and A. Skjellum, *A secure low-cost edge device authentication scheme for the Internet of Things,* in 31st International Conference on VLSI Design and 17th International Conference on Embedded Systems, VLSID 2018, Pune, India, January 6-10, 2018 EEE Computer Society, 2018, pp. 85–90.

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Oluwakemi Hambolu, Lu Yu, Jon Oakley, Richard R. Brooks, Ujan Mukhopadhyay, Anthony Skjellum: *Provenance threat modeling*. PST 2016: 384-387, December 2016.

Ujan Mukhopadhyay, Anthony Skjellum, Oluwakemi Hambolu, Jon Oakley, Lu Yu, Richard R. Brooks: *A brief survey of Cryptocurrency systems*. PST 2016: 745-752.

Carl Worley and Anthony Skjellum, *Blockchain Tradeoffs and Challenges for Current and Emerging Applications: Generalization, Fragmentation, Sidechains, and Scalability.* Accepted symposium paper for IEEE Blockchain 2018, Halifax, Canada.

Janice Cañedo, Anthony Skjellum. "Adding scalability to Internet of Things gateways using parallel computation of edge device data." HPEC 2016: pp. 1-5.

Benjamin Fogel, Shane Farmer, Hamza Alkofahi, Anthony Skjellum, Munawar Hafiz: POODLEs, More POODLEs, FREAK Attacks Too: How Server Administrators Responded to Three Serious Web Vulnerabilities. ESSoS 2016: 122-137.

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Amin Hassani, Anthony Skjellum, Purushotham Bangalore, Ron Brightwell: "Practical resilient cases for FA-MPI, a transactional fault-tolerant MPI." ExaMPI@SC 2015: 1:1-1:10.

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Jothi P. Neelamegam, Srigurunath Chakravarthi, Manoj Apte, Anthony Skjellum: PromisQoS: An Architecture for Delivering QoS to High-Performance Applications on Myrinet Clusters. LCN 2003: 510-517.

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James H. Graham, Anthony Skjellum: 22nd International Conference on Parallel and Distributed Computing and Communication Systems, PDCCS 2009, September 24-26, 2009, Marriott Louisville Downtown, Louisville, Kentucky, USA ISCA 2009.

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Steven Eliuk, Cameron Upright and Anthony Skjellum, "dMath: A Scalable Linear Algebra and Math Library for Heterogeneous GP-GPU Architectures," CoRR abs/1604.01416, 2016, http://arxiv.org/abs/1604.01416.

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Crawford, G. III, Y. Dandass, and A. Skjellum, "The JMPI Commercial Message Passing Environment and Specification: Requirements, Design, Motivations, Strategies, and Target Users."

Selected Presentations

Workshops

Skjellum, A., R. Batchu, Y. Dandass, and M. Beddhu, "MPI/FT: A Model-Based Approach for Low-Overhead Fault-Tolerance," 1st Sandia/CSRI Fault Tolerance Workshop, Albuquerque, NM, June 10, 2002.

Skjellum, A., Hebert, S., A. Kanevsky, and Z. Cui, "MPIDC99 Tutorial on MPI/RT," Third MPI Developers and Users Conference, Atlanta, March 1999 (half-day tutorial).

Skjellum, A., and P. Bangalore, "MPIDC99 Tutorial on MPI-2," Third MPI Developers and Users Conference, Atlanta, March 1999, (half-day tutorial).

Skjellum, A., and P. Bangalore, "SIAM Tutorial on MPI-2," SIAM 9th Conference On Parallel Processing for Scientific Computing, San Antonio, March 1999, (half-day tutorial).

Skjellum, A., and P. Bangalore, "IPPS Tutorial on High Performance Computing," IPPS'97, Geneva, Switzerland, April 1997 (half-day tutorial).

Skjellum, A., and P. Bangalore, "IPPS Tutorial on MPI," IPPS'97, Geneva, Switzerland, April 1997 (half-day tutorial).

Skjellum, A., “Design and Development of Real-Time Message Passing Interface (MPI/RT) Standard,” High Performance Embedded Computing Workshop, September 1997.

Skjellum, A., “A Second Talk about MPI,” SCRI Cluster Workshop ‘93, Florida State University, December 8, 1993.

Skjellum, A., “Writing Parallel Libraries with MPI,” AMPI: A Message Passing Interface Mini-Symposium, Supercomputing 1993, Portland, OR, November 19, 1993.

Skjellum, A., “Message Passing Systems: Portability, Capability, Performance, Standards,” The First CRPC Workshop on Standards for Message Passing in a Distributed Memory Environment, Williamsburg, VA, April 1992 (invited presentation).

“The Reactive Kernel and Cosmic Environment: Native and Emulated Systems for Medium-Grain Multicomputers and Workstation Networks.” The First CRPC Workshop on Standards for Message Passing in a Distributed Memory Environment, Williamsburg, VA, April, 1992 (invited presentation).

Invited Lectures

“MPI 4: An Exascale Message Passing Strawman Standard,” Sandia National Laboratories, April, 2011.

“Gibraltar GPU RAID”, EMC Technical Talk, co-presented with Matthew Curry, November 8, 2010, Cambridge, Mass.

“MPI-3: Evolution, Revolution, or Status Quo,” Sandia National Laboratories, June 12, 2002.

“Efficient Implementations of MPI,” Lawrence Livermore National Laboratory, February 16, 1995.

“The National High Performance Distributed Computing Consortium,” Lawrence Livermore National Laboratory, October 21, 1993.

“MPI: An Effort to Standardize Multicomputer Message Passing,” Los Alamos National Laboratory, CNLS Seminar, July 6, 1993 (also presented at NASA Ames, August 18, 1993; and Lawrence Livermore National Laboratory, August 19, 1993).

“Building Parallel Libraries and Applications in the MPP Environment,” Lawrence Livermore National Laboratory, August 17, 1993.

“The Multicomputer Toolbox: First-and Second-Generation Scalable Libraries and Algorithms Research,” Sandia National Laboratories, Massively Parallel Computing Research Laboratory, June 2, 1993 (also presented at Argonne National Laboratories, September 7, 1993).

University Service

At Auburn
Computer Science and Software T&P Committee, 2014-2017.
Computer Science and Software Engineering Recruitment Committee, 2016-2017.

At UAB
Chair, University-wide Committee, "Research Capacity Building Committee," 2009-2014.
Organized and Led Training sessions for NSF Career Award Submissions: provided in-service workshops for Professors seeking NSF CAREER awards, 2008-2014.

At Mississippi State
Computer Science Department/Research Center Liaison Committee, 2001-02
- Chairman, 2001-02
Computer Science Faculty Search Committee, 1997-98, 1999-00
Computer Science Facilities Committee, 1998-02
- Chairman, 1998-99, 2000-01
Computer Science *Ad Hoc* Committee on Graduate Student Concerns, 2001-02
Computer Science Affiliation Agreements Committee, 1999-00
Computer Science *Ad Hoc* Committee on Target Schools, 2000-01
Computer Science Strategic Planning Committee, 2000-01

Courses Taught

At Auburn
COMP 5350/6350/6356 – Digital Forensics
COMP 5370/6370/6376 – Computer and Network Security

At UAB
CS 306 Object-oriented Perl Programming
CS 420/520 Software Engineering
CS 436/636 Computer Security
CS 434/634 Parallel Computing
CS 620/630 Bioinformatics I/II (Coordinator)
CS 499 Senior Capstone
CS 591/691 Virtualization
CS 680/780 Foundations of Numerical Computing
CS 334/534 Introduction to TCP/IP

At Mississippi State University
CS 9133 Parallel Scientific Computing
CS 8733 Advanced Systems Programming
CS 4992/6992 Advanced Programming Using C++
CS 3183 Systems Programming
CS 4812/6812 Computer Systems Laboratory I
CS 4743/6743 Operating Systems II
CS 4192/6192 Computer Systems Laboratory II
CS 4163/6163 Design of Parallel Algorithms
CS 4153/6153 Data Communications and Networking
CS 1213 Fortran for Scientists and Engineers

Students Advised or on Committee (Currently)

UTC Ph.D. students [advisor]: Amani Altarawneh, Sai Medury (transfers from Auburn)
Chang Phoung

Auburn Ph.D. students [co-advisor or committee]:
Ujan Mukhopadhyay,
Janice Canedo, Rodrigo Sardinas, Yien Wang, Jason Cuneo, Rodney Visser, Heba Alawneh, Hamza Alkofahi, Heba Alawneh, Pinchen Chen, Nawrin Sultana

Students Advised (Graduated)

Postdoctoral Fellow at UAB (2013-14): Zekai Demirezen
Postdoctoral Fellow at UTC (2018-19): Ryan Marshall

Ph.D. students advised (with degrees granted):

At UAB:
Hadia Ahmed (2017) [mentored; advised by P. Pirkelbauer], Amin Hassani (2016) [mentored, advisor P.V. Bangalore], Zhiwei Sun (2013), Zekai Demirezen (2012), Brad Wardman (2011), Matthew Curry (2010), Vetria Byrd (2010), Zhijie Guan (2005)

At Mississippi State:
Rossen Dimitrov, Manoj Apte, Purushotham V. Bangalore, Boris V. Protopopov, Yoginder Dandass

Master's students advised:

At Auburn:
Bruce Payne (2015), Carlos Lemus (2016), Jared Ramsey (2016), Ankit Singh (2016), Hamza Alkofahi (2016), Ananya Ravipati (2017), Sai Medury (2017), Pinchen Cui (2017)

At UAB:
Amin Hassani (2014), Hadia Ahmed (2013), Matthew Farmer (2013), Alex Filby (2013), Evana Rahaman, (2011), Saoni Mukherjee (2011), Yin Liu (2005)

At Mississippi State:
Wenhao Wu, MS 2003
Vijay Velusamy, MS, 2003
Diane Mosser-Wooley, MS 2002
Kumaran Rajaram, MS 2002
Jothi Padmanabhan Neelamegam, MS 2001
Xinyan Zan, "A Real-Time Message Layer Over Myrinet Networks," August 2000.
Srigurunath "Ecap" Chakravarthi, "Predictability and Performance Factors Influencing the Decision of Real-Time Messaging Layers," May 2000.
Matthew Gleeson, December 2000
Lubomir Birov, " C++ As A High Performance Language for Vector, Signal, and Image Processing Libraries," August 1999.

Zhenqian Cui, “A Study of Quality of Service Communication for High-Speed Packet-Switching Computer Sub-Networks,” May 1999
Ajitha Choudary, May 1998
Rossen Dimitrov, “A Windows NT Kernel-Mode Device Driver for PCI Myrinet LANai 4.x Interface Adapters,” May 1997.
Jin Li, May 1996
Ziyang Lu, PhD (MS 1996)
Mark Rauschkolb, May 1995
Purushotham V. Bangalore, “The Data-Distribution-Independent Approach to Scalable Parallel Libraries,” May 1995
Chandrashekar Laveti, 1995
Ron Brightwell, 1995
Nisreen Ammari, graduated 2003
Raghu Angadi, graduated 2002
Srihari V. Angaluri, graduated 2004.
Rajanikanth Batchu, graduated 2003
Mangayarkarasi Dhandapani, graduated 2003
Shanthisowjownya Kottakotta, graduated 2003
Ranjith Balachandran, graduated 2003
Changzheng Rao, graduate 2003
Ravi Vadapalli, graduated 2002

b) Curriculum Vitae of CUIP Director, Dr. Mina Sartipi

Mina Sartipi

Founding Director - Center for Urban Informatics and Progress
Guerry Professor - University of Tennessee (UT) Chattanooga
Data Science and Engineering Faculty - Bredesen Interdisciplinary Research Center, UT
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Home Page: http://www.utc.edu/CUIP

EDUCATION

Young American Leaders Program (YALP)	Harvard Business School Boston, MA	2019
UT Leadership Institute	University of Tennessee Knoxville, TN	2017
Ph.D in Electrical and Computer Engineering	Georgia Institute of Technology Atlanta, GA	2003 - 2006
M.S. in Electrical and Computer Engineering	Georgia Institute of Technology Atlanta, GA	2001 - 2003
B.S. in Electrical Engineering	Sharif University of Technology Tehran, Iran	1996 - 2000

RESEARCH AREAS

- Smart Cities (Mobility, Energy, and Health)
- Urban Informatics
- Cyber-Physical Systems (CPS)
- Data Acquisition and Compressive Sensing
- Modern Error Control Coding and Information Theory

EXPERIENCE

Founding Director for the Center of Urban Informatics and Progress (CUIP) — **Chattanooga, TN** — **2018 - present**

- Lead a team of 25 people
  - Consisting of research faculty, postdoctoral fellows, students from interdisciplinary background, and marketing
- Developed MLK Smart Corridor - an urban testbed for testing smart mobility solutions in the real-world settings
  - Engaging industry and academic institutions to utilize the testbed
- Engaging experts from across the statewide UT system in cross-disciplinary research into solutions to urban challenges
- Coordinating Smart City research and the strategic vision for Urban Science
- Growing CUIP's recognition
  - Invited to panels and workshops

- Organize monthly webinars in mobility, health, equity, and energy
- Moderated the US Congressional Caucus on Smart Cities - August 2019
- Organized the second-annual Chattanooga Deep Learning Conference, focused on Smart City Testbeds
- Organized the first 2019 Smart Street Data Competition

- Coordinating collaborative efforts with community and other academic institutions and national labs
- Set up CUIP's Advisory Board
  - Scott Andes - Executive Director at the Block Center for Technology and Society, Carnegie Melon University
  - Kevin Comstock - Smart City Director, Chattanooga
  - Dr. Dominie Garcia - Smart Cities Program Director, Battelle
  - Dr. Margaret Loper - Chief Scientist, GTRI
  - Dr. Jane MacFarlane - Executive Director Smart Cities, Institute of Transportation Studies, University of California Berkeley
  - Dr. Mike Paulus - Director, Technology Transfer, Oak Ridge National Laboratory
  - Macon Toledano - Associate Director, Lyndhurst Foundation

Current Collaborators

- Chattanooga DOT/ TDOT
- EPB of Chattanooga
- The Enterprise Center
- Tennessee Valley Authority
- Siskin Hospital
- Erlanger Health Systems
- Chattanooga Area Regional Transportation Authority (CARTA)
- Hamilton County Emergency Services and Homeland Security
- US Ignite
- MetroLab Networks
- South Big Data Hub
- Georgia Tech
- University of Pittsburgh
- University of Tennessee Knoxville
- Eastern Tennessee State University
- Vanderbilt University
- Colorado School of Mines
- University of TX Dallas
- Baylor University
- Virginia Tech
- Institute of Transportation Studies, University of California Berkeley
- Georgia Tech Research Institute
- Oak Ridge National Laboratory

Lead Scientist for Smart Cities and Urban Science Chattanooga, TN 2016 - 2018
University of Tennessee at Chattanooga

- Organized the first Chattanooga Deep Learning Workshop Coordinated Smart City research and the strategic vision for Urban Science
- Built a multidisciplinary collaboration in this area across the campus
- Growing Urban S&T's recognition
  - Invited to panels and workshops
  - Featured in the White House News Release - October 2016

- Live demo at the Smart Cities Connect & US Ignite Application Summit - 2017

- Success in securing research funding
  - NSF, NIH, industry, and state
- Led efforts in establishing a new PhD concentrations at UTC
  - Recruiting PhD students and coordinating the program
- Coordinated collaborative efforts with other academic institutions and national labs
- Organized the first Undergraduate Research and Creative Endeavor (URaCE) fellowships for Smart City applications - Summer 2018

UC Foundation Professor, **Chattanooga, TN** **2015 - present**
Department of Computer Science and Engineering
University of Tennessee at Chattanooga

- PhD program coordinator
- Proposing algorithms for urban connectivity, observability, and controllability
- Proposing algorithms for connected autonomous vehicles in urban environments
- Developing algorithms for anomaly detection and power error billing
- Developing personalized trip planning based on multi-modal mobility
- Developing a data-driven smart health system to improve the life quality of human being
- Investigating user-aware demand response of buildings through smart models
- Proposing an infrastructure for the next-generation wireless communications

UC Foundation Associate Professor, **Chattanooga, TN** **2011 - 2015**
Department of Computer Science and Engineering
University of Tennessee at Chattanooga

- Proposed an optimal balance between computation and communication needs for networks of sensors in applications such smart manufacturing systems
- Proposed an efficient data acquisition in advanced metering infrastructure in smart grid
- Proposed mStroke - a smart system for remote monitoring of post-stroke patients
- Proposed an enhanced compression algorithm in distributed sensing applications
- Introduced a multiple description coding scheme to restore the image from a small subset of samples with reasonable accuracy

Visiting Faculty, **Atlanta, GA** **July 2014 - December 2014**
Information and Communications Lab
Georgia Tech Research Institute

- Introduced an algorithm to reduce PAPR at the receiver using compressive sensing
- Proposed sub-sampled compressive-sensing receiver processing
- Investigated non-uniform sampling in both the receiver and the transmitter for hyper-wideband enabled RF messaging

Assistant Professor, **Chattanooga, TN** **2006 - 2010**
Department of Computer Science and Engineering
University of Tennessee at Chattanooga

- Created a wireless sensor network research group
- Built a communication lab for telecommunication undergraduate and graduate courses
- Proposed TinyTermite - a secure and scalable routing algorithm for MANETs
- Proposed Information hiding scheme using modern error control coding

Assistant Professor, **Chattanooga, TN** **2006 - 2007**
Department of Electrical Engineering
College of Engineering and Computer Science
University of Tennessee at Chattanooga

- Implemented an energy-efficient multicast algorithm on TinyOS-based Intel Mote2
- Built a wireless sensor network lab for graduate students

Graduate Research Assistant, Georgia Tech **Atlanta, GA** **2001 - 2006**

- Introduced an energy-efficient and reliable multicasting protocol for wireless sensor networks
- Proposed a new design criteria for data compression in wireless sensor network
- Designed two-dimensional codes by two-dimensional wavelet transform
- Generated new algebraic finite-length low-density parity check (LDPC) codes
- Proposed a new scheme for generating rate-adaptive codes by wavelet transform
- Assisted with the preparation of research proposals and technical reports

FUNDED AWARDS:

- Over $10M from DOE, NSF, NIH, TDoT, TVA, UC Foundation, Lyndhurst Foundation, state, and industry
- First research grants from NSF and NIH in the College of Engineering and Computer Science at UTC

PROFESSIONAL ACTIVITIES

- Appointed to EPB's Board of Directors - 2021
- NSF Panelist, 2009 - present
- Appointed to EPB's Board of Directors - 2021
- Member of the board of directors at the Enterprise Center in Chattanooga, TN, April 2017-present
- Member of the board of Trustees at the Thrive Regional Partnership, January 2018-present
- Member of the board of directors at Variable Inc, 2012-present
- Technical Program Committee Member

  - Workshop on Parallel AI and Systems for the Edge
  - International Science of Smart City Operations and Platforms Engineering in partnership with Global City Teams Challenge
  - IEEE International Conference on Computing, Networking and Communications (ICNC)
- Served as a member of the STEM advisory board for CGLA (Chattanooga Girls Leadership Academy), 2009
- Faculty advisor for the Girls in Computer Science (GiCS) at University of Tennessee Chattanooga
- Reviewer for the IEEE Transactions on Information Theory, IEEE Transactions on Signal Processing, IEEE Transaction on Wireless Communications, IEEE Transactions on Communications, IEEE Transaction on Communications Letters, IEEE Journal on Selected Areas in Communications Special Issue, IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP), IEEE Infocom, IEEE Communications Society Conference on Sensor, Mesh and Ad Hoc Communications and Networks (SECON)
- IEEE member of Women in Engineering, 2005-present
- IEEE member, Signal Processing Society and Communications Society, 2003-present

PRESENTATION / PANEL

- Presenter at multiple federal funding agency workshops, 2016 - present
- Live demo and presenter at the Smart City Connect, 2017-present
- Moderator at the US Congressional Caucus on Smart Cities, 2019
- Presenter to the Tennessee Senate Transportation and Safety Subcommittee, 2021
- UT Day on the Hill (Research Changing Lives), 2020
- UT State Relations and Advocacy, 2020
- Hamilton County Emergency Services and Homeland Security, 2020
- Chattanooga Rotary Club, 2019
- Transportation Research Board (TRB), 2019
- Sprint IoT, 2019
- Panelist at the Joint MetroLab and NSF Workshop, 2019
- Smoky Mountains Computational Science and Engineering Conference, 2019
- Smoky Mountains Mobility Conference, 2019
- Chattanooga Technology Council (CHATech), 2019
- Presenter at the University of Tennessee (UT) Board of Trustees meeting, UT System Delegation, and Hamilton County Legislative, 2017
- Panelist at the Smart Cities Summit, 2018
- Council on Competitiveness Forum, 2018
- TennSmart, 2018
- Joint MetroLab and NSF Workshop, 2018
- National Transportation Training Directors, 2018

PUBLICATIONS

1. M. K. M. Fadul, D. R. Reising and M. Sartipi, "Identification of OFDM-Based Radios Under Rayleigh Fading Using RF-DNA and Deep Learning," in IEEE Access, vol. 9, pp. 17100-17113, 2021.

