QUALIFICATION SUMMARY

HIGHLIGHTS

- Highly accomplished technology leader in fields of mechatronics, motion control, adaptive manufacturing, machine vision, and human-machine interaction.
- Founder and CTO of successful technology company - acquired 5 years after inception by global leader in automation.
- CTO at world-class supplier of sophisticated robotics, control, advanced manufacturing, and nuclear handling solutions with gross annual sales of approx. $30M.
- Associate Professor at the Georgia Institute of Technology, Woodruff School of Mechanical Engineering.
- Chief architect of world-class mechatronic technologies, motion-control algorithms, and products for advanced robotics and automation.
- Directed development and implementation of hundreds of complex, multi-disciplinary mechatronic systems for high-profile industry leaders such as Toyota, Ford, Alcoa, Caterpillar, Boeing, NuScale, and many others, as well as high-profile facilities such as Fukushima and Chernobyl.

INDUSTRY

Dr. Khalid Sorensen has over 20 years of experience developing and deploying cutting-edge mechatronic, motion control, and automation solutions. He is the founder of a technology company where he invented and was the chief architect of Expertoperator™, Safemove™, Automove™, and Cranevision™ – technology known within the primary metals, automotive, and heavy-equipment sectors for enhancing crane safety, productivity, and ease-of-use. Sorensen also developed state-of-the-art, on-line, time-optimal trajectory synthesis software for Cartesian machines. These industry-recognized technologies were key drivers in the acquisition of his company 5 years after inception by a global leader in automation.

Dr. Sorensen also served as CTO at PaR Systems, a world-class supplier of large-scale robotic automation, control, advanced manufacturing, and nuclear-handling solutions. Responsibilities included: technical oversight of critical projects; identifying and mitigating technical risk areas; leading in the creation of new and cutting-edge control, automation, and robotics technologies; directing R&D efforts; managing and protecting IP portfolio; disseminating and facilitating best-practice engineering methodologies; identifying and adopting emerging technologies for advancing company's technical capabilities; and identifying and executing strategic partnerships.

In 2020, Dr. Sorensen founded Finity Engineering (FE), and presently serves as CTO. FE provides design, analysis, consulting, and litigation support services in the areas of robotics, automation, mechatronics.

ACADEMIA

Dr. Sorensen is an Adjunct Associate Professor at the Georgia Institute of Technology. He teaches on various engineering topics including Dynamics, Advanced Motion Control, Vibrations, Mechatronics, The Design Process, Product Development, Engineering Best Practices, Intellectual Property, Product Liability, and others. In addition to Georgia Tech, Sorensen has given invited talks in these areas at premiere institutions globally including MIT, Kumoh National University of Technology, the Korea Atomic Energy Research Institute, Hyung Hee University, and Huazhong University of Science & Technology. Sorensen holds 2 granted patents, 2 pending patents, and has published 25 refereed journal and conference articles pertaining to advanced motion control and human factors. Dr. Sorensen is a former NSF STEP Fellow, USAA National Collegiate Engineer, and ARCS fellowship recipient.

LITIGATION SUPPORT

Dr. Sorensen has been recognized as an expert in numerous product liability and IP disputes – both at the Federal and District court levels, as well as by the International Trade Commission, US Patent and Trademark Office, and US Customs and Border Protection. Areas of expertise in which he has provided litigation support include: automation, dynamics and controls, kinematics, machine vision, mechatronics, photogrammetry, robotics, sensors, wheeled inverted mobility systems such as Segways, tire mechanics, traction control, wheel slip, vibrations, and warnings.

EDUCATION

Doctor of Philosophy – Mechanical Engineering.....2008
Georgia Institute of Technology, Atlanta, GA.

- Concentration: System Dynamics and Controls
- Thesis: Operational Performance Enhancement of Human Operated Flexible Systems
- Adviser: Dr. William Singhose
- GPA: 4.0

Master of Science – Mechanical Engineering.....2005
Georgia Institute of Technology, Atlanta, GA.

- Thesis: A Combined Feedback and Command Shaping Controller for Improving Positioning and Reducing Cable Sway in Cranes
- Adviser: Dr. William Singhose
- GPA: 4.0

Bachelor of Science – Mechanical Engineering.....2002
Walla Walla University, College Place, WA.

- Summa Cum Laude
- Senior Project: Design of a Low Head-Loss Vane Pump
- GPA: 3.94

Associates of Science – Engineering.....1999
Southern Adventist University, Collegedale, TN.

- Magna Cum Laude
- GPA: 3.9

EXPERT WITNESS TESTIFYING ACTIVITIES

TESTIFY AT DEPOSITION OR TRIAL IN THE LAST 4 YEARS

Bissell v. Tineco ..... Mar 2022 – Dec 2022
Firm: Quinn Emanuel Urquhart & Sullivan LLP
Type: Patent / IPR
Number: 337-TA-1304
Work Product: Document Review & Consulting; Infringement & Validity Reports; Construction Declaration; Deposition & Trial Testimony.
Roll: Opined on Mechatronics Issues Related to Wet/Dry Vacuum Technology, Infringement, Validity, DI, Secondary Considerations.