2. J. Roland, P. D. Way, C. Firat, T. -N. Doan, M. Sartipi, “Modeling and predicting vehicle accident occurrence in Chattanooga, Tennessee,” Elsevier Journal of Accident Analysis & Prevention, Volume 149, 2021, 105860, ISSN 0001-4575.

3. Peter D. Way, Jeremiah Roland, Osama Osman, Mina Sartipi, "Spatio-Temporal Accident Prediction: Effects of Negative Sampling on Understanding Network-Level Accident Occurrence," Transportation Research Record, 2021.

4. Y. Patel, C. Firat, T. Childers and M. Sartipi, "Ridership Prediction Of New Bus Routes At Stop Level By Modeling Socio-economic Data Using Supervised Machine Learning Methods", Transportation Research Board, Jan. 2021.

5. A. Alharin, T. -N. Doan and M. Sartipi, "Reinforcement Learning Interpretation Methods: A Survey," in IEEE Access, vol. 8, pp. 171058-171077, September 2020.

6. L.T. Phan, T. Doan, M. Sartipi. "Understanding the Effect of COVID-19 on Fuel Consumption of Public Transportation: The case study of Chattanooga, TN", IEEE BigData 2020

7. A. Alharin , Y. Patel, T. Doan, and M. Sartipi. "Data Analysis and Visualization of Traffic in Chicago with Size and Landuse-Aware Vehicle to Buildings Assignment." In Smoky Mountains Computational Sciences and Engineering Conference, pp. 518-529. Springer, Cham, 2020.

8. M. Mansouri, J. Roland, S. Nukala, J. Cho, and M. Sartipi, “The Heavy Lifting Treatment Helper (HeaLTH) Algorithm: Streamlining the Clinical Trial Selection Process.” In Smoky Mountains Computational Sciences and Engineering Conference (pp. 542-552). Springer, Cham, 2020.

9. YT. Doan, L. Phan, M. Sartipi, “Bus Fuel Consumption Problem: An in-depth Analysis and Prediction”, In the Proc. Of UrbComp 2020: The 9th SIGKDD International Workshop on Urban Computing, August 2020.

10. P. Way, J. Roland, M. Sartipi, “On the Nature of Negative Sampling: How Non-Accident Data Helps us Understand Accident Occurrence”, Proc. of the International Conference on Machine Learning and Data Mining, 2020

11. J. Cho, M. Sartipi, M. Fathollahzadeh, P. Tabares-Velasco, and S. Mohagheghi, "Residential Building A/C Load Analysis Using Deep Learning for Demand Response Management”, Submitted to IEEE Access, 2020

12. B. Allen, A. Harris, J. Cho, Z. Hu, M. Sartipi, K. Place, R. Salstrand, H. True, and N. Fell, "Functional Measurement Post-stroke via Mobile Application and Body-Worn Sensor Technology" Journal of mHealth, December 2019.

13. K. Kotobi and M. Sartipi, “A Novel Congestion Avoidance Algorithm for Autonomous Vehicles Assessed by Queue Modeling”, International Journal of Interdisciplinary Telecommunications and Networking, Volume 11, Issue 2, April-June 2019

14. J. Cho, A. Alharin, Z. Hu, N. Fell, and M. Sartipi, "Predicting Post-stroke Hospital Discharge Disposition Using Interpretable Machine Learning Approach", the Proc. of IEEE Big Data Conference, December 2019.

15. A. Harris, J. Stovall, and M. Sartipi, “MLK Smart Corridor: An Urban Testbed for Smart City Applications“, the Proc. of IEEE Big Data Conference, December 2019.

16. J. Stovall, A. O’Grady, and M. Sartipi, “Scalable Object Tracking for Smart Cities”, the Proc. of IEEE Big Data Conference 2019, December 2019.

17. A. Harris, M. Sartipi, “Data Integration Platform for Smart and Connected Cities,” in Proc. of Cyber-Physical Systems and Internet-of-Things, April 2019.

18. J. Roland, P. Way, M. Sartipi, “Studying the Effects of Weather and Roadway Geometrics Daily Accident Occurrence using a Multilayer Perceptron Model,” in Proc. of Cyber-Physical Systems and Internet-of-Things, April 2019.

19. R. Thompson, J. Stovall, D. Velasquez, V. Anne, A. Samoylov, M. Sartipi, “All-in-One Urban Mobility Mapping Application with Optional Routing Capabilities,” in Proc. IEEE Big Data Conference, December 2018.

20. K. Hollingsworth, K. Rouse, J. Cho, A. Harris, M. Sartipi, S. Sozer, B. Enevoldson, "Energy Anomaly Detection with Forecasting and Deep Learning", in Proc. IEEE Big Data Conference, December 2018.

21. K. Kotobi and M. Sartipi, "Efficient and Secure Communications in Smart Cities using Edge, Caching, and Blockchain,” in the Proc. of 1st International Workshop on Blockchain Enabled Sustainable Smart Cities, Sept. 2018.

22. M. Fadul, A. Patel, D. Reising, T. D. Loveless, and M Sartipi, “Estimating Energy Consumption Using Instantaneous Temperature,” in Proc. of ASHRAE, June 2018.

23. J. Cho, Z. Hu, and M. Sartipi, “Non-Intrusive A/C Load Disaggregation Using Deep Learning,” in the Proc. of 2018 IEEE Power & Energy Society T&D Conference & Exposition, April 2018.

24. R. Thompson, Z. Hu, J. Cho, J. Stovall, A. Harris, and M. Sartipi “Enhancing Driver Awareness Using See-Through Technology,” in the Proc. of WCX17: SAE World Congress Experience, April 2018.

25. H. True, N. Fell, A. Harris, J. Cho, Z. Hu, M. Sartipi, "Functional Measurement Post-Stroke via Mobile Technology,” in the Proc. of American Physical Therapy Association’s Combined Sections, February 2018.

26. J. Cho, Z. Hu, and M. Sartipi, “A/C Load Forecasting Using Deep Learning,” accepted to appear in the Proc. of IEEE CSCI - Big Data and Data Science, December 2017.

27. H. Suarez, A. Harris, Z. Hu, and M. Sartipi, “HIPAA Compliant Data Solution For a Smart Mobile Health Application,” in the Proc. of ACM Mid-Southeast, November 2017.

28. R. Thompson, Z. Hu, J. Cho, J. Stovall, A. Harris, and M. Sartipi, “See-Through Technology Using V2X Communication,” in the Proc. of ACM Mid-Southeast, November 2017.

29. J. Cho, Z. Hu, N. Fell, G. Heath, R. Qayyum, and M. Sartipi, “Hospital Discharge Disposition of Stroke Patients in the State of Tennessee,” Journal of the Southern Medical Association, September 2017.

30. J. Cho, Z. Hu, and M. Sartipi, "Post-stroke Discharge Disposition Prediction using Deep Learning," the Proc. of IEEE Southeastcon, March 2017.

31. B. Williams, B. Allen, Z. Hu, H. True, J. Cho, A. Harris, N. Fell, and M. Sartipi, "Real-Time Fall Risk Assessment Using Functional Reach Test," The International Journal of Telemedicine and Applications, January 2017.

32. A. Harris, H. True, Z. Hu, J. Cho, N. Fell, and M. Sartipi, “Fall Recognition using Wearable Technologies and Machine Learning Algorithms,” the Proc. of IEEE Big Data Conference, December 2016.

33. Z. Hu, S. Mohagheghi, and M. Sartipi, “Flexible Data Acquisition, Compression, and Reconstruction in Advanced Metering Infrastructure”, in Proc. of Power Systems Conference, March 2016.

34. B. Williams, B. Allen, H. True, N. Fell, D. Levine, and M. Sartipi, “A Real-time, Mobile Timed Up and Go System”, in Proc. of IEEE Body Sensor Networks Conference, June 2015.

35. Z. Hu, S. Mohagheghi, and M. Sartipi, “Efficient Data Acquisition in Advanced Meter Infrastructure”, in Proc. of IEEE Power and Energy Society, July 2015.

36. N. Fell, K. Lowry, E. Smith, B. Wade, H. True, B. Allen, and M. Sartipi, “Validation of the Functional Reach Test in a Mobile Platform: A Pilot Study with Subjects Post-Acute Stroke”, Mobile Health in Rehabilitation, Boston University, Oct. 2014.

37. B. Allen, R. Derveloy, N. Fell, W. Gasior, G. Yu, and M. Sartipi, “Telemedicine Assessment of Fall Risk Using Wireless Sensors,” in Proc. of IEEE International Conference on Sensor and Ad Hoc Communications and Networks, June 2014.

38. B. Allen, R. Derveloy, K. Lowry, H. Handley, N. Fell, W. Gasior, G. Yu and M. Sartipi, “Evaluation of Fall Risk for Post-Stroke Patients Using Bluetooth Low-Energy Wireless Sensor”, in Proc. of IEEE Globecom, December 2013.

39. M. Sartipi, “On the Rate-Distortion Performance of Compressive Sensing in Wireless Sensor Networks”, in Proc. of International Conference on Computing, Networking and Communications, January 2013.

40. M. Sartipi, “Low-Complexity Distributed Compression in Wireless Sensor Networks”, in Proc. IEEE Data Compression Conference, March 2012.

41. P. Ramchandara, M. Sartipi, “Compressive Sensing Based Imaging via Belief Propagation”, IEEE Asilomar Conference on Signals, Systems, and Computer, October 2011.

42. M. Sartipi, R. Fletcher, “Energy-efficient data acquisition in wireless sensor networks using compressed sampling”, in Proc. IEEE Data Compression Conference, March 2011.

43. L. Yang, M. Sartipi, M. McNeely, “Usable Protection to Healthcare Application”, in Proc. of ACM Workshop on Cyber Security and Information Intelligence Research, January 2011.

44. M. Sartipi, “LDPC Codes for Information Embedding and Lossy Distributed Source Coding”, Proc. of IEEE Data Compression Conference, April 2010.

45. M. Sartipi and J. Patterson, “TinyTermite: A Secure Routing Algorithm on Intel Mote 2 Sensor Network Platform,” Proc. of the twenty-First Conference on Innovative Applications of Artificial Intelligence (IAAI-09), July 2009.

46. M. Sartipi, F. Fekri, “Lossy Distributed Source Coding using LDPC, IEEE Communications Letters, Volume 13, Issue 2, pp. 136-138, February 2009.

47. M. Sartipi, B. N. Vellambi R, N. Rahnavard, F. Fekri,” DSCM: An Energy Efficient Multicast Protocol for Wireless Sensor Networks Using Distributed Source Coding,“ Proc. of IEEE Infocom, April 2008.

48. F. Delgosha, M. Sartipi, and F. Fekri, “Construction of Two-dimensional Paraunitary Filter Banks over Fields of Characteristic Two and their Connections to Error-Control Coding,” IEEE Transactions on Circuits and Systems I, Volume 55, Issue 10, pp. 3095-53109, November 2008.

49. M. Sartipi, F. Fekri, “Distributed Source Coding using Short to Moderate Rate-Compatible LDPC Codes: The Entire Slepian-Wolf Rate Region,” IEEE Transactions on Communications, Volume 56, Issue 3, pp. 400-411, March 2008.

50. M. Sartipi, F. Delgosha, F. Fekri, “Two-Dimensional Half-Rate Codes Using two-Variable Finite-Field Filter Banks,’’ IEEE Transactions on Signal Processing, Volume 55, Issue 12, pp. 5846-5853, December 2007.

51. F. Fekri, M. Sartipi, R. M. Mersereau, R. W. Schafer, “Convolutional Codes Using Finite-Field Wavelets; Time-Varying Codes and more,’’ IEEE Transactions on Signal Processing, Volume 53, Issue 5, pp.1881-1896 May 2005.

52. M. Sartipi, F. Fekri, “Distributed Source Coding in Wireless Sensor Networks Using LDPC Coding: a Non-Uniform Framework,’’ Proc. of IEEE Data Compression Conference, March 2005.

53. M. Sartipi, F. Fekri, “Distributed Source Coding in Wireless Sensor Networks Using LDPC coding: The entire Slepian-Wolf Rate Region,’’ Proc. of IEEE Wireless Communications and Networking Conference, pp. 1939-1944, March 2005.

54. M. Sartipi, F. Fekri, “Source and Channel Coding in Wireless Sensor Networks Using LDPC Codes,’’ Proc. of IEEE Communications Society Conference on Sensor Communications and Networks, pp. 309-316, October 2004.

55. M. Sartipi, F. Fekri, “Two-Dimensional Error Correcting Codes Using Finite-Field Wavelets,’’ Proc. of IEEE Information Theory Workshop, pp. 22-29, October 2004.

56. M. Sartipi, F. Fekri, “Low-Density Parity-Check Codes Based on Cyclotomic Cosets and Their Extension by Latin-Square Matrices,’’ Proc. of Forty-First Annual Allerton Conference on Communication, Control and Computing, October 2003.

57. M. Sartipi and F. Fekri, " Distributed Source Coding using LDPC Codes: Lossy and Lossless Cases with Unknown Correlation Parameter," Forty-Third Annual Allerton Conference on Communication, Control and Computing, October 2005.

58. F. Fekri, F. Delgosha, M. Sartipi, “Results on Finite-Field Wavelets and Their Applications to Error Correcting Codes,” American Mathematical Society special meeting on codes and applications, October 2004.

AWARDS

- Guerry Professor, 2020, Distinguished service to education, research and scholarship
- G20 Smart Cities Alliance, Chattanooga, TN was chosen as one of the two US cities to implement G20's Smart City Alliance policy roadmap
- Named 2019 Chattanooga Influencer- Chosen by the Edge, Chattanooga’s Business Magazine, as the 2019 Chattanooga Influencer for her role in Smart City research and collaboration with city, county, and industry partners
- 2020 Smart 50 Awards, Digital Transformation, at the Smart Cities Connect Conference (MLK Smart Corridor)
- 2020 International Data Corporation (IDC) Smart Cities North America Award Winner – Police and Law Enforcement Category
- 2020 Smoky Mountain Computational Science and Engineering Conference, Runner-up for best paper, “Data Analysis and Visualization of Traffic in Chicago with Size and Landuse-aware Vehicle to Buildings Assignment”, A. Alharin, Y. Patel, T. -Nam Doan and M. Sartipi
- 2019 IDC Smart Cities North America Award in the education category (with Chattanooga Smart Collaborative Community)
- 2019 Smart 50 Awards, Horizon Award, at the Smart Cities Connect Conference (with Chattanooga Smart Collaborative Community)
- Received the best presenter award in the Faculty Elevator Speech competition Research Day, 2018
- Received the CO.LAB Entrepreneurship Award, 2018
- Elevated to IEEE Senior membership, 2016
- Received the University Of Tennessee Chattanooga (UTC) Outstanding Faculty Research and Creative Achievement award, 2016
- Received Faculty Evaluation and Development by Objectives (EDO) Exceeds Expectations Performance Award, 2010, 2011, 2013-present
- Received “Keep the Stars Shining” Award, 2012
- Outstanding Researcher in the Department of Computer Science and Engineering, 2010, 2013 & 2015
- Outstanding Researcher in the College of Engineering and Computer Science, 2010, 2014 & 2015
- UC Foundation, 2008

B. Rubrics Used for Outcomes Assessment

a) Academic Preparation Rubric

SACS Assessment Year_____

Computational Science PhD Program
Concentration: (Select One)
College of Engineering and Computer Science
University of Tennessee at Chattanooga

Rubric for Assessing Outcome #1: ACADEMIC PREPARATION
Measure: Assessing Computational Science Core Competencies

Student Name/UTC ID: _____ Examination Date: _____

Name of Examining Committee Member: _____

Examination Subject Area:
- ☐ Mathematics: _____
- ☐ Computer Science: _____
- ☐ Domain Topic 1: _____
- ☐ Domain Topic 2: _____

Examination Iteration: 1 2

Criteria / Evaluation		Needs Significant Improvement	Needs Improvement	Satisfactory	Very Good	Excellent
1. Answered All Questions Thoroughly	Written					
	Oral					
2. Demonstrates Knowledge and Understanding of Examination Subject Area	Written					
	Oral					
3. Demonstrates Ability to Identify Correct Solution Procedure	Written					
	Oral					
4. Demonstrates Ability to Articulate / Explain Solution Procedure	Written					
	Oral					

Overall Assessment: The assessment of the overall performance of the student based on the evidence provided in the above items.

	Overall Performance Rating				
CRITERIA	**Does NOT PASS PRELIMINARY Exam**	**Passes PRELIMINARY Exam**			
OVERALL, my rating of this student's knowledge about CORE Competencies	**Needs Significant Improvement**	**Needs Improvement**	**Satisfactory**	**Very Good**	**Excellent**

If applicable, please provide additional comments on the backside of this page.

b) Independent Research Rubric

SACS Assessment Year _____

Computational Science PhD Program
College of Engineering and Computer Science
University of Tennessee at Chattanooga

Rubric for Assessing Outcome #3: CONDUCTING INDEPENDENT RESEARCH
Measure: ASSESSING QUALITY OF DISSERTATION RESEARCH

Student Name/UTCID: _____ Defense Date: _____

Name of Faculty Member: _____

Criteria / Evaluation		Needs Significant Improvement	Needs Improvement	Satisfactory	Very Good	Excellent
1. **Problem Definition:** Stated the research problem clearly, providing motivation for undertaking the research.						
2. **Literature and Previous Work:** Demonstrated sound knowledge of literature in the area, and of prior work on the specific research problem.						
3. **Impact of Proposed Research:** Demonstrated the potential value of solution to the research problem in advancing knowledge within the area of study.						
4. **Solution Plan:** Provided a sound plan for applying state-of-the-field research methodologies/tools to solving the defined problem and shows a good understanding of how to use methods/tools effectively.						
5. **Results:** Analyzed and interpreted research results effectively.						
6. **Quality of Written and Oral Communication:** Communicated contents of thesis/dissertation clearly and professionally in both written form and oral form.	Written					
	Oral					
7. **Quality of Response to Questions:** Responses were complete, arguments reasonably organized, and exhibited knowledge of subject area.						
8. **Critical Thinking:** Demonstrated capability for independent research in the area of study, preparedness in core competencies relevant to the research, and ability to complete the research.						
9. **Broader Impact:** Demonstrated awareness of broader implications of the research. Broader implications may include aspects associated with economics, technical, ethics, business, etc.						
10. **Publications:** Journal or conference publications have resulted, or are anticipated, from this research.						

Overall Assessment: The assessment of the overall performance of the student based on the evidence provided in the above items.

	Overall Performance Rating				
	QUALITY of Dissertation UNACCEPTABLE	**QUALITY of Dissertation ACCEPTABLE**			
CRITERIA	**Needs Significant Improvement**	**Needs Improvement**	**Satisfactory**	**Very Good**	**Excellent**
OVERALL, my ASSESSMENT of the Student's Dissertation RESEARCH					

SACS Assessment Year _____

If applicable, please provide additional comments below or on the backside of this page.

C. Dissertations During Review Cycle

1. Nasir Boakye-Boateng, Ph.D., May 2020, Dissertation Title: "Variable reluctance motor airgap geometry for maximizing force production: a data analysis approach using finite element generated characteristics"
2. James Trimble, Ph.D., August 2019, Dissertation Title: "Network connectivity tracking for a team of unmanned aerial vehicles"
3. Jhiin Joo, Ph.D., August 2019, Dissertation Title: "Large-Eddy Simulation of Turbulent Wall-Pressure Fluctuations Using the Finite Element Method"
4. Philip W. Fackler, Ph.D., December 2017, Dissertation Title: "A physics-based adaptive point distribution method for computational domain discretization"
5. William Lawton Shoemake, Ph.D., December 2017, Dissertation Title: "Linear elastic mesh deformation via localized orthotropic material properties optimized by the adjoint method"
6. Kristen C. Karman, Ph.D., December 2017, Dissertation Title: "Higher order mesh curving using geometry curvature extrapolation"
7. Tuo Liu, Ph.D., December 2017, Dissertation Title: "Automatic higher order mesh generation and movement utilizing spring-field and vector-adding"
8. Xueying Zhang, Ph.D., May 2017, Dissertation Title: "Time-dependent adjoint-based optimization of photonic crystals and metamaterials using a stabilized finite element method"
9. Max David Collao, Ph.D., May 2017, Dissertation Title: "Computational Study of the Effects of Protruding Studs Casing Treatment on the Performance of an Axial Transonic Turbofan"
10. Weiyang Lin, Ph.D., December 2016, Dissertation Title: Design Optimization of Acoustic Metamaterials and Phononic Crystals With a Time Domain Method"
11. Ethan Alan Hereth, Ph.D., December 2016, Dissertation Title: "Automatic Parallel Octree Grid Generation Software With an Extensible Solver Framework and a Focus on Urban Simulation"
12. Arash Ghasemi, Ph.D., August 2016, Dissertation Title: "Spectral Hulls: a Degree of Freedom Reducing hp-Strategy in Space/Time"
13. Faranak Behzadi, Ph.D., August 2016, Dissertation Title: "Solution of Fully-Coupled Shallow Water Equations and Contaminant Transport Using a Primitive Variable Riemann Solver and a Semi-Discrete SUPG Method"
14. Cameron T. Druyor Jr., Ph.D., August 2016, Dissertation Title: "Advances in Parallel Overset Domain Assembly"

15. Jaber Javanshir Hasbestan, Ph.D., August 2016, Dissertation Title: "Least Squares Spectral Element Method for Laminar and Turbulent Flows, –Continuous and Discontinuous Approaches–"
16. Matthew D. O'Connell, Ph.D., August 2016, Dissertation Title: "A Fault Tolerant Grid Generation Technique"
17. Arman Raoufi, Ph.D., August 2016, Dissertation Title: "Computational Design, Sensitivity Analysis and Optimization of Fuel Reforming Catalytic Reactor"
18. Behrouz Shamsaei, Ph.D., August 2016, Dissertation Title: "On the Uncertainty Quantification and Non-Linear Hyper Elastic Simulation of Biological Tissues"
19. Don C. Warrington, Ph.D., August 2016, Dissertation Title: "Improved Methods for Forward and Inverse Solution of the Wave Equation for Piles"
20. Chao Liu, Ph.D., May 2016, Dissertation Title: "A Stabilized Finite Element Dynamic Overset Method for the Navier-Stokes Equations"
21. Anshul Mittal, Ph.D., December 2015, Dissertation Title: "A Parabolized Navier-Stokes Method for Wind Farm Applications"
22. Alma Cemerlic, Ph.D., August 2015, Dissertation Title: "Continuum Modeling of the Deceleration Transient State in Stochastic Traffic Flow"
23. Behzad Reza Ahrabi, Ph.D., August 2015, Dissertation Title: "An hp-Adaptive Petrov-Galerkin Method for Steady-State and Unsteady Flow Problems"
24. Christopher Bruce Hilbert, Ph.D., August 2015, Dissertation Title: "Tetrahedral Mesh Optimization and Generation via Topological Transformation and Gradient Based Node Perturbation"

D. Credentials of Concentration Coordinators

a) Curriculum Vitae for Dr. Lingju Kong

Curriculum Vitae
Lingju Kong

(Last Updated on 2/9/2021)

Work Address:
Department of Mathematics
The University of Tennessee at Chattanooga
615 McCallie Avenue
Chattanooga, TN 37403
Phone: 423-425-4582 (office)

Education

- Ph.D. in Mathematics, Northern Illinois University, DeKalb, IL, August 2005
- M.S. in Mathematics, Ocean University of China, Qingdao, China, June 1999
- B.S. in Mathematics Education, Shandong Normal University, Jinan, China, June 1996

Positions and Experience

- Department of Mathematics, The University of Tennessee at Chattanooga, Chattanooga, TN

  Graduate Program Coordinator, August 2020–Present
- Department of Mathematics, The University of Tennessee at Chattanooga, Chattanooga, TN

  Professor in Mathematics, August 2014–Present
  Associate Professor in Mathematics, August 2010–July 2014
  Assistant Professor in Mathematics, August 2005–July 2010
- Department of Mathematical Sciences, Northern Illinois University, DeKalb, IL

  Graduate Teaching Assistant, January 2001–May 2005
- Caterpillar Inc., Joliet, IL

  Intern, May 2003–August 2003
- Department of Mathematics, Ocean University of China, Qingdao, China

  Instructor, September 1999–December 2000

Grants, Honors, and Awards

- UTC College of Arts and Sciences Faculty Achievement Award (FAA), Spring 2020.
- PI of the grant from the Center of Excellence in Applied Computational Science and Engineering (CEACSE) at UTC for the project "Modeling Information Diffusion and User Adoption and Abandonment of Online Social Network Dynamics", July 1, 2018–June 30, 2019. Award Amount: $96,380. (Co-PIs: J. R. Graef and A. Ledoan).

- Co–PI of the NSF Grant (Award No.: DMS-1261308, Award Amount: $296,543) for the Project Titled "REU Site: Differential/Difference Equation Models and Number Theory", March 1, 2013–February 29, 2016. (PI: J. R. Graef).
- Induction to the Alpha Scholastic Honor Society at the University of Tennessee at Chattanooga, Spring 2016.
- UTC College of Arts and Sciences Supplemental Travel Grant, Spring 2015, Spring 2016, Fall 2016, Spring 2018.
- The Ruth S. Holmberg Grant for Faculty Excellence, The University of Tennessee at Chattanooga, Fall 2014.
- Selected to be a member of UTC Council of Scholars in Spring 2014.
- Certificate from Elsevier for one of the 20 Most Cited Articles 2007–2011 published in *Journal of Differential Equations* for the following article:

  John R. Graef, *Lingju Kong*, and Haiyang Wang, Existence, multiplicity, and dependence on a parameter for a periodic boundary value problem, *Journal of Differential Equations*, Volume **245**, Issue 5, Pages 1185–1197, 2008.
- Outstanding Research Award of the College of Arts and Sciences at UTC, Spring 2011.
- Sabbatical Leave for Fall 2012.
- Have been awarded an EDO rating of *"Exceeds Expectations"* for the 2006-2007, 2007-2008, 2008-2009, 2009-2010, 2010-2011, 2011-2012, 2012-2013, 2013-2014, 2014-2015, 2015-2016, 2018-2019, and 2019-2020 academic years.
- UC Foundation Faculty Grants, The University of Tennessee at Chattanooga, Fall 2016, Spring 2018.
- UC Foundation Faculty Development Grants, The University of Tennessee at Chattanooga, Fall 2005, Spring 2006, Spring 2007, Spring 2008, Summer 2009, Spring 2010, Spring 2011, Summer 2011, Fall 2011, Summer 2012, Summer 2013, Spring 2015.
- UC Foundation Faculty Research Grants, The University of Tennessee at Chattanooga, Fall 2006, Spring 2008, Spring 2009, Spring 2011.
- Summer Faculty Fellowship, The University of Tennessee at Chattanooga, Summer 2007, Summer 2010.
- Service Award, The University of Tennessee at Chattanooga, Fall 2010.
- National Science Foundation Travel Grants for
  - ◇ The AIMS' Seventh International Conference on Dynamical Systems and Differential Equations, Summer 2008.
  - ◇ The Seventh Mississippi State - UAB Conference on Differential Equations and Computational Simulations, Fall 2007.
  - ◇ The Sixth Mississippi State - UAB Conference on Differential Equations and Computational Simulations, Spring 2005.
  - ◇ The AIMS' Fifth International Conference on Dynamical Systems and Differential Equations, 2004.

- Certificate of Merit for Academic Achievements, Department of Mathematical Sciences, Northern Illinois University, Spring 2005.
- Summer Fellowship for Ph.D. Students, Department of Mathematical Sciences, Northern Illinois University, Summer 2004.
- Northern Illinois University Graduate School Travel Grant, 2004.
- D.R. Ostberg Award, Department of Mathematical Sciences, Northern Illinois University, 2003.
- Scholarship for Graduate Excellence, Ocean University of China, 1998.
- Scholarship for Undergraduate Excellence, Shandong Normal University, 1994, 1995.

Courses Taught

- **At The University of Tennessee at Chattanooga**
  - ◇ Math 1130–College Algebra (Fall 2006, Fall 2008)
  - ◇ Math 1710–Precalculus I (Summer 2009, Spring 2010, Fall 2019)
  - ◇ Math 1720–Precalculus II (Summer 2006, Spring 2008, Summer 2008, Summer 2010, Fall 2014, Fall 2018)
  - ◇ Math 1830–Calculus for Management, Life, and Social Sciences (Fall 2005, Spring 2007, Summer 2008, Spring 2010, Summer 2011, Summer 2013, Fall 2013, Spring 2014, Summer 2014, Fall 2015, Spring 2016, Summer 2016, Fall 2016, Spring 2017, Summer 2018 (online), Summer 2019 (online))
  - ◇ Math 1910–Calculus I (Fall 2007, Fall 2010, Spring 2011, Summer 2011, Fall 2011, Summer 2012, Spring 2013)
  - ◇ Math 1911–Calculus I Laboratory (Fall 2010, Spring 2011, Summer 2011, Fall 2011, Summer 2012)
  - ◇ Math 1920–Calculus II (Spring 2006, Spring 2009)
  - ◇ Math 2450–Introduction to Differential and Difference equations (Fall 2005, Spring 2006, Spring 2007, Summer 2007, Fall 2009, Fall 2014, Spring 2015, Summer 2015, Spring 2016, Fall 2017, Spring 2018, Spring 2020, Summer 2020, Fall 2020)
  - ◇ Math 2550–Multivariable Calculus (Summer 2006, Spring 2009, Summer 2017)
  - ◇ Math 3510–Introduction to Analysis I (Fall 2007, Fall 2008, Fall 2010, Fall 2011, Fall 2013, Fall 2020)
  - ◇ Math 4010–Basic Concepts of Geometry (Fall 2006)
  - ◇ Math 4450–Ordinary Differential Equations (Fall 2016, Fall 2018)
  - ◇ Math 4460–Partial Differential Equations (Spring 2017)
  - ◇ Math 4510–Introduction to Analysis II (Spring 2011, Spring 2012, Spring 2013, Spring 2014, Spring 2020, Spring 2021)
  - ◇ Math 4550–Applied Analysis (Spring 2008)
  - ◇ Math 4570–Complex Analysis (Fall 2015)

- ◇ Math 5450–Ordinary Differential Equations (Fall 2016, Fall 2018)
- ◇ Math 5460–Partial Differential Equations (Spring 2017, Spring 2019)
- ◇ Math 5500–Introduction to Analysis II (Spring 2011, Spring 2012, Spring 2013, Spring 2014, Spring 2020, Spring 2021)
- ◇ Math 5530–Calculus of Variations (Fall 2019)
- ◇ Math 5570–Complex Analysis (Fall 2015, Fall 2017)
- ◇ Math 5999R–Thesis (Fall 2020)
- ◇ Math 5997–Individual Studies (Spring 2013, Fall 2015)

- **At Northern Illinois University**
  - ◇ Calculus I–Math 229 (Fall 2004)
  - ◇ Conducted recitations for the following courses: Finite Mathematics–Math 210, Calculus for Business and Social Science–Math 211 (Spring 2001–Spring 2005)
- **At Ocean University of China**
  - ◇ Advanced Mathematics (Including Calculus I–III), Boundary Value Problems (Fall 1999–Fall 2000)

Academic Service

To the Department of Mathematics

- Course Coordinator for Math 1830, August 2015–July 2018.
- Member of the Academic Awards Committee, August 2012–July 2014, August 2016–July 2019.
- Member of the Ad Hoc Committee to prepare a report for the 5-year Program Review of the Mathematics Department at UTC, Fall 2014.
- Member of the Advisory Committee, August 2016–July 2017.
- Member of the Colloquium Committee, August 2005–July 2009, August 2013–July 2014, August 2018–July 2019.
- Member of Curriculum Committee, August 2017–July 2018, August 2019–Present.
- Member of the Faculty Recruitment Committee, August 2010–July 2011, August 2014–July 2018, August 2019–Present. (Served as the Chair from August 2014–July 2018.)
- Member of the Graduate Coordinating Committee, August 2013–October 2016. August 2018–Present. (Served as the Chair from August 2020–Present.)
- Member of the Library Committee, August 2006–July 2007, August 2009–July 2010.
- Member of the Math 1830 Textbook Search Committee, Spring 2012, Spring 2020.
- Member of the Rank, Tenure and Promotion Committee, August 2010–Present.
- Member of Scheduling Committee, August 2020–Present.
- Member of the Student Relation Committee, August 2005–July 2010, August 2011–July 2014.

- Member of the TMTA Exam Committee, August 2008–July 2013.
- Member of the Unum Chair of Excellence Search Committee, August 2011–July 2012.

To The University of Tennessee at Chattanooga

- Member of the Bookstore Committee, August 2010–July 2011.
- Member of the the Departmental Honors Committee, August 2015–July 2016.
- Member of the Faculty Grants Committee, August 2016–July 2017, August 2018–Present.
- Member of the Faculty Research Committee, August 2007–July 2010, August 2013–July 2015.
- Member of the Faculty Development Committee, August 2008–July 2009, August 2011–July 2013.
- Member of the Graduate Council, August 2014–July 2015.
- Member of the Undergraduate Curriculum Committee, August 2017-July 2018.

Other Service

- Served as a member of the Ph.D. Dissertation Defending Committee for Chayu Yang from UTC in Summer 2020.
- Served as an external reviewer to comment on Dr. Thomas E. St. George's research for his Tenure and Promotion application at Carroll University in Fall 2019.
- Served as a member of the Master Thesis Defending Committee for Conrad G. Ratchford from UTC in Spring 2018.
- Served an external examiner for the dissertation for Sougata Dhar from Northern Illinois University in Spring 2017.
- Served an external examiner for the Master Thesis for Yailei Zhang from Trent University, Canada in Spring 2017.
- Served as a member of the Master Thesis Defending Committee for Chayu Yang from UTC in Spring 2017.
- Served as a member of the Master Thesis Defending Committee for Darryl Johnson from UTC in Spring 2017.

REU Students Supervised

◇ Jacob Parsley–REU student from Tennessee Technological University, Summer 2015.

◇ Kaitlin Rizzo–REU student from Allegheny College, Summer 2015.

◇ Nicholas Russell–REU student from Marist College, Summer 2015.

◇ Joshua Barrow–REU student from Southern Adventist University, Summer 2014.

◇ Robert DeYeso III–REU student from University of Tennessee at Martin, Summer 2014.

◇ Frank Petronella–REU student from Baylor University, Summer 2014.

- ◇ Alexander M. Ruys de Perez–REU student from Vanderbilt University, Summer 2013.
- ◇ Jacob D. Johnson–REU student from University of Tennessee at Knoxville, Summer 2013.
- ◇ Michael G. Ruddy–REU student from University of Tennessee at Martin, Summer 2013.
- ◇ Paula Jean Sawyer–Master student from UTC (She did a project with me), Spring 2013.

Editorial Service

- ◇ Member of the Editorial Board of *Differential Equations & Applications*
- ◇ Co-guest editor for a special issue published in the journal of *Communications on Applied Analysis*
- ◇ Co-guest editor for a special issue published in the journal of *Dynamic Systems and Applications*

Reviewerships

- Reviewed a research proposal for Czech Science Foundation
- Reviewed the book proposal "Periodic Solutions of First-Order Functional Differential Equations in Population Dynamics" for Springer
- Reviewed the book proposal "Positive Solutions for Nonlinear Boundary Value Problems" for Elsevier
- Reviewed the book proposal "Qualitative Analysis of Delay Partial Difference Equations" for "Contemporary Mathematics and Applications" book series of Hindawi Publishing Corporation
- Reviewed the book proposal "Solutions of Nonlinear Differential Equations" for World Scientific Publishing Co.
- Reviewer for Mathematical Reviews of the American Mathematical Society
- Refereed papers for the following journals in mathematics:
  - ◇ Abstract and Applied Analysis
  - ◇ Acta Mathematica Sinica
  - ◇ Acta Mathematica Scientia
  - ◇ Advances in Difference Equations
  - ◇ Applied Mathematics and Computation
  - ◇ Applied Mathematics Letters
  - ◇ Boundary Value Problems
  - ◇ Bulletin of Mathematical Analysis and Applications
  - ◇ Communications in Applied Analysis
  - ◇ Communications in Nonlinear Science and Numerical Simulations
  - ◇ Communications on Applied Nonlinear Analysis
  - ◇ Computers and Mathematics with Applications

- ◇ Differential Equations & Applications
- ◇ Discrete and Continuous Dynamical Systems
- ◇ Discrete Dynamics in Nature and Society
- ◇ Dynamic Systems and Applications
- ◇ Dynamical Systems and Differential Equations
- ◇ Dynamics of Continuous, Discrete and Impulsive Systems
- ◇ Electronic Journal of Differential Equations
- ◇ Electronic Journal of Qualitative Theory of Differential Equations
- ◇ Fixed Point Theory and Applications
- ◇ Fractional Calculus & Applied Analysis
- ◇ Hacettepe Journal of Mathematics and Statistics
- ◇ Indian Journal of Pure and Applied Mathematics
- ◇ International Journal of Dynamical Systems and Differential Equations
- ◇ International Journal of Differential Equations
- ◇ Italian Journal of Pure and Applied Mathematics
- ◇ Journal of Abstract Differential Equations and Applications
- ◇ Journal of Applied Mathematics & Computing
- ◇ Journal of Difference Equations and Applications
- ◇ Journal of Fixed Point Theory and Applications
- ◇ Journal of the Franklin Institute
- ◇ Journal of Mathematical Analysis and Applications
- ◇ Journal of Nonlinear Functional Analysis
- ◇ Kragujevac Journal of Mathematics
- ◇ Matematicki Vesnik
- ◇ Mathematica Bohemica
- ◇ Mathematical and Computer Modeling
- ◇ Mathematical Methods in the Applied Sciences
- ◇ Mathematical Problems in Engineering
- ◇ Nonlinear Analysis: Hybrid Systems
- ◇ Nonlinear Analysis: Real World Applications
- ◇ Nonlinear Analysis: Theory, Methods, and Applications
- ◇ PLOS ONE
- ◇ Publications Mathematicae Debrecen.
- ◇ Qualitative Theory of Dynamical Systems
- ◇ Revista de la Real Academia de Ciencias Exactas, Fisicas y Naturales. Serie A. Matemáticas
- ◇ Rocky Mountain Journal of Mathematics
- ◇ Science China Mathematics
- ◇ Studia Scientiarum Mathematicarum Hungarica
- ◇ The International Journal of Mathematics and Mathematical Sciences
- ◇ The Journal of Nonlinear Sciences and Applications

- ◇ The Rocky Mountain Journal of Mathematics
- ◇ The Royal Society of Edinburgh Proceedings A (Mathematics)
- ◇ Topological Methods in Nonlinear Analysis
- ◇ Turkish Journal of Mathematics

Special Sessions Co-organized

(1) Co-organized the special session *on Boundary Value Problems for Differential, Difference, and Fractional Equations* in the American Mathematical Society 2020 Fall Virtual Southeastern Sectional Meeting, October 10–11, 2020

(2) Co-organized the Virtual Conference *Recent Advances in Differential and Difference Equations and their Applications*, June 9–11, 2020. The information of this virtual conference can be found at: https://sites.google.com/view/vde2020/home.

(3) Co-organized the special session *Recent Advances and Applications of Differential Equations* in the 12th AIMS International Conference on Dynamical Systems, Differential Equations and Applications, Taipei, Taiwan, July 5–9, 2018

(4) Co-organized the *Workshop on Boundary Value Problems and Applications* in the 6th International Conference on Dynamic Systems and Applications & the 5th International Conference on Neural, Pararrel & Scientific Computations, Atalanta, GA, May 27–30, 2015

(5) Co-organized the special session *Applications of Functional Analytic Techniques to Nonlinear Boundary Value Problems* in the American Mathematical Society 2012 Fall Southeastern Section Meeting, Tulane University, New Orleans, LA, October 13–14, 2012

(6) Co-organized the special session *Topological and Variational Methods for Boundary Value Problems* in the 9th AIMS International Conference on Dynamical Systems, Differential Equations and Applications, Orlando, FL, July 1–5, 2012

(7) Co-organized the special session *Applications of Differential, Difference, and Dynamic Equations* in the 4th International Conference on Neural, Pararrel & Scientific Computations, Atalanta, GA, August 11–14, 2010

Presentations

(A) Conference talks given by myself:

(1) *Multiple nontrivial solutions for a nonlinear discrete problem of the second order*
Invited talk (via Zoom) in the AMS Special Session on Advances and Applications in Integral and Differential Equations, Virtual Joint Mathematics Meetings, January 6–9, 2021.

(2) *Uniqueness of weak solutions for a biharmonic system.*
Invited talk (via Zoom) in the AMS Special Session on Analysis of Fractional, and Stochastic Dynamic Systems with Applications, Virtual Joint Mathematics Meetings, January 6–9, 2021

(3) *On an anisotropic discrete boundary value problem of Kirchhoff type*
Presentation via Zoom in the Special Session on Boundary Value Problems for Differential, Difference, and Fractional Equations, the American Mathematical Society 2020 Fall Virtual Southeastern Sectional Meeting, October 10–11, 2020.

(4) *Positive solutions for singular discrete Dirichlet problems*
Presentation via Zoom at the virtual conference *Recent Advances in Differential and Difference Equations and their Applications*, June 9–11, 2020. (Conference website: https://sites.google.com/view/vde2020/home.)

(5) *On the principle eigenvalue of a biharmonic system*
Contributed talk at the 39th Southeastern-Atlantic Regional Conference on Differential Equations, Daytona Beach, FL, October 26–27, 2019.

(6) *Modeling online social network dynamics using fractional order differential equations*
Invited Talk in the AMS Special Session on Fractional, Stochastic, and Hybrid Dynamical Systems with Applications, Joint Mathematics Meetings, Baltimore, MD, January 16–19, 2019.

(7) *Degenerate elliptic systems with variable exponents*
Invited Talk in the Special Session on Recent advances and applications of differential equations, the 12th AIMS International Conference on Dynamical Systems, Differential Equations and Applications, Taipei, Taiwan, July 5–9, 2018.

(8) *Solutions for a discrete fourth order boundary value problem*
Invited Talk in the Special Session on Complex Bio-systems and Their Applications, American Mathematical Society 2018 Spring Southeastern Sectional Meeting, Vanderbilt University, Nashville, TN , April 14–15, 2018.

(9) *On a discrete fourth order boundary value problem*
Contributed talk at the 37th Southeastern-Atlantic Regional Conference on Differential Equations, Kennesaw, GA, October 7–8, 2017.

(10) *Weak solutions for nonlinear Neumann boundary value problems*
Invited Talk in the AMS Special Session on Fractional, Stochastic, and Hybrid Dynamical Systems with Applications, Joint Mathematics Meetings, Atlanta, GA, January 4–7, 2017.

(11) *Positive radial solutions for quasilinear biharmonic equations*
Contributed talk at the Seventh International Congress of Chinese Mathematicians, Beijing, China, August 7–11, 2016.

(12) *Homoclinic solutions for a higher order differential equation with p-Laplacian*
Invited talk in the workshop on boundary value problems and applications, the 7th International Conference on Dynamic Systems and Applications & the 5th International Conference on Neural, Parallel & Scientific Computations, Atlanta, GA, May 27–30, 2015.

(13) *Two nontrivial solutions for fourth order elliptic problems with $p(x)$-Biharmonic operators*
Invited talk in the workshop on multiplicity of solutions for nonlinear problems

and applications, the 7th International Conference on Dynamic Systems and Applications & the 5th International Conference on Neural, Parallel & Scientific Computations, Atlanta, GA, May 27–30, 2015.

(14) *Multiple solutions of system fractional boundary value problems: part II*
Invited Talk in the AMS Special Session on Fractional, Stochastic, and Hybrid Dynamical Systems with Applications, Joint Mathematics Meetings, Baltimore, MD, January 15–18, 2014.

(15) *Homoclinic solutions for second order difference equations with p-Laplacian*
Invited talk in the Peterson Conference to celebrate the many accomplishments of Professor Allan Peterson, Charles Bessey Professor of Mathematics at the University of Nebraska-Lincoln, University of Nebraska-Lincoln, Lincoln, NE, October 25–27, 2013.

(16) *Existence of solutions to a discrete fourth order periodic boundary value problem*
Invited talk in the "New Trends in Differential and Difference Equations Conference" in honor of Prof. John R. Graef's 70th birthday, University of Tennessee at Chattanooga, Chattanooga, TN, March 15–16, 2013.

(17) *Existence of positive solutions to a higher order singular boundary value problem with fractional q-derivatives*
Invited Talk in the Special Session on Applications of Functional Analytic Techniques to Nonlinear Boundary Value Problems, American Mathematical Society 2012 Fall Southeastern Section Meeting, Tulane University, New Orleans, LA, October 13–14, 2012.

(18) *On a discrete fourth order periodic boundary value problem*
Invited Talk in the Special Session on Topological and Variational Methods for Boundary Value Problems, the 9th AIMS International Conference on Dynamical Systems, Differential Equations and Applications, Orlando, FL, July 1–5, 2012.

(19) *Existence of multiple solutions for a class of fractional boundary value problems*
Invited Talk in the AMS Special Session on Fractional, Hybrid, and Stochastic Dynamical Systems with Applications, Joint Mathematics Meetings, Boston, MA, January 4–7, 2012.

(20) *Existence of multiple solutions for a generalized discrete beam equation*
Invited Talk in the Special Session on Dynamic Systems on Time Scales with Applications, American Mathematical Society 2011 Fall Central Section Meeting, University of Nebraska at Lincoln, Lincoln, NE, October 2011.

(21) *Positive almost periodic solutions for a forced first order functional differential equation*
Invited Talk in the Workshop on Topological Methods for Boundary Value Problems, the Sixth International Conference on Dynamic Systems and Applications, Atlanta, GA, May 2011.

(22) *Asymptotics of eigencurves for half-linear Sturm-Liouville problems*
Invited Talk in the Special Session on Applications of Differential, Difference,

and Dynamic Equations, the Fourth International Conference on Neural, Parallel & Scientific Computations, Atlanta, GA, August 2010.

(23) *Nodal solutions of second order boundary value problems with separated boundary conditions*
Invited Talk at the 7th Conference on Biological Dynamic System and Stability of Differential Equations, Chongqing Jiaotong University, Chongqing, May 2010.

(24) *Uniqueness and dependence of positive solutions of second order singular boundary value problems with integral boundary conditions*
Invited Talk in the Special Session on Topological Methods for Boundary Value Problems for Ordinary Differential Equations, American Mathematical Society 2009 Fall Central Section Meeting, Waco, TX, October 2009.

(25) *Existence of positive solutions for higher order boundary value problems with nonhomogeneous boundary conditions*
Invited Talk in the Special Session on Topological Methods for Boundary Value Problems, the 7th AIMS International Conference on Dynamical Systems, Differential Equations and Applications, Arlington, TX, May 2008.

(26) *Solutions of higher order boundary value problems*
Invited Talk in the Seventh Mississippi State - UAB Conference on Differential Equations and Computational Simulations, Birmingham, AL, November 2007.

(27) *Existence results for nonlinear periodic boundary value problems*
Invited Talk in the Workshop on Topological Methods for Boundary Value Problems, the Fifth International Conference on Dynamic Systems and Applications, Atlanta, GA, June 2007.

(28) *Solutions of multi-point boundary value problems of the second-order*
Invited Talk in the Special Session on Differential Equations and Computations, the Third International Conference on Neural, Parallel & Scientific Computations, Atlanta, GA, August 2006.

(29) *Existence of solutions for nonlinear boundary value problems*
Invited Talk in the AMS-SIAM Special Session on Boundary Value Problem for Ordinary Differential Equations, Joint Mathematics Meetings, San Antonio, TX, January 2006

(30) *Right-definite half-linear Sturm-Liouville problems*
Invited Talk in the Sixth Mississippi State - UAB Conference on Differential Equations and Computational Simulations, Mississippi State University, Mississippi State, MS, May 2005.

(31) *Half-linear Sturm-Liouville eigenvalue problems*
Invited Talk in the Special Session on Spectral Problems of Differential Operators, American Mathematical Society 2004 Fall Central Section Meeting, Northwestern University, Evanston, IL October 2004.

(32) *Existence results for boundary value problems of second-order differential equations*
Special Session on Topological Methods for Boundary Value Problems, AIMS'

Fifth International Conference on Dynamical Systems and Differential Equations, California State Polytechnic University, Pomona, CA, June 2004.

(33) *On a class of nonlinear multi-point eigenvalue problems involving higher-order derivatives*
Workshop on Nonlinear Boundary Value Problems, the Fourth International Conference on Dynamic Systems and Applications, Morehouse College, Atlanta, GA, May 2003.

(34) *Oscillation of a difference equation of neutral type*
AIMS' Second International Conference on Dynamical Systems and Differential Equations, Shanghai Jiaotong University, Shanghai, China, June 1998.

(B) Conference talks coauthored with me and presented by others (Below, the presenters are in italic):

(1) *On a discrete elliptic problem with a weight* (with *Z. El Allali* and M. Ousbika)
Presentation via Zoom at the virtual conference *Recent Advances in Differential and Difference Equations and their Applications*, June 9–11, 2020. (Conference website: https://sites.google.com/view/vde2020/home.)

(2) *A second order discrete boundary value problem with mixed periodic boundary conditions* (with *M. Wang*)
Presentation via Zoom at the virtual conference *Recent Advances in Differential and Difference Equations and their Applications*, June 9–11, 2020. (Conference website: https://sites.google.com/view/vde2020/home.)

(3) *Existence of solutions for a second order discrete boundary value problem with mixed periodic boundary conditions* (with *M. Wang*)
Contributed talk at the 39th Southeastern-Atlantic Regional Conference on Differential Equations, Daytona Beach, FL, October 26–27, 2019.

(4) *The forward and inverse problems for a fractional boundary value problem* (with J. R. Graef, Y. Feng, and *M. Wang*)
Invited Talk in the AMS Special Session on Fractional, Stochastic, and Hybrid Dynamical Systems with Applications, Joint Mathematics Meetings, San Diego, CA, January 10-13, 2018.

(5) Existence of solutions to a discrete fourth order boundary value problem (with *J. R. Graef*, S. Heidarhani, and M. Wang)
Invited Talk in the AMS Special Session on Advances in Difference, Differential, and Dynamic Equations with Applications, Joint Mathematics Meetings, San Diego, CA, January 10-13, 2018.

(6) *Existence of solutions to a discrete fourth order periodic boundary value problem* (with J. R. Graef and *X. Liu*)
Invited Talk in the Special Session on Topological Methods for Nonlinear Boundary and Initial Value Problems, the 11th AIMS International Conference on Dynamical Systems, Differential Equations and Applications, Orlando, FL, July 1–5, 2016.

(7) *On a fractional boundary value problem with a positive Green's function* (with J. R. Graef, Q. Kong, and *M. Wang*)
Invited Talk in the Special Session on Topological Methods for Nonlinear Boundary and Initial Value Problems, the 11th AIMS International Conference on Dynamical Systems, Differential Equations and Applications, Orlando, FL, July 1–5, 2016.

(8) *Anti-periodic solutions to a higher order difference equation with a p-Laplacian* (with J. Parsley, K. Rizzo, and *N. Russell*)
Presented at the AMS Session on Undergraduate Research, Joint Mathematics Meetings, Seattle, WA, January 6–9, 2016.

(9) *Anti-periodic solutions to a higher order difference equation with a p-Laplacian* (with J. Parsley, K. Rizzo, and *N. Russell*)
Presented at the 35th Southeastern-Atlantic Regional Conference on Differential Equations, University of North Carolina at Greensboro, Greensboro, October 10–11, 2015.

(10) *Existence of solutions to an impulsive Dirichlet boundary value problem* (with *J. R. Graef* and S. Heidarhani)
Invited talk in the International Conference on Nonlinear Operators, Differential Equations and Applications, Cluj-Napoca, Romania, July 14–17, 2015.

(11) *Green's functions for fractional boundary value problems* (with J. R. Graef and *M. Wang*)
Invited talk in the workshop on boundary value problems and applications, the 7th International Conference on Dynamic Systems and Applications & the 5th International Conference on Neural, Pararrel & Scientific Computations, Atlanta, GA, May 27–30, 2015.

(12) *Existence of positive solutions of fractional boundary value problems involving bounded linear operators* (with *J. R. Graef* and S. Heidarhani)
Invited Talk in the AMS Special Session on Fractional, Stochastic, and Hybrid Dynamical Systems with Applications, Joint Mathematics Meetings, San Antonio, TX, January 10–13, 2015.

(13) *A fractional boundary value problem with Dirichlet boundary conditions* (with J. R. Graef, Q. Kong, and *M. Wang*)
Invited Talk in the AMS Special Session on Fractional, Stochastic, and Hybrid Dynamical Systems with Applications, Joint Mathematics Meetings, San Antonio, TX, January 10–13, 2015.

(14) *Positive radially symmetric solutions for a system of quasilinear biharmonic equations in the plane* (with *J. Barrow*, R. DeYeso III, and F. Petronella)
Presented at the 34rd Southeastern-Atlantic Regional Conference on Differential Equations, University of Memphis, Memphis, October 11–12, 2014

(15) *Existence of homoclinic solutions for second order difference equations with p-laplacian* (with *J. R. Graef* and M. Wang)
An invited address presented in the Special Session "Applications of Topological and Variational Methods to Boundary Value Problems" at the Tenth AIMS

International Conference on Dynamical Systems, Differential Equations, and Applications, held at Universidad Autónoma de Madrid, in Madrid, Spain, July 7–11, 2014.

(16) *Modeling the spread of antibiotic resistant inflection in hospital intensive care units* (with *J. R. Graef* and M. Wang)
An invited plenary lecture presented at the International Workshop on Boundary Value Problems: New Trends and Applications-2014, held at the University of Évora, Évora, Portugal, July 3–4, 2014.

(17) *Multiple solutions of system fractional boundary value problems: part I* (with *J. R. Graef* and Q. Kong)
Invited Talk in the AMS Special Session on Fractional, Stochastic, and Hybrid Dynamical Systems with Applications, Joint Mathematics Meetings, Baltimore, MD, January 15–18, 2014.

(18) *Existence and uniqueness of solutions for a fractional boundary value problem with a separated boundary conditions* (with J. R. Graef and *M. Wang*)
Invited talk in the AMS Special Session on Fractional, Stochastic, and Hybrid Dynamical Systems with Applications, Joint Mathematics Meetings, Baltimore, MD, January 15–18, 2014.

(19) *Doubly Periodic Solutions of Nonlinear Telegraph Equations* (with J. R. Graef and *M. Wang*)
Invited talk in the Peterson Conference to celebrate the many accomplishments of Professor Allan Peterson, Charles Bessey Professor of Mathematics at the University of Nebraska-Lincoln, University of Nebraska-Lincoln, Lincoln, NE, October 25–27, 2013

(20) *Existence of Positive Periodic Solutions for a Higher Order Singular Functional Difference Equation* (with J. D. Johnson, *M. G. Ruddy*, and A. M. Ruys de Perez)
Presented at the 33rd Southeastern-Atlantic Regional Conference on Differential Equations, University of Tennessee at Knoxville, Knoxville, TN, September 21–22, 2013

(21) *Positive Periodic Solutions for a Higher Order Functional Difference Equation, Part I* (with J. D. Johnson, M. G. Ruddy, and *A. M. Ruys de Perez*)
Presented at the 33rd Southeastern-Atlantic Regional Conference on Differential Equations, University of Tennessee at Knoxville, Knoxville, TN, September 21–22, 2013

(22) *Positive Periodic Solutions for a Higher Order Functional Difference Equation, Part II* (with *J. D. Johnson*, M. G. Ruddy, and A. M. Ruys de Perez)
Presented at the 33rd Southeastern-Atlantic Regional Conference on Differential Equations, University of Tennessee at Knoxville, Knoxville, TN, September 21–22, 2013

(23) *A Chebyshev spectral method for solving Riemann-Liouville fractional boundary value problems* (with J. R. Graef and *M. Wang*)

Invited talk in the "New Trends in Differential and Difference Equations Conference" in honor of Prof. John R. Graef's 70th birthday, University of Tennessee at Chattanooga, Chattanooga, TN, March 15–16, 2013

(24) *Uniqueness and parameter dependence of positive solutions to a higher order boundary value problem with fractional q-derivatives* (with *J. R. Graef*, Q. Kong, and M. Wang)
An invited address presented in the AMS Special Session on Fractional, Hybrid, and Stochastic Dynamic Systems with Applications, Joint Mathematics Meetings, San Diego, CA, January 9–12, 2013

(25) *Positive Solutions of Nonlocal Fractional Boundary Value Problems* (with J. R. Graef and *M. Wang*)
An invited address presented in the Special Session on Nonlinear and Nonlocal Boundary Value Problems, the International Conference on the Theory, Methods and Applications of Nonlinear Equations, Kingsville, TX, December 17 - December 21, 2012

(26) *Existence of positive solutions to an abstract Hammerstein equation* (with *J. R. Graef* and A. Benmezai)
Invited Talk in the Special Session on Applications of Functional Analytic Techniques to Nonlinear Boundary Value Problems, American Mathematical Society 2012 Fall Southeastern Section Meeting, Tulane University, New Orleans, LA, October 13–14, 2012

(27) *Positive solutions of nonlocal fractional boundary value problems* (with J. R. Graef, Q. Kong, and *M. Wang*)
Invited Talk in the Special Session on Applications of Functional Analytic Techniques to Nonlinear Boundary Value Problems, American Mathematical Society 2012 Fall Southeastern Section Meeting, Tulane University, New Orleans, LA, October 13–14, 2012

(28) *Fractional boundary value problems with integral boundary conditions* (with J. R. Graef and *M. Wang*)
Invited Talk in the Special Session on Topological and Variational Methods for Boundary Value Problems, the 9th AIMS International Conference on Dynamical Systems, Differential Equations and Applications, Orlando, FL, July 1–5, 2012

(29) *Existence of nontrivial solutions to systems of multi-point boundary value problems* (with *J. R. Graef* and S. Heidarkhani)
Invited Talk in the Special Session on Topological and Variational Methods for Boundary Value Problems, the 9th AIMS International Conference on Dynamical Systems, Differential Equations and Applications, Orlando, FL, July 1–5, 2012

(30) *Positive solution for a class of higher order boundary value problems with fractional q-derivatives* (with *J. R. Graef*)
An invited address presented in the AMS Special Session on Fractional, Hybrid, and Stochastic Dynamical Systems with Applications, Joint Mathematics Meetings, Boston, MA, January 4–7, 2012

(31) *Positive solutions for a fourth order three point focal boundary value problem* (with *J. R. Graef* and B. Yang)
Presented at the 31th Southeastern-Atlantic Regional Conference on Differential Equations, Georgia Southern University, Statesboro, GA Friday, September 30, 2011-Saturday, October 1, 2011

(32) *Uniqueness and parameter dependence of positive solutions for systems of fractional boundary value problem* (with *J. R. Graef* and Q. Kong)
An invited address presented in the AMS Special Session "Stochastic, Fractional, Fractional, and Hybrid Dynamic Systems with Applications" at the Joint Mathematics Meetings, New Orleans, LA, January 6–9, 2011

(33) *Estimates to positive solutions of a fourth order boundary value problem and their applications* (with *J. R. Graef*, Q. Kong, and B. Yang)
An invited address presented at the conference Emerging Problems in Nonlinear Analysis and Differential Equations: Advances in Theory and Applications (Dedicated to Professor J. R. L. Webb on the occasion of his retirement), held at the University of Glasgow, Glasgow, Scotland, June 1-4, 2010

(34) *Uniqueness and parametric dependence of positive solutions of third order boundary value problems with p-Laplacian* (with *J. R. Graef*)
An invited address presented in the Special Session "Topological Methods for Boundary Value Problems" at the Eighth AIMS International Conference on Dynamical Systems, Differential Equations, And Applications, held at Dresden University, Dresden, Germany, May 25–28, 2010

(35) *Higher order semipositone multi-point boundary value problems on time scales* (with J. R. Graef and *A. Dogan*)
An invited address presented in the Special Session "Topological Methods for Boundary Value Problems" at the Eighth AIMS International Conference on Dynamical Systems, Differential Equations, And Applications, held at Dresden University, Dresden, Germany, May 25–28, 2010

(36) *Second order boundary value problems with sign-changing nonlinearities and nonhomogeneous boundary conditions* (with *J. R. Graef*, Q. Kong, and B. Yang)
An invited lecture presented at EQUADIFF 12, Conference on Differential Equations and Their Applications, held at Masaryk University, Brno, Czech Republic, July 20–24, 2009

(37) *Positive solutions to a nonlinear third order three-point boundary value problem* (with *J. R. Graef* and B. Yang)
Presented at the Eighth Mississippi State-UAB Conference on Differential Equations and Computational Simulations, held at Mississippi State University, Mississippi State, Mississippi, May 7–9, 2009

(38) *Nodal solutions of multi-point boundary value problems* (with *Q. Kong*)
An invited address presented in the Special Session Topological Methods for Boundary Value Problems, at the Seventh AIMS International Conference on Dynamical Systems, Differential Equations, and Applications, held at the University of Texas at Arlington, Arlington, Texas, May 18–21, 2008

(39) *Positive solutions of a nonlinear higher order three point boundary value problem* (with J. R. Graef and *B. Yang*)
An invited address presented in the Special Session Topological Methods for Boundary Value Problems, at the Seventh AIMS International Conference on Dynamical Systems, Differential Equations, and Applications, held at the University of Texas at Arlington, Arlington, Texas, May 18–21, 2008

(40) *Existence of positive and negative solutions of a nonlinear periodic boundary value problem* (with *J. R. Graef*)
Presented at the Seventh Mississippi State - UAB Conference on Differential Equations and Computational Simulations, held at the University of Alabama in Birmingham, Birmingham, Alabama, November 1–3, 2007

(41) *Right-definite half-linear Sturm-Liouville problems* (with *Q. Kong*)
An invited address presented at the Joint Mathematics meetings, San Antonio, Texas, January 12-15, 2006

(42) *Boundary value problems for functional differential equations* (with *Q. Kong*)
An invited address presented at the International Conference on Dynamics of Continuous Discrete and Impulsive Systems, London, Canada, July 27-31, 2001

(C) Colloquium talks:

(1) *On principal eigenvalues of biharmonic systems*
Department of Mathematics, Kennesaw State University, Marietta, GA, November 8, 2019

(2) *Degenerate elliptic systems with variable exponents*
School of Mathematical Sciences, Qufu Normal University, China, July 24, 2018

(3) *Homoclinic solutions for a higher order difference equation*
School of Mathematical Sciences, Qufu Normal University, China, July 24, 2018

(4) *Existence and uniqueness of positive almost periodic solutions to a forced first order functional differential equation*
Department of Mathematics, Middle Tennessee State University, Murfreesboro, TN, October 24, 2012

(5) *Existence results for a class of fourth order periodic boundary value problems of difference equations*
Department of Mathematics, University of Alabama in Huntsville, Huntsville, AL, August 31, 2012

(6) *On positive solutions for third order singular boundary value problems*
Department of Mathematics, Northern Illinois University, DeKalb, IL, October 2008

(7) *Positive solutions for higher order multi-point boundary value problems*
Department of Mathematics, Ocean University of China, Qingdao, China, June 2008

(D) Colloquium talks given in the Mathematics Department at UTC:

(1) *On a quasilinear biharmonic equation*, October 21, 2016

(2) *On homoclinic solutions for a higher order difference equation*, November 20, 2015

(3) *Multiple solutions for fourth order elliptic problems with $p(x)$-biharmonic operators*, January 22, 2015

(4) *On a fourth order elliptic problem with a $p(x)$-biharmonic operator*, October 3, 2013

(5) *Infinitely many solutions for a discrete fourth order periodic boundary value problem*, March 28, 2013

(6) *Positive almost periodic solutions for a first order functional differential equation with time-varying delays and a forcing term*, September 2011

(7) *On eigencurves for half-linear Sturm-Liouville problems*, October 2010

(8) *Uniqueness and dependence results for second order boundary value problems*, September 2009

(9) *On nodal solutions for second order boundary value problems*, October 2008

(10) *New existence results for higher order multi-point boundary value problems*, October 2007

(11) *Asymptotic formulas for right-indefinite half-linear Sturm-Liouville problems*, January 2007

(12) *A necessary and sufficient conditions for existence of positive solutions of nonlinear boundary value problems*, January 2006

Research Interests

Ordinary and partial differential equations, difference equations, discrete dynamical systems, stochastic and deterministic epidemic models, and other related topics.

Publications

Research Monographs:

(1) *Multiple Solutions of Boundary Value Problems, A Variational Approach*, Trends in Abstract and Applied Analysis, Volume 1, World Scientific Publishing Company, New Jersey, 2016, (with J. R. Graef).

(2) *Ordinary Differential Equations and Boundary Value Problems, Volume I: Advanced Ordinary Differential Equations*,Trends in Abstract and Applied Analysis, Volume 7, World Scientific Publishing Company, New Jersey, 2018, (with J. R. Graef, J. Henderson, and S. Liu).

(3) *Ordinary Differential Equations and Boundary Value Problems, Volume II: Boundary Value Problems*, Trends in Abstract and Applied Analysis, Volume 8, World Scientific Publishing Company, New Jersey, 2018, (with J. R. Graef, J. Henderson, and S. Liu).

Accepted Papers:

(4) Stefan-Boltzmann problem for heat transfer in a fin, *Math. Methods Appl. Sci.*, (with B. P. Belinskiy and J. R. Graef).

(5) On a discrete elliptic problem with a weight, *J. Appl. Anal. Comput.*, (with Z. El Allali and O. Mohamed).

(6) Existence results for impulsive fractional differential equations with p-Laplacian via variational method, *Math. Bohem.*, (with J. R. Graef and S. Heidarkhani, and S. Moradi).

(7) Existence of multiple solutions to a discrete fourth order periodic boundary value problem via variational method, *Differ. Equ. Dyn. Syst.*, (with S. Dhar).

2021:

(8) On principal eigenvalues of biharmonic systems, *Commun. Pure Appl. Anal.* **20** (2021), 1–15, (with R. Nichols).

(9) Existence of multiple anti-periodic solutions for a higher order nonlinear difference equation, *Mediterr. J. Math.* **18** (2021), Paper No. 23, 16 pp, (with S. Dhar).

2020:

(10) A critical point approach to multiplicity results for a fractional boundary value problem, *Bull. Malays. Math. Sci. Soc.* **43** (2020), 3617–3633, (with S. Dhar).

(11) Stability analysis of a fractional online social network model, *Math. Comput. Simulat.* **178** (2020), 625–645, (with J. R. Graef, A. Ledoan, and M. Wang).

(12) Multiple and particular solutions of a second order discrete boundary value problem with mixed periodic boundary conditions, *Electron. J. Qual. Theory Diff. Equ.*, No. **47** (2020), 1–13, (with M. Wang).

(13) Infinitely many solutions for anisotropic discrete boundary value problems of Kirchhoff type, *Int. J. Difference Equ* **15** (2020), 389–401, (with J. R. Graef and S. Heidarkhani, and S. Moradi).

(14) Positive solutions for a class of singular discrete Dirichlet problems with a parameter, *Appl. Math. Lett.* **109**, 106548, 7pp. (with J. Kuang).

(15) Existence of solutions for a second order discrete boundary value problem with mixed periodic boundary conditions, *Appl. Math. Lett.* **102** (2020), 106138, 7pp, (with M. Wang).

2019:

(16) A degenerate elliptic system with variable exponents, *Sci. China Math.* **62** (2019), 1373–1390.

(17) Multiple anti-periodic solutions to a discrete fourth order nonlinear equation, *Differ. Equ. Dyn. Syst.* **27** (2019), 601–610, (with J. R. Graef and X. Liu).

(18) A fractional differential equation model for bike share systems, *J. Nonlinear Function. Anal.* **2019** (2019), Article ID 23, 14pp, (with J. R. Graef, S. Ho, and M. Wang).

(19) Three Weak Solutions to a degenerate quasilinear elliptic system, *Le Matematiche* **LXXIV** (2019), 191-210, (with J. R. Graef, S. Heidarkhani, and A. Salari).

2018:

(20) Homoclinic solutions for a higher order difference equation, *Appl. Math. Lett.* **86** (2018), 186–193.

(21) Solutions of a class of discrete fourth order boundary value problems, *Minimax Theory Appl.* **3** (2018), 35–46.

(22) The forward and inverse problems for a fractional boundary value problem, *Appl. Anal.* **97** (2018), 2474–2484, (with Y. Feng, J. R. Graef, and M. Wang).

(23) Existence of solutions to a discrete fourth order boundary value problem, *J. Difference Equ. Appl.* **24** (2018), 849–858, (with J. R. Graef, S. Heidarkhani, and M. Wang).

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2017:

(25) Anti-periodic solutions for a higher order difference equation with p-Laplacian, *J. Appl. Anal.* **23** (2017), 111–125, (with J. Parsley, K. Rizzo, and N. Russell).

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(27) Generalized Hammerstein equations and applications, *Result. Math.* **72** (2017), 369–383, (with J. R. Graef and F. M. Minhós).

(28) Variational-hemivariational inequalities of Kirchhoff-type with small perturbation of nonhomogeneous Neumann boundary conditions, *Mathematics in Engineering, Science and Aerospace* **8** (2017), 345–357, (with J. R. Graef and S. Heidarkhani).

(29) Infinitely many periodic solutions to a class of perturbed second-order impulsive Hamiltonian systems, *Differ. Equ. Appl.* **9** (2017), 195–212, (with J. R. Graef and S. Heidarkhani).

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(73) Existence of solutions for a class of fourth-order multi-point boundary value problems on time scales, *Nonlinear Oscil.* **16** (2013), 336–349, also published in the paginated issue *J. Math. Sci.* **201** (2014), 310–324, (with Z. Du and Z. Fu).

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(81) Solutions of a nonlinear fourth order periodic boundary value problem for difference equations, *Dynam. Contin. Discrete Impuls. Syst. Series A* **20** (2013), 53–63, (with J. R. Graef and M. Wang).

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(83) On a generalized discrete beam equation via variational methods, *Commun. Appl. Anal.* **16** (2012), 293–308, (with J. R. Graef and Q. Kong).

(84) Application of the mixed monotone operator method to fractional boundary value problems, *Fract. Differ. Calc.* **2** (2012), 87–98, (with J. R. Graef and Q. Kong).

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2008:

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2007:

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(140) A necessary and sufficient condition for existence of positive solutions of nonlinear boundary value problems, *Nonlinear Anal.* **66** (2007), 2389–2412, (with J. R. Graef).

(141) Necessary and sufficient conditions for the existence of symmetric positive solutions of singular boundary value problems, *J. Math. Anal. Appl.* **331** (2007), 1467–1484, (with J. R. Graef).

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2006:

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2005:

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2004:

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2003:

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2002:

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2001:

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2000:

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(161) Positive solutions of a class of nonlinear boundary value problems, *Dynam. Syst. Appl.* **9** (2000), 281–289, (with B. G. Zhang).

(162) Positive solutions of fourth-order singular boundary value problems, *Nonlinear Stud.* **7** (2000), 70–77, (with B. G. Zhang).

1998:

(163) Existence of oscillatory solutions of a difference equation of neutral type, *J. of Shanghai Jiaotong University* Vol. **E-3**, (I), June 1998, 44–49, (with J. R. Graef and B. Yang).

Preprints

(1) Nontrivial solutions for nonlinear discrete boundary value problems of the fourth order, (with D. Layne).

(2) Uniqueness of weak solutions for a biharmonic system, (with Y. Sang).

(3) Multiple nontrivial solutions for a nonlinear discrete problem of the second order, (with M. Wang).

(4) A variational framework for a second order discrete boundary value problem with mixed periodic boundary conditions, (with J. R. Graef and M. Wang).

(5) Three solutions for impulsive fractional boundary value problem with p-Laplacian, (with J. R. Graef, S. Heidarkhani, and S. Moradi).

(6) On an anisotropic discrete boundary value problem of Kirchhoff type, (with J. R. Graef, S. Heidarkhani, and S. Moradi).

b) Curriculum Vitae for Dr. James C. Newman III

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Education

Ph.D., Mechanical Engineering, Virginia Polytechnic Institute and State University, July 1997
M.S., Aerospace Engineering, Old Dominion University, May 1994
B.S., Mechanical Engineering, Old Dominion University, May 1993

Employment

Department Head, *(July 2017 – Present)*
Department of Mechanical Engineering, University of Tennessee Chattanooga

Graduate Program Director, *(July 2016 – Present)*
Computational Science PhD Program, University of Tennessee Chattanooga

Interim Department Head*, (July 2015 – June 2016)*
Department of Computational Engineering, University of Tennessee Chattanooga

Assistant Director*, (July 2015 – Present)*
SimCenter: Center of Excellence in Applied Computational Science and Engineering, Chattanooga, TN

Joint Faculty Appointment*, (April 2014 – Present)*
Department of Energy, Oak Ridge National Laboratory, Oak Ridge, TN

Professor (tenured)*, (August 2011 – Present)*
Graduate School of Computational Engineering (*August 2011 – June 2016*)
Department of Mechanical Engineering (*July 2016 – Present*), University of Tennessee Chattanooga &
SimCenter: Center of Excellence in Applied Computational Science and Engineering, Chattanooga, TN

Associate Professor (tenured)*, (August 2002 – July 2011)*
Department of Aerospace Engineering, Mississippi State University&
Computational Simulation and Design Center, Engineering Research Center, Mississippi State, MS

Assistant Professor, *(August 1997 – July 2002)*
Department of Aerospace Engineering, Mississippi State University&
Computational Simulation and Design Center, Engineering Research Center, Mississippi State, MS

NASA Fellow/Graduate Research Assistant*, (June 1994 – July 1997)*
Virginia Polytechnic Institute and State University, Department of Mechanical Engineering, Blacksburg, V A. NASA GSRP Fellow- NASA Langley Research Center, Hampton, VA

Research Areas

Dr. Newman has been active in the areas of multidisciplinary analysis, sensitivity analysis, and computational design optimization since 1994. Prior to this, Dr. Newman's focus area was in the simulation of complex-steady and unsteady moving boundary configurations using both unstructured grid and structured grid domain-decomposition techniques. Dr. Newman has developed software to perform computational fluid-structure, and fluid-thermal, interaction and analysis as well as pioneered new algorithms for evaluating multidisciplinary sensitivity derivatives

and for uncertainty analysis. Additionally, he and fellow researchers have created a high-order finite-element based framework enabling multiphysics simulations encompassing fluid dynamics, structural dynamics, electromagnetics, and acoustics. Dr. Newman has worked closely with NASA, Air Force, Navy, DIA/MSIC, and Army researchers to incorporate these techniques into software to provide multidisciplinary analysis and computational design capabilities, and has utilized them in industrially relevant applications.

Honors and Awards

2013 Outstanding Faculty Educator, Computational Engineering, CECS

2002 Office of Naval Research Young Investigator Program Award Recipient

1997/2008/2009 IMAGE (Increase Minority Access to Graduate Education) Faculty Award

1994 NASA GSRP (Graduate Student Researcher Program) Fellowship Recipient

1991 NASA LaRSS (Langley Research Summer Scholar) Recipient

Academic Specialties

"*Methods and Apparatus for an Asymmetrical Fairing*," U.S. Patent No. 8,157,216. April 17, 2012. Inventors: Thomas Deiters, Tomoya Ochinero, and James C. Newman III.

Professional Membership

Associate Fellow, American Institute of Aeronautics and Astronautics (AlAA)
Member, American Society of Mechanical Engineers (ASME)
Member, American Society of Engineering Educators (ASEE)
Pi Tau Sigma (Mechanical Engineering Honorary)
Tau Beta Pi (Engineering Honorary)

Professional Consulting

ATA Engineering, Inc.
Eagle Aeronautics, Inc.
Optimal LLC

Reviewer

Archival Journals

- AIAA Journal
- Journal of Aircraft
- Aerospace Science and Technology
- International Journal of Structural and Multidisciplinary Optimization
- International Journal for Numerical Methods in Engineering
- International Journal of Computational Fluid Dynamics
- Journal of Computers and Fluids

Book Reviews John Wiley & Sons

Proposal Reviews National Science Foundation (NSF) Small Business Innovation Research (SBIR) Program (2000, 2003)

Conference Proceedings

- Mississippi State Conference on Differential Equations and Computational Simulation

AIAA Conference Papers
ASME Conference Papers

University Service

University of Tennessee Chattanooga (Aug. 2011- Present):

Chair, University Graduate Council (2018 – 2019)
Best Practice Chair, University Graduate Council (2017 – 2018)
CECS Faculty Mentor [5 mentees] (2016 – present)
SimCenter Budget Coordinator Search Committee (2016 – 2017)
Mechanical Engineering RPT Committee (2016 – 2017)
CECS Director of Student Success Search Committee (2016)
Director of Career Center Search Committee (2016)
Mechanical Engineering (Automotive) Faculty Search Committee (2016 – 2017)
CECS Graduate Curriculum Committee (2016 – 2017)
University Graduate Council (2015 – present)
University Graduate Curriculum Committee (2015 – 2017)
University Graduate Recruitment Committee (2015 – 2016)
GENI Rack Workgroup (2015)
Vice Chancellor of Research/Dean of the Graduate School Search Committee (2014 – 2015)
CME Departmental Graduate Committee (2011 – 2015)

Mississippi State University (Aug. 1997- July 2011):

AIAA Student Chapter Faculty Advisor (January 1998 – July 2011)
SAE Heavy Lift Student Design/Build/Fly Faculty Advisor (2010, Spring 2011)
Departmental Committee on Mechanics Education (1997 – 2011)
Departmental Committee on Structures Education (2000 – 2011)
Departmental Graduate Committee (1998 – 2011)
College of Engineering Hearin Cross-Disciplinary Committee (1998 – 2000)
Engineering College Faculty Council (ECFC, 2001 – 2004)
Aerospace Engineering Department Head Search Committee (2002 – 2003)
Aerospace Engineering/ERC Faculty Search Committee (2003)
Aerospace Engineering/CAVS Faculty Search Committee (2003 – 2004)
Bagley College of Engineering Faculty Mentor [3 mentees] (2004 – 2006, 2008 – 2010)
Chair, Departmental Promotion and Tenure Committee (2005)
IMAGE (Increase Minority Access to Graduate Education) Faculty Mentor (1997 – 2009)
Society of Women Engineers (SWE) Summer Camp Lecturer (1999, 2000)
ABET Review Team (Syllabi and Course Folders)

Refereed Journal Articles

- Wu, Z., and Newman III, J.C., "Application of Complex-Step Derivative Method for k-Eigenvalue Sensitivity Calculation in Neutron Transport Models," *Annals of Nuclear Engineering*, Vol. 151, Article 107975, February 2021.
- Behzadi, F., and Newman III, J.C., "An Exact Source-Term Balancing Scheme for Finite Element Solution of Shallow Water Equations with Wetting and Drying," *Computer Methods in Applied Mechanics and Engineering*, Vol 359, Feb. 2020.

- Behzadi, F., and Newman III, J.C., "Solution of Fully-Coupled Shallow Water Equations and Contaminant Transport using a Primitive-Variable Riemann Method," Environmental Fluid Mechanics, Vol. 18, No. 2, April 2018, pp. 515-535.
- Anderson, W.K., Newman III, J.C., and Karman, S.L., "Stabilized Finite Elements in FUN3D," *Journal of Aircraft*, Vol. 55, No. 2, March 2018, pp. 696-714.
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- Zhang, X., Newman III, J.C., Lin, W., and Anderson, W.K., "Time-Dependent Adjoint Formulation for Metamaterial Optimization using Petrov-Galerkin Methods," *Applied Computational Electromagnetics Society Journal*, Vol. 1, No. 7, July 2016, pp. 201-204.
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Analysis for Variable Mach Flows," *Int. J. Numer. Meth. Engng.*, Vol. 66, No.2, April 2006, pp. 297-318.

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Book Chapters

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Conference Publications

- Wu, Z., Newman III, J.C., and Taylor III, A.C., "Higher Order Accurate K-Eigenvalue Sensitivity Estimation Using the Complex-Step Derivative Method," International Conference on Mathematics and Computational Methods for Nuclear Science and Engineering, Portland, Oregon, August 2019.
- Tanis, C., Sreenivas, K., Newman III, J.C., and Webster, R., "Performance Portability of a Multiphysics Finite-Element Code," AIAA Aviation Technology, Integration, and Operations Conference, AIAA Paper 2018-2890, Atlanta, Georgia, June 2018.
- Anderson, W.K., and Newman III, J.C., "High-Order Stabilized Finite Elements on Dynamics Meshes," *AIAA Science and Technology Forum and Exposition*, AIAA 2018-1307, Kissimmee, Florida, January 2018.
- Anderson, W.K., Newman III, J.C., and Karman, S.L., "Stabilized Finite Elements in FUN3D," *AIAA Science and Technology Forum and Exposition*, AIAA 2017-0077, Grapevine, TX, January 2017.
- Lin, W., Newman III, J.C., and Anderson, W.K., "Design of Broadband Acoustic Cloak using Topology Optimization," Accepted for publication, *ASME International Mechanical Engineering Congress & Exposition*, IMECE Paper 2016-68135, Phoenix, AZ, Nov. 2016.
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- Lin, W., Anderson, W.K., Newman III, J.C., and Zhang, X., "Shape Optimization of Two-Dimensional Acoustic Metamaterials and Phononic Crystals with a Time-Dependent Adjoint Formulation," *Proceedings of the 57th AIAA/ASCE/ASC Structures, Structural Dynamics, and Materials Conference*, AIAA Paper 2016-1980, San Diego, CA, January 2016.
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- Liu, C., Newman III, J.C., and Anderson, W.K., "Three-Dimensional Dynamic Overset Method for Stabilized Finite Elements," *Proceedings of the 22nd Computational Fluid Dynamics Conference*, AIAA Paper 2015-3423, Dallas, TX, June 2015.

- Ahrabi, B.R., Anderson, W.K., and Newman III, J.C., "An Adjoint-Based *hp*-Adaptive Petrov-Galerkin Method with Hierarchical Basis for Turbulent Flows," *Proceedings of the 22nd Computational Fluid Dynamics Conference*, AIAA Paper 2015-2603, Dallas, TX, June 2015.
- Newman Jr., J.C., and Newman III, J.C., "Finite-Element Simulations on Extremely Large Cracked Panels using the Critical CTOA Fracture Criterion," *ASTM/ESIS Fatigue and Fracture Mechanics Symposium*, Anaheim, CA, May 2015.
- Anderson, W.K., Ahrabi, B.R., and Newman III, J.C., "Finite-Element Solutions for Turbulent Flow (Invited)," *Proceedings of the 53rd AIAA Aerospace Sciences Meeting,* AIAA Paper 2015-1531, Kissimmee, FL, January 2015.
- Hasbestan, J.J., Newman III, J.C., and Arabshahi, A., "A New Approach to Mesh Adaptation Procedure using Linear Elasticity for Geometries Undergoing Large Displacements," *Proceedings of the 4th Joint US-European Fluids Engineering Division Summer Meeting*, FEDSM2014-22010, Chicago, IL, Aug. 2014.
- Liu, C., Newman III, J.C., and Anderson, W.K., "A Streamline/Upwind Petrov-Galerkin Overset Grid Scheme for the Navier-Stokes Equations with Moving Domains,"*Proceedings of the 32nd AIAA Applied Aerodynamics Conference*, AIAA Paper 2014-2980, Atlanta, GA, June 2014.
- Ahrabi, B.R., Anderson, W.K., and Newman III, J.C., "High-Order Finite-Element Method and Dynamic Adaptation for Two-Dimensional Laminar and Turbulent Navier-Stokes Equations," *Proceedings of the 32nd AIAA Applied Aerodynamics Conference*, AIAA Paper 2014-2983, Atlanta, GA, June 2014.
- Janus, J.M., Newman III, J.C., Ivancic, P., and Luke, E., "Conservative Fluid-Structure Data Transfer Algorithm for Mismatched-Mesh Simulations," *Proceedings of the 21st AIAA Computational Fluid Dynamics Conference*, San Diego, CA, June 2013.
- Kapadia, S., Anderson, W.K., Newman III, J.C., "Computational Analysis and Design of Solid Oxide Fuel Cells,"*ASME 10th International Fuel Cell Science, Engineering & Technology Conference*, San Diego, CA, July 2012.
- Ochinero, T., Deiters, T., Higgins, .J.E., Blades, E., and Newman III, J.C., "Design and Testing of a Large Composite Asymmetric Payload Fairing," *Proceedings of the 50thAIAA/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference*, AlAA Paper 2009-2696, Palm Springs, CA, May 2009.
- Burgreen, G.W., and Newman III, J.C., "Robust Simulation ofCFD-Predicted Hemolysis," *NIH/FDA/NSF Computational Modeling for Cardiovascular Devices Meeting Proceedings*, Rockville, MD, June 2009.
- Yamada, Y, Newman III, J.C., and Newman Jr., J.C., "Elastic-Plastic Finite-Element Analysis of Compression Pre cracking and Its Influence on Subsequent Fatigue-Crack-Growth Behavior," *Proceedings of the 7thInternational ASTM/ESIS Symp.on Fatigue and Fracture*, Tampa. FL, Nov. 2007.
- Newman III, J.C., and Blades, E.L., "Parallel Optimization Strategy for Large-Scale Computational Design,"*Proceedings of the 3rdAIAA Multidisciplinary Design Optimization Specialists Conference*, AIAA Paper 2007-1930, Waikiki, HI, April 2007.
- Blades, E.L., and Newman III, J.C., "Aeroelastic Effects of Spinning Missiles," *Proceedings of the 48thAIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference*, AIAA Paper 2007-2243, Waikiki, HI, April 2007.
- Blades, E.L., and Newman III, J.C, "Computational Aeroelastic Analysis of an Unmanned Aerial Vehicle using U2NCLE," *Proceedings of the AIAA Dynamics Specialists Conference*, AIAA Paper 2007-2237, Waikiki, HI, April 2007.

- Balasubramanian, R., and Newman III, J.C., "Comparison of Adjoint-based and Feature-based Grid Adaptation for Functional Outputs," *Proceedings of the 36th AIAA Fluid Dynamics Conference and Exhibit*, AIAA Paper 2006-3314, San Francisco, CA, June 2006.
- Groner III, B.J, Lee, M.A, Moorhead, R.J., Martin, J.P., Newman III, J.C., "Concurrent Visualization of a Parallelized Computational Fluid Dynamics Code," *International Society for Modeling and Simulation, HPC Spring Simulation Multiconference*, Huntsville, AL, April 2006.
- Groner III, B.J., Lee, M., Martin, J., Moorhead, R. J., and Newman III, J.C., "A Concurrent Visualization System for High-Performance Computational Simulations," *IEEE Visualization 2005 Proceedings Compendium*, March 2005.
- Balasubramanian, R., and Newman III, J.C., "Discrete Direct and Discrete Adjoint Sensitivity Analysis for Arbitrary Mach Number Flows," *SIAM Conference on Computational Science and Engineering*, Orlando, FL, February 2005.
- Brewer, W.H., Newman III, J.C., and Burgreen, G.W., "Computational Design of Propulsors for Improved Cavitation Performance," *Proceedings of the 8th International Conference on Numerical Ship Hydrodynamics*, Busan, Korea, September 2003.
- Burg, C.O.E., Sheng, C., Newman III, J.C., Brewer, W.H., Blades, E., and Marcum, D.L., "Verification and Validation of Forces Generated by an Unstructured Flow Solver,"*Proceedings of the 16th Computational Fluid Dynamics Conference,* AIAA Paper 2003-3983, Orlando, FL, June 2003.
- Newman III, J.C., Pankajakshan, R., Whitfield, D.L., and Taylor, L.K., "Computational Design Using RANS,"*Proceedings of the 24th Symposium on Naval Hydrodynamics*, Fukuoka, Japan. July 2002.
- Janus, J.M., and Newman III, J.C., "Aerodynamic and Thermal Design Optimization for Turbine Airfoils," *Proceedings of the 38th Aerospace Sciences Meeting & Exhibit*, AIAA Paper 2000-0840, Reno, NV, January 2000.
- Newman III, J.C., Whitfield, D.L., and Anderson, W.K., "A Step-Size Independent Approach for Multidisciplinary Sensitivity Derivatives," *Proceedings of the 17th Applied Aerodynamics Conference*, Vol. 1, pp. 1-12, AIAA Paper 99-3101, June 1999.
- Anderson, W.K., Newman III, J.C., Whitfield, D.L., and Nielsen, E.J., "Sensitivity Analysis for the Navier-Stokes Equations on Unstructured Meshes Using Complex Variables,"*Proceedings of the 14th Computational Fluid Dynamics Conference*, Vol. 1, pp. 381-389, AlAA Paper 99-3294, June 1999.
- Newman III, J.C., Taylor III, A.C., and Barnwell, R.W., "Aerodynamic Shape Sensitivity Analysis and Design Optimization of Complex Configurations Using Unstructured Grids,"*Proceedings of the 15th Applied Aerodynamics Conference*, Vol. 1, pp. 420-431, AIAA Paper 97-2275, June 1997.
- Taylor III, A.C., Oloso, A, and Newman III, J.C., "CFL3D.ADII (Version 2.0): An Efficient, Accurate, General-Purpose Code for Flow Shape-Sensitivity Analysis," *Proceedings of the 15th Applied Aerodynamics Conference*, Vol. 1, pp. 188-197, AlAA Paper 97-2204, June 1997.
- Newman III, J.C., Newman, P.A, Taylor III, A.C., and Hou, G.J.-W., "Nonlinear Aerodynamic Design Optimization of a Flexible Wing,"*Proceedings of the 6th AIAA/NASA/USAF Multidisciplinary Analysis and Optimization Symposium*, Vol. 2, pp. 36-46, AIAA Paper 96-4108, September 1996.
- Newman III, J.C., and Taylor III, A.C., "Three-Dimensional Aerodynamic Shape Sensitivity Analysis and Design Optimization Using the Euler Equations on Unstructured Grids," *Proceedings of the 14th Applied Aerodynamics Conference*, Vol. 1, pp. 177-189, AlAA Paper

96-2464, June 1996.

- Newman III, J.C., Taylor Ill, A.C., and Burgreen, G.W., "An Unstructured Grid Approach to Sensitivity Analysis and Shape Optimization Using the Euler Equations," *Proceedings of the 12th Computational Fluid Dynamics Conference*, Vol. 1, pp. 69-80, AIAA Paper 95-1646, June 1995.
- Singh, K.P., Newman III, J.C., and Baysal, O., "Dynamic Unstructured Method for Flows Past Multiple Objects in Relative Motion,"*Proceedings of the 32nd Aerospace Sciences Meeting & Exhibit*, AIAA Paper 94-0058, Reno, NV, January 1994.
- Newman III, J.C., and Baysal, O., "Transonic Solutions of a Wing/Pylon/Finned Store Using Hybrid Domain Decomposition," *Proceedings of the 38th Atmospheric Flight Mechanics Conference*, Vol. 1, pp. 441450, AIAA Paper 92-4571, August 1992.
- Fouladi, K., Baysal, O., and Newman III, J.C., "Hybrid Domain Decomposition for Configurations with Multiple Non-Similar Components," *Proceedings of the5th SIAM Conference on Domain Decomposition Methods for Partial Differential Equations*, May 1991.

Dissertation/Thesis

- Newman III, J.C., "Integrated Multidisciplinary Design Optimization Using Discrete Sensitivity Derivatives for Geometrically Complex Aeroelastic Configurations," PhD Dissertation, Virginia Polytechnic Institute and State University, July 1997.
- Newman III, J.C., "Flow Simulations About Steady-Complex and Unsteady Moving Configurations Using Structured-Overlapped and Unstructured Grids," MS Thesis, Old Dominion University, May 1994.

Courses Taught [Sections]

University of Tennessee Chattanooga (Aug. 2011-Present):

Undergraduate:

ENCE 1040 Vector Statics [1]
ENME 2480 Dynamics [2]
ENME 4450 Mechanical Vibrations [3]

Graduate:

ENCM 5400 Computational Structural Dynamics I [2] †
ENCM 5130 Introduction to the Finite Element Method [5] †
ENCM 7130 Advanced Finite Element Methods [2] †
ENCM 7400 Computational Structural Dynamics II [1]†
ENCM 5380 Continuum Mechanics [3] †
ENCM 7910 Computational Design [1]

Mississippi State University (Aug. 1997- July 2011):

Undergraduate:

EM 2413 Engineering Mechanics I: Statics [6]
EM 2433 Engineering Mechanics II: Dynamics [4]
EM 3413 Vibrations [6]
EM 3213 Mechanics of Materials [8]
ASE 3213 Aircraft Structural Analysis [6]

Graduate:

EM 4123/6123 Finite Element Method [7]
EM 4990/6990 Engineering Design Optimization [3]†
EM 8203 Applied Elasticity [2]
EM 8113 Continuum Mechanics [2]

ENME Mechanical Engineering
ENCM Computational Engineering
ENCE Civil Engineering
EM Engineering Mechanics
ASE Aerospace Engineering
† New course developed at institution.

Graduate Students Advised

University of Tennessee Chattanooga (Aug. 2011-Present):

Major Advisor	***Committee Member***
Nickolas Currier (Ph.D., CME)	Xueying Zhang (M.S., CME)
Jabar Hasbestan (Ph.D., CME)	Jamasp Azarnoosh (M.S., CME)
Behrouz Shamsaei (Ph.D., CME)	Philip Fackler (Ph.D., CME)
Chao Liu (Ph.D., CME)	Max David Collao (Ph.D., CME)
Don Warrington (Ph.D., CME)	Mathew O'Connell (Ph.D., CME)
Faranak Behzadi (Ph.D., CME)	Cameron Druyor (Ph.D., CME)
Weiyang Lin (Ph.D., CME)	Jhiin Joo (Ph.D., CME)
Lawton Shoemake (Ph.D., CME)	Mary Barker (M.S., CME)
Behzad Ahrabi (Ph.D., CME)	Bruce Hilbert (Ph.D., CME)
Kenneth Croft (M.S., CME)	Tou Liu (Ph.D., CME)
Jeffery Cox (M.S., CME)	Nasir Boateng (Ph.D., CME)
Xueying Zhang (Ph.D., CME)	Kristen Karman (Ph.D., CME)
Arash Ghasemi (Ph.D., CME)	Cannon DeBardelaben (Current M.S., ME)
Arman Raoufi (Ph.D., CME)	Jason DeHay (Current Ph.D., Comp. Sci)
Amirehsan Ghasemi (Current M.S., CE)	

Mississippi State University (Aug. 1997- July 2011):

Major Advisor	***Committee Member***	***Minor Advisor***
R. Balasubramanian (M.S., Ph.D.,CME)	Clarence Burg (Ph.D., CME)	Ricky Aveline (M.S., ME)
Rohit Verma (M.S., CME)	Zhaohui Huo (M.S., ASE)	Dong Yu (M.S., ME)
Shannon Brown (M.S., CME)	Sanjay Deo (M.S., ASE)	Vern McDonald (M.S., ME)
C. Burdyshaw (M.S., Ph.D.[2], CME)	H. Kalyanasundaram (M.S., ASE)	Jeffrey Skinner (M.S., ME)
Marco Capozzi (M.S., ASE)	Luca Massa (Ph.D., ASE)	Carlos Trice (M.S., ME)
Yongquan Zhou (Ph.D., CME)	Doug Plotner (M.S., CME)	Kiran Solanki (M.S., ME)
Ji Young Hur (Ph.D., ASE)[3]	Wesley Brewer (Ph.D., CME)	
Jefferson Parrish (Ph.D., CME)[4]	Michael McNabb (M.S., ASE)	
Phillip Ivancic (M.S., ASE)[5]	Ravi Nagaraju (M.S., ASE)	
	Joshua Thumann (M.S., ASE)	
	Mukti Nath Singh (M.S., ASE)	
	Eric Blades (Ph.D., CME)	
	HurJi Young (M.S.., ASE)	
	Aaron Harcrow (M.S., ASE)	
	Brian Lambert (Ph.D., CME)	
	Bin Su (M.S., ASE)	
	Elizabeth Bartlett (M.S., ME)	
	Vasanth K. Murali (M.S., CME)	
	Paul Quagliana (Ph.D., CME)	
	Pang Hui Wong (M.S., ME)	
	Prasad Ramaiah (M.S., CME)	
	Shelley Hebert (Ph.D., CME)	
	GopiPrashanth (M.S., CME)	
	Rajkumar Prabhu (M.S., CME)	
	Chris Cureton (M.S., ASE)	
	David Bodkin (M.S., ASE)	
	Alcides D. Busatto (Ph.D., CME)	

ASE Aerospace Engineering
ME Mechanical Engineering
CE Civil Engineering
CME Computational Engineering

1 Co-Major Advisor with Dr. W. Kyle Anderson.
2 Transferred and completed Ph.D. at the University of Tennessee Chattanooga with Dr. W. Kyle Anderson as Major Advisor.
3 Co-Major Advisor with Dr. David Thompson. Original MSU Major Advisor Dr. Bharat Soni. Did not complete degree program (ABD).
4 Completed degree with Dr. Masoud Rais-Rohani as Major Advisor, external committee member (December 2013 graduation).
5 Completed degree with Dr. J. Mark Janus as Major Advisor (May 2013 graduation).

c) Curriculum Vitae for Dr. Donald Reising

DONALD R. REISING, Ph.D.
Associate Professor, Electrical Engineering, UTC
College of Engineering and Computer Science
615 McCallie Avenue
Chattanooga, TN 37403

Education:
Air Force Institute of Technology, Dayton, OH
Ph.D. Electrical Engineering, 2012
Air Force Institute of Technology, Dayton, OH
M.S. Electrical Engineering, 2009
University of Cincinnati, Cincinnati, OH
B.S. Electrical Engineering, 2006

Teaching Experience:
Associate Professor, *University of Tennessee at Chattanooga, TN,* 7/2020-Present
- Taught Digital Communications, Digital Signal Processing, Electromagnetic Fields & Waves

Assistant Professor, *University of Tennessee at Chattanooga, TN,* 8/2014-7/2020
- Taught Analog Communications, Digital Signal Processing, Electric Circuits I

Adjunct Professor, *Sinclair Community College, OH,* 8/2011-8/2013
- Taught College Algebra

Adjunct Professor, *Air Force Institute of Technology, OH,* 12/2012-8/2014
- Taught Signal Collection and Post-Processing

Professional Experience
Electronics Engineer, *Air Force Research Laboratory, Sensors Directorate*, 7/2009-7/2014
- Led research team in development and testing of RF fingerprinting air monitor.
- Managed an annual research budget of $350k.
- Created branch RF research laboratory.

Communications Engineer, *Air Force Aeronautical Systems Center*, 7/2006-7/2009
- Provided technical consultation on current and developing communication capabilities versus user requirements.
- Directed, facilitated, and developed the Crypto-Modernization Roadmap in coordination with a team of personnel from the Crypto-logic Systems Group.
- Represented the program during bi-weekly airborne cross-cutters to ensure CSAR-X development will meet Global Information Grid requirements.

Publications (* - Denotes Student, ^ - Undergraduate):
- Fadul*, Reising, and Sartipi, "Identification of OFDM-based Radios under Rayleigh Fading using RF-DNA and Deep Learning," IEEE Access, vol. 9, Jan. 2021.
- Cannon*^, Loveless, Estrada*^, Boggs*, Lawrence*, Santos*, McCurdy, Sternberg, Finzell, Cannon, and Reising, "Electrical Measurement of Cell-to-Cell Variation of Critical Charge in SRAM and Sensitivity to Single-Event Upsets by Low-Energy Protons," IEEE Trans on Nuclear Science, *Accepted*, Feb. 2021.

- Loveless, Reising, Cancelleri*, Massengill, and McMorrow, "Analysis of Single Event Transients (SETs) using Machine Learning and Ionizing Radiation Effects Spectroscopy (IRES)," IEEE Trans on Nuclear Science, *Accepted*, Jan. 2021.
- Fadul*, Reising, Loveless, and Ofoli, "Nelder-Mead Simplex Channel Estimation for the RF-DNA Fingerprinting of OFDM Transmitters Under Rayleigh Fading Conditions," IEEE Transactions on Information Security and Forensics, *Accepted*, Jan. 2021.
- Reising, Cancelleri*, Loveless, Kandah, and Skjellum, "Pre-print: Radio Identity Verification-based IoT Security Using RF-DNA Fingerprints and SVM," IEEE Internet of Things Journal, *Accepted*, Dec. 2020.
- Wilson*, Reising, Hay, Johnson, Karrar, and Loveless, "Automated Classification of Electrical Disturbance Waveforms within an Operational Smart Power Grid," vol. 11, no. 5, pp. 4380-4389, Sept. 2020.
- Mannon*^, Suggs*^, Reising, and Hay, "Automated Identification of Re-Closing Events in an Operational Smart Power Grid," IEEE SoutheastCon 2020, Mar. 2020.
- Loveless, Patel*, Reising, Roca*^, Allen*^, Massengill, and McMorrow, "Single Event Transient Spectroscopy," IEEE Trans on Nuclear Science, Vol. 67, No. 1, Jan. 2020.
- Wilson*, Reising, and Loveless, "Integration of Matched Filtering within the RF-DNA Fingerprinting Process," IEEE Global Communications Conference (GLOBECOM), Dec. 2019.
- Kandah, Cancelleri*^, Reising, Altarawneh, and Skjellum, "A Hardware-Software Codesign Approach to Identity, Trust, and Resilience for IoT/CPS at Scale," IEEE International Conference on Internet of Things (iThings), Jul. 2019.
- Fadul*, Reising, Loveless, and Ofoli, "RF-DNA Fingerprinting Classification of OFDM Signals Using a Rayleigh Fading Channel Model," IEEE Wireless Communications and Networking Conference (WCNC), Apr. 2019.
- Patel*, Joplin*, Boggs*, Reising, McCurdy, Massengill, and Loveless, "Ionizing Radiation Effects Spectroscopy (IRES) for Analysis of Total-Ionizing Dose Degradation in Voltage-Controlled Oscillators," IEEE Trans on Nuclear Science, Vol. 66, No. 1, Oct. 2018.
- Wilson*, Reising, Hay, Johnson, "Automated Fuse Identification within An Operational Smart Power Grid," IEEE PES Asia-Pacific Power and Energy Engineering Conference (APPEEC), Oct. 2018.
- Fadul*, Patel*, Reising, Loveless, Sartipi, "Estimating Energy Consumption Using Instantaneous Temperature," American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Annual Conference, Jun. 2018.
- Wheeler*, and Reising, "Assessment of the Impact of CFO on RF-DNA Fingerprint Classification Performance," IEEE Int'l Conference on Computing, Networking and Communications (ICNC), Jan. 2017.
- Reising, Temple, and Jackson, "Authorized and Rogue Device Discrimination Using Dimensionally Reduced RF-DNA Fingerprints," IEEE Trans on Information Forensics and Security, Vol. 10, No. 6, pp. 1180-1192, Jun. 2015.
- Harmer, Reising, and Temple, "Classifier Performance Comparison Using 2D RF-DNA Features". IEEE Int'l Conference on Communications (ICC), Jun. 2013.
- Reising, and Temple, "WiMAX Mobile Subscriber Verification Using Gabor-Based RF-DNA Fingerprints," IEEE Int'l Conference on Communications (ICC), Jun. 2012.

- Reising, Temple, and Oxley, "Gabor-based RF-DNA Fingerprinting for Classifying 802.16e WiMAX Mobile Subscribers," IEEE Int'l Conference on Computing, Networking and Communications (ICNC), Jan. 2012.
- Reising, Prentice, and Temple, "An FPGA Implementation of Real-Time RF-DNA Fingerprinting for RFINT Applications." 2011 Military Communications Conference (MILCOM 2011), Oct. 2011.
- Williams, Temple, and Reising, "Augmenting Bit-Level Network Security Using Physical Layer RF-DNA Fingerprinting," IEEE Global Communications Conference (GLOBECOM), Dec. 2010.
- Reising, Temple, and Mendenhall, "Improving Intra-Cellular Security Using Air Monitoring with RF Fingerprints," IEEE Wireless Communication and Networking Conference (WCNC), Apr. 2010.
- Reising, Temple, and Mendenhall, "Improved Wireless Security for GMSK-based Devices Using RF Fingerprinting," Int'l J. Electronic Security and Digital Forensics, Vol. 3, No. 1, pp. 41-59, 2010.
- Klein, Temple, Mendenhall, and Reising, "Sensitivity Analysis of Burst Detection and RF Fingerprinting Classification Performance," IEEE Int'l Conference on Communications (ICC), Jun. 2009.

Awards and Affiliations:

- University of Tennessee at Chattanooga Outstanding University Service Award, 2018
- Recognized for "Outstanding contributions" to the University of Tennessee at Chattanooga by the Provost's Office, 2016 & 2017
- U.S. Air Force Dr. John L. McLucas Basic Research Award Nominee, 2014
- AFRL Sensors Directorate Dr. Samuel M. Burka Award, 2013
- Tau Beta Pi – Engineering Honor Society, 2010
- Association of Old Crows Research Excellence Award, 2009
- Measurement and Signature Intelligence Committee Academic Excellence Award, 2009
- Eta Kappa Nu – Electrical Engineering Honor Society, 2008
- Institute for Electrical and Electronic Engineers (IEEE), 2003-Present

d) Curriculum Vitae for Dr. Mina Sartipi
(please see page 69)

e) Curriculum Vitae for Dr. Kidambi Sreenivas

KIDAMBI SREENIVAS

(423) 425 - 5506 (Office)
Kidambi-Sreenivas@utc.edu

EDUCATION

Ph. D., General Engineering (Computational Fluid Dynamics); Minor: Math — December 1996
Mississippi State University

M.S., Aerospace Engineering — August 1993
Mississippi State University

B. Tech., Aerospace Engineering — June 1991
Indian Institute of Technology, Madras

EMPLOYMENT

Professor — 08/2020 - Present
Mechanical Engineering, University of Tennessee at Chattanooga

Associate Professor — 01/2017 – 07/2020
Mechanical Engineering, University of Tennessee at Chattanooga

Joint Faculty Appointment — 04/2014 – 04/2019
Department of Energy, Oak Ridge National Laboratory, Oak Ridge, TN

Research Professor — 07/2011 – 12/2016
SimCenter, University of Tennessee at Chattanooga

Associate Research Professor — 09/2002 - 06/2011
SimCenter, University of Tennessee at Chattanooga

Associate Research Professor — 07/2002 - 09/2002
Computational Simulation & Design Center, Mississippi State University

Assistant Research Professor — 07/1999 - 06/2002
Computational Simulation & Design Center, Mississippi State University

Visiting Researcher — 07/1998 - 06/1999
Computational Fluid Dynamics Laboratory, Mississippi State University

Post-Doctoral Fellow — 01/1997 - 06/1998
Computational Fluid Dynamics Laboratory, Mississippi State University

Graduate Research Assistant — 08/1993 - 12/1996
Computational Fluid Dynamics Laboratory, Mississippi State University

Graduate Research Assistant — 08/1991 - 07/1993
MSU/NSF Engineering Research Center, Mississippi State University

RESEARCH AREAS

Dr. Sreenivas has been active in the area of unstructured, multi-physics flow solvers since 1996. Prior to this, his focus was in the area of structured flow solver development with applications to acoustics and stability of turbomachines. Dr. Sreenivas pioneered the capability to enable rotating machinery simulations using unstructured meshes. Additionally, he has developed pre-conditioners that enable simulations of fluids with non-ideal equations of state. Dr. Sreenivas has applied these advanced capabilities to solve real-world problems involving complex geometry and complex physics. The range of applications include hypersonic applications, maneuvering submarines and surface ships, simulations of wind farms, multi-stage turbomachinery, improvement in aerodynamic efficiency of Class 8 trucks, particle deposition within the human respiratory system, contaminant dispersal through urban environments, and embedded propulsion systems. Dr. Sreenivas has worked closely with researchers from NASA, Navy, Department of Energy and various private companies and has transitioned the latest developments to provide them with advanced flow simulation capabilities.

PROFESSIONAL MEMBERSHIPS

American Institute of Aeronautics and Astronautics (AIAA)
American Society of Mechanical Engineers (ASME)
Sigma Xi
Phi Kappa Phi

REVIEWER

Archival Journals

AIAA Journal
Computers & Fluids
Energy Reports
International Journal of Aerodynamics
International Journal of Computational Fluid Dynamics
Journal of Aircraft
Journal of Computational Physics
Journal of Fluids Engineering
Journal of Propulsion and Power
Journal of Turbomachinery
Measurement
Shock Waves

Conference Proceedings

ASME Turbo Expo
AIAA Propulsion Conference
ASME IMECE Conference
AIAA Aviation
AIAA SciTech

UNIVERSITY SERVICE

Conduct preliminary exams for Computational Fluid Dynamics exam area for the PhD program, 2014 - present
PhD Coordinator, Computational Engineering Concentration, 2017 - present
Undergraduate Appeals Committee, 2020 - present
Undergraduate Admissions Committee, 2019 – 2020
Faculty Academic Integrity Investigation Committee, 2019 – 2020
Undergraduate Research and Creative Endeavor (URaCE) advisory committee, 2016 - 2018
Grant Administrator search committee, SimCenter, 2017-18
Budget Coordinator search committee, SimCenter, 2017
System Administrator search committee, SimCenter, 2016-17
Chair, ME Department RTP committee, August 2020 - present
Member, EE Department Head Search Committee, August 2019 – April 2020
Member, Mechanical Engineering (Thermal-Fluids) faculty search committee, August 2019 – April 2020
Faulty Advisor, AIAA Student Chapter, October 2019 - present
Curriculum Committee, Mechanical Engineering, 2017 - present
Workload Policy Committee, Mechanical Engineering, 2017 – present
Strategic Planning Committee, Mechanical Engineering, 2018 – present
Faculty Advisor, Flying Mocs, August 2018 - present
Technical Advisor, Design/Build/Fly Team, Jan 2018 – present
Chair, Mechanical Engineering (Thermal-Fluids) faculty search committee, 2018-19
Member, Mechanical Engineering (Advanced Manufacturing) faculty search committee, 2017-18

PROFESSIONAL SERVICE

Member, AIAA Applied Aerodynamics Technical Committee, June 2017 - present
Technical Co-Chair, AIAA Applied Aerodynamics Conference, Dallas TX, June 2019
Technical Chair, AIAA Applied Aerodynamics Conference (Aviation 2021; Virtual), August 2021

PUBLICATIONS

1. Crawford, A.M., and **Sreenivas, K.**, "Helios and Tenasi Results for the Workshop for Integrated Propeller Prediction," Accepted for presentation at AIAA Aviation 2020, Reno, NV, June 2020.

2. Azarnoosh, J., **Sreenivas, K.**, Arabshahi, A., "Numerical Simulation of Tidal Breathing through the Human Respiratory Tract," Journal of Biomechanical Engineering, Available online January 1, 2020.
3. Mittal, A., Sreenivas, K., Hereth, L., and Taylor, L.K., "Numerical Simulation of the Interaction between Tandem Wind Turbines with Offset," under preparation for submission to Journal of Propulsion and Power, 2020.
4. Tanis, C., **Sreenivas, K.**, Newman, J., and Webster, R.S., "Performance Portability of a Multiphysics Finite Element Code," 2018 Aviation Technology, Integration, and Operations Conference, Atlanta GA, June 2018 (AIAA 2018-2890)
5. **Sreenivas, K.**, Webster, R.S., Collao, D.M., "Computational Simulations of the Low-Noise SDT2-R4 Configuration Using Tenasi," 2018 Applied Aerodynamics Conference, Atlanta, GA, June 2018 (AIAA 2018-4203)
6. **Sreenivas, K.**, Webster, R., and Hereth, E., "Impact of High-Order Spatial Accuracy on Multi-Stage Turbomachinery Simulations", 53rd AIAA/SAE/ASEE Joint Propulsion Conference, AIAA Propulsion and Energy Forum, Atlanta, GA, July 2017. (AIAA 2017-4823).
7. **Sreenivas, K.**, Webster, R., and Hereth, E., "Single and Dual Flow Nozzle Simulations using Tenasi", 53rd AIAA/SAE/ASEE Joint Propulsion Conference, AIAA Propulsion and Energy Forum, Atlanta, GA, July 2017. (AIAA 2017-4656).
8. Collao, M.D., Webster, R., **Sreenivas, K.**, "Testing Protruding Studs as a Form of Casing Treatment on a Transonic Turbofan: A Computational Study," Proceedings of ASME Gas Turbine Technical Congress and Exposition, 2017, Charlotte, NC, June 2017. Paper GT 2017-65257.
9. Hereth, E., **Sreenivas, K.**, Taylor, L.K., and Nichols, D.S., "An Automatic Parallel Octree Grid Generation Software with an Extensible Solver Framework and a Focus on Urban Simulation" AIAA Paper 2017-0587, Grapevine, TX, January 2017.
10. Mittal, A., Briley, W.R., **Sreenivas, K**., and Taylor, L.K., "A Parabolic Velocity-Decomposition Method for Wind Turbines," ***Journal of Computational Physics***, Vol. 330, pp 650–667, 2017.
11. Collao, M.D., Webster, R.S., Sreenivas, K., and Lin, W., "Computational Study of the Effects of Protruding Studs Casing Treatment on the Performance of an Axial Transonic Turbofan, " AIAA Paper 2016-4646, 52nd AIAA/SAE/ASEE Joint Propulsion Conference, 2016.
12. **Sreenivas, K**., Mittal, A., Hereth, L., Taylor, L.K., and Hilbert, C.B., "Numerical Simulation of the Interaction between Wind Turbines," ***Journal of Wind Engineering and Industrial Aerodynamics*****,** Vol**.** 157, pp 145–157, 2016.
13. Mittal, A., **Sreenivas, K**., Taylor, L., Hereth, L., Hilbert, C.B., "Blade-Resolved Simulations of a Model Wind Turbine: Effect of Temporal Convergence," ***Wind Energy***, Vol. 19, pp 1761–1783, 2016.
14. Azarnoosh, J., **Sreenivas, K**., Arabshahi, A., "CFD Investigation of Human Tidal Breathing through Human Airway Geometry," ***Procedia Computer Science***, Volume 80, pp 965–97, 2016.
15. **Sreenivas, K**, Webster, R.S., Hereth, E., Key, N.L., and Berdanier, R.A., "Computational Simulations of a Multi-Stage Subsonic Research Compressor," AIAA Paper 2016-0395, 54th AIAA Aerospace Sciences Meeting, January, 2016.
16. Mittal, A., **Sreenivas, K**., Briley, W.R., Taylor, L.K., "Towards Wind Farm Layout Design Using Sensitivity Derivatives Obtained from a Parabolic Method," AIAA Paper 2016-2198, 34th Wind Energy Symposium, January, 2016.
17. **Sreenivas, K**., Mittal, A., Taylor, L.K., and Hereth, L., "Higher-Order Accurate Simulations of Wind Turbine Flow Fields: A Poor Man's Approach," AIAA Paper 2016-0749, 34th Wind Energy Symposium, January, 2016.
18. Mittal, A., Briley, W.R., Taylor, L.K., and **Sreenivas, K**., "A Parabolic Method without Pressure Approximations for a Wind Farm," EWEA Offshore 2015, Copenhagen, Denmark.
19. Hassan, W.E., **Sreenivas, K**., Mittal, A., Taylor, L.K., and Hereth, L. "Blade Resolved Simulation for a Wind Farm," AIAA Paper 2015-2269, 33rd AIAA Applied Aerodynamics Conference, Dallas, TX, June 2015.
20. Mittal, A., **Sreenivas, K**., Briley, W.R., and Taylor, L.K., "A Parabolic Method for Accurate and Efficient Wind Farm Simulation," AIAA Paper 2015-2268, 33rd AIAA Applied Aerodynamics Conference, Dallas, TX, June 2015.
21. Mittal, A., Taylor, L.K., **Sreenivas, K**., Briley, W.R., and Nichols, D.S., "Extension of a Parabolic Method without Pressure Approximations for Wind Turbines in ABL Flows," AIAA Paper 2015-3391, 33rd AIAA Applied Aerodynamics Conference, Dallas, TX, June 2015.
22. Kamali, S., Ahrabi, B.R., Webster, R.S., and **Sreenivas, K**., "Numerical Simulation of Compressible Flow in a Diffusing S-duct with and without Vortex Generators," AIAA Paper 2015-2715, 33rd AIAA Applied Aerodynamics Conference, Dallas, TX, June 2015.
23. Gruetzemacher, R., Arabshahi, A., and **Sreenivas, K.**, "Effects of Inhalation Transcience on Flow Structures During Numerical Simulation of Airflow through a CT-Based Airway Geometry," Summer Biomechanics, Bioengineering

and Biotransport Conference (SB3C), Snowbird Resort, Utah, June 2015.

24. Webster, R. S., **Sreenivas, K**., and Hilbert, C. B., "Computational Simulation of the Fan and Low-pressure Compressor Stages of the Energy Efficient Engine," AIAA Paper 2015-1344, January, 2015.
25. **Sreenivas, K**., Mittal, A., Hereth, L., and Taylor, L.K., "Computational Simulation of the Interaction Between Tandem Wind Turbines with Offset," AIAA Paper 2015-0224, 33rd Wind Energy Symposium, AIAA SciTech 2015, January 2015.
26. Mittal, A., Briley, W.R., Taylor, L.K., and **Sreenivas, K**., "A Parabolic Method without Pressure Approximations for Wind Turbines," AIAA Paper 2015-0728, 33rd Wind Energy Symposium, AIAA SciTech 2015, January 2015.
27. Mittal, A., **Sreenivas, K**., Taylor, L.K., and Hereth, L., "Improvements to the Actuator Line Modeling for Wind Turbines," AIAA Paper 2015-0216, 33rd Wind Energy Symposium, AIAA SciTech 2015, January 2015.
28. Gruetzemacher, R., Arabshahi, A., and **Sreenivas, K**., "Numerical Simulation of Airflow in a CT-based Human Airway Model with Physiologically Appropriate Boundary Conditions," Poster Presentation within the Respiratory Bioengineering Track, Biomedical Engineering Society Annual Meeting, San Antonio, Texas, October 2014.
29. **Sreenivas, K**., Mittal, A., Hereth, L., Taylor, L.K., and Hilbert, C.B., "High-Fidelity Computational Simulation of the Interaction between Tandem Wind Turbines," 32nd AIAA Applied Aerodynamics Conference, June 2014, AIAA Paper 2014-2278
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G R A D U A T E S T U D E N T S

University of Tennessee at Chattanooga

Major Professor	*Committee Member*
Jason DeHay (PhD)	Tuo Liu (PhD; 2017)
Jhiin Joo (PhD; 2019)	Philip Fackler (PhD, 2017)
Max David Collao (PhD; 2017)	Kristen Karman (PhD, 2017)
Ethan Hereth (PhD; 2016)	Xueying Zhang (PhD; 2017)
Anshul Mittal (PhD; 2015)	Weiyang Lin (PhD; 2016)
Ashish Gupta (PhD; 2013)	Chao Liu (PhD; 2016)
	Nicholas Currier (PhD; 2014)
	Srijith Rajamohan (PhD; 2014)
	Erwin Taylor (PhD; 2013)
James Snuggs (MS)	Ryan Boggs (MS; 2019)
Alexander Snyder (MS)	Mary Barker (MS; 2015)
Cannon DeBardelaben (MS)	Tony McDaniel (MS; 2014)
Jamasp Azarnoosh (MS, 2016)	Richard Gruetzemacher III (MS; 2014)
Walied Hassan (MS; 2015)	Brent Mitchell (MS; 2007)
Weiyang Lin (MS; 2013)	
Guy Austin Flynt (MS; 2013)	
Adam Lee Cofer (MS; 2013)	
Arash Ghasemi (MS; 2013)	
Shane Sawyer (MS; 2012)	

Mississippi State University

Major Professor	*Committee Member*
Vishwas Shringi (MS; 2001)	Dudley Stephen Nichols (PhD; 2002)
Bhanu Bandaru (MS; 2004)	Sunil S. Nandihalli (MS; 2004)
	Kishore Satya Majety (MS; 2003)
	Vasanth Kumar Murali (MS; 2002)
	Ravishankar Balasubramanian (MS; 2002)

UNDERGRADUATE STUDENTS

Aaron Crawford (2018 - 2020)
- Summer Intern with US Army Aviation Development Directorate, NASA Ames Research Center, 2019
- Departmental Honors Thesis, 2020

Hannah Gifford (2017 – 2019)
- Summer Intern with US Army Aviation Development Directorate, NASA Ames Research Center, 2019

Juan Hernandez (2018 – 2019)
- Year-long internship with National Boiler Service 2018 – 2019
- Departmental Honors Thesis, 2019

Cannon DeBardelaben (2018 - 2019)
- Summer Intern with Pointwise, Inc., 2019

Jacob Jenkins (2021 – 2022)

COURSES TAUGHT

ENME 3070 - Fluid Mechanics
ENME 3070L - Fluid Mechanics Laboratory
ENME 2240 - Introduction to Engineering Computations
ENCM 5500 - Practicum in Structured and Unstructured Flow Solver Development
ENME 5100 - Computational Fluid Dynamics I
ENME 5010 - Introduction to Computational Fluid Dynamics

DISSERTATION/THESIS

Linearized Euler Analysis of Turbomachinery, PhD Dissertation
Major Professor: David L. Whitfield, Mississippi State University, Mississippi State, MS

High Resolution Numerical Simulation of the Linearized Euler Equations in Conservation Law Form, MS Thesis
Major Professor: David L. Whitfield, Mississippi State University, Mississippi State, MS

E. Graduate Faculty Application Form

REQUEST FOR **APPOINTMENT** (INITIAL and REAPPT) AS
GRADUATE FACULTY AT
THE UNIVERSITY OF TENNESSEE AT CHATTANOOGA

Information in the boxed area is to be completed by applicant.

Applicant's Name (type or print):_____ Date:_____

Applicant's Signature:_____

Applicant's Rank/Title:_____

Email Address:_____

Please check the appropriate box:

☐ Tenured/Tenure Track ☐ Research Appointment ☐ Administrative Appointment

☐ Clinical Appointment ☐ Not a university employee ☐ Other (please describe)

Department:_____

College/School (or Employment Affiliation):_____

Category of Graduate Faculty Appointment Request:

☐ Full Membership ☐ Associate Membership ☐ Special

☐ Applicant will not teach graduate courses. (ex. Serving on a graduate thesis/dissertation committee)

☐ Applicant will be teaching graduate courses and has a terminal or highest degree offered in the discipline of teaching or has professional work experience that qualifies for teaching in a specified discipline as verified through the Provost Office.**

RECOMMENDATION

SIGNATURES

☐ Approved ☐ Denied	_____ Typed Name	_____ Academic Department Head	Date
☐ Approved ☐ Denied	_____ Typed Name	_____ College Dean	Date
☐ Approved ☐ Denied	_____ Typed Name	_____ Dean, The Graduate School	Date
☐ Approved ☐ Denied	_____ Typed Name	_____ SACSCOC liaison, if teaching graduate classes	Date

*Graduate School received date:*_____

CURRICULUM VITA FORM for GRADUATE FACULTY APPOINTMENT or REAPPOINTMENT

Use the following categories to provide the information requested in the sequence shown.
(Curriculum Vitae may be used if it addresses all of the sections.)

DO NOT EXCEED THREE PAGES

NAME	POSITION / TITLE

EDUCATION / TRAINING (Begin with the baccalaureate degree or other initial professional education, listing advanced degree(s) and include postdoctoral training.)

INSTITUTION AND LOCATION	DEGREE (if applicable)	YEAR(s)	FIELD OF STUDY

A. Positions and Honors

1. Positions and/or Employment (begin with current position, place of employment, position/rank, length of employment, role/function, etc.)

2. Honors

3. Peer-Reviewed Publications and Creative Works (list for the last five (5) years *only*).

4. Graduate Student Training & Teaching (List of the past five (5) years, courses taught, students mentored as major advisor/professor/director or committee member)

5. Ongoing Research, Scholarship and Creative Activity

**Verification:

The signatures below verify that the information provided above is correct. Also, for individuals who will be teaching graduate courses, the signatures verify that the teaching credentials of the applicant are on file in the Provost Office and the individual has been approved for teaching graduate courses.

NOTE: Official university verification of credentials for the purpose of meeting SACS requirements is done in the Associate Provost Office. Verification must be completed in the Provost Office before processing this form for graduate faculty appointment.

F. Faculty Mentor Plan

CECS Mentoring Plan

To better prepare junior faculty members for successful academic careers, the College of Engineering and Computer Science launched a faculty mentoring program in Fall 2016. This document should be used as a guide in developing teaching, research and service plans for each mentee faculty. The mentoring program consists of the following processes: a) develop a written plan, b) review the plan with a pre-designated mentor(s), c) after reviewing with the mentor, submit the plan to the Department Head and Dean, d) implement the plan, and e) review the progress as needed. The plan may be reviewed as necessary throughout the year and should be reviewed at the end of the year by the Mentee & Mentor.

Academic year: 20XX-20XX

This sheet is a template to use when developing your annual mentoring plan. The topics below are suggestions that should be considered. Other topics may be relevant and can be added.

Mentee Information

Name: _____

Dept.: _____

Rank: _____

Mentor Information

Name: _____

Dept.: _____

Rank: _____

Teaching (provide a list of the courses you are planning to teach or would like to teach – with the approval of your department Head. Also list any teaching initiatives such as a course redesign, training, etc.)

Courses to teach	Teaching initiatives	Semester

Other teaching related activities

Activities	Partnering Org

Research - Publications (provide a list of planned publications)

Title	Journal	Co-Authors	Expected date of submittal

Research - Proposals (provide a list planned proposals)

Topic/Title	Agency	Agency deadline	Funding amount	Co-PI

Research - how you plan to leverage resources / opportunities internally, locally and regionally to build their research is a key; how can your mentor support?

Travel (list planned travel such as conference presentations, visits to program managers, and project review meetings. Include expected/desired funding amounts and names of funding sources)

Purpose	Dates	Amount	Funding source

Students (provide a list of students you are currently supervising and students you plan to bring into your lab. Note any planned conference presentations, and scholarship opportunities)

Student Name	Research topic	Funding source and amount	Expected date of graduation	Expected Conference presentations	Expected Journal Publications	Scholarships students should apply for

Laboratory space (provide a summary of your lab and any needed expansions)

Lab location	Sq ft.	Existing Equipment	Needs

Training (list workshops you plan on attending – both internal and external)

Workshops to attend	Dates	Locations	Funding source

Tenure/Promotion (identify potential authors of a letter of support, you should consider full professors from AAU universities - https://en.wikipedia.org/wiki/Association_of_American_Universities)

Name	University	Rank

Service (list planned significant service such as national committees in which to participate, regional committees, internal committees, and interaction with student groups)

Date reviewed: _____

_____ **_____**

Mentee **Mentor**