Opex v. HC Robotics ..... Dec 2021 – Dec 2022
Firm: Desmarais LLP
Type: Patent / IPR
Number: 337-TA-1293
Work Product: Document Review & Consulting. Infringement Report; Deposition & Trial Testimony.
Roll: Opined on Automated Storage & Retrieval Systems, Infringement, and DI.

iRobot v. SharkNinja ..... Apr 2021 – Jan 2021
Firm: Gibson, Dunn & Crutcher LLP
Type: Patent / IPR
Number: 337-TA-1252
Work Product: Expert Report, Rebuttal Report, Deposition, Trial Testimony.
Roll: Opined on Mechatronics Issues Related to Autonomous Robot Vacuums, Validity, Infringement, and DI.

Bishop v. DeLaval ..... Nov 2020 – Nov 2021
Firm: Stueve Siegel Hanson LLP
Type: Contract
Number: 5:19-cv-06129 (District Court, Western District of Missouri)
Work Product: Expert Report (Functional Requirements Analysis, and Product Defects), Deposition.
Roll: Opined on Issues Related to the Mechatronics and Functionality of Automated Milking Systems.

Usewick v. Smugglers' Notch ..... May 2019 – Oct 2019
Firm: Clark, Werner & Flynn, PC
Type: Product Liability
Number: 5:18-cv-120 (District Court, District of Vermont)
Work Product: Expert Report (Failure Mode, Hazard, Training, Warning Analyses), Deposition.
Roll: Opined on Segway, Controls, Mechatronics, and Warnings Issues.

Wirtgen v. Caterpillar ..... Jan 2019 – Jun 2019
Firm: Finnegan, Henderson, Farabow, Garrett & Dunner, LLP
Type: Patent / IPR
Number: IPR2018-01200
Work Product: Two Declarations on Validity and Claim Amendments, Two Depositions.
Roll: Opined on Controls and Mechatronics Issues and Validity.

INDUSTRY ACTIVITIES

FOUNDER & CHIEF TECHNOLOGY OFFICER
Finity Engineering, Walla Walla, WA ..... 2020 – Present

Duties & Responsibilities:

- Lead teams of highly accomplished experts with substantial industrial automation, mechatronic, robotics, and consumer-product experience, together with leading researchers at top engineering universities to provide design, analysis, consulting, and litigation support services.
- Respond to strategic RFPs and RFIs.

Key Highlights:
Oversight and execution of fundamental and applied research efforts within the fields of dynamics, vibration, and controls with application to haptic motors. These efforts resulted in the development of novel haptic actuators, and new characterization, modeling, and control techniques with broad application to consumer mobile devices and wearables. Development and extensive use of forensic analysis software for industrial and construction crane accidents. Design methodology analyses for high-value mechatronic systems including a $30M warehouse automation system, and automatic milking machines at issue in a class action resulting in a $55M settlement. Design support for the largest NOG-1 crane manipulator in the world with ultra-precise position/orientation capabilities.

CHIEF TECHNOLOGY OFFICER & ENGINEERING FELLOW
PaR Systems, Shoreview, MN ..... 2013 – 2020

Duties & Responsibilities:

- Position PaR as a technical leader by facilitating the development, testing, and implementation of next-generation motion control technology. Direct R&D efforts and budgets.
- Identify and adopt emerging technologies important to advancing PaR's technical capabilities.
- Identify and execute strategic technology partnerships.
- Oversee projects with critical technical content or risk. Identify and mitigate areas of technical risk.
- Strengthen PaR's offerings by implementing new product features and capabilities, evaluating products critically and facilitating improvements.
- Disseminate and facilitate the use of best-practice engineering methodologies to deliver best-in-class solutions.
- Respond to strategic RFPs and RFIs.
- Facilitate identification, prosecution, and management of intellectual property.

Key Highlights:
Developed first-in-class motion technology presently deployed on over 500 cranes and industrial robots throughout the world in automotive, primary metals, heavy equipment, aerospace, print, nuclear, and other industries. Directed development of largest NOG-1 crane manipulator in the world with ultra-precise position/orientation capabilities. Oversight and execution of critical R&D projects including: novel remote manipulator for nuclear environments, morphing algorithms for adaptive manufacturing, pendant-embedded anti-sway product, 2D and 3D custom machine vision systems for robust localization and real-time tracking in unstructured environments. Developed strategic partnerships with industry leaders for co-development of novel motion products. Developed and implemented guidelines for managing and protecting IP.

CO-FOUNDER & CHIEF TECHNOLOGY OFFICER
CAMotion Cranes, Atlanta, GA..... 2008 – 2013

Duties & Responsibilities:

- Development of next-generation motion control algorithms.
- Business development and development of strategic partnerships.
- Oversee and develop advanced control techniques for the motion and user performance of industrial material-handling machines.
- Product development.

- Implement, test, and debug control strategies on industrial hardware platforms.
- Conduct control theory learning sessions for company personnel.

Key Highlights:
Chief architect and developer of world-class motion control technologies now widely used and recognized throughout select industries: Expertoperator™, Safemove™, Automove™, and Cranevision™. Developed state-of-the art trajectory synthesis method that simultaneously satisfies geometric, kinematic, oscillatory, and time-optimality constraints. These technologies were of paramount importance in the 2013 acquisition of CAMotion Cranes by PaR Systems. These technologies also facilitated the development of two disruptive technology products: the CAMotion Log Depalletizer (LDP) and Expertoperator-plus (EOP) crane control system.

CRANE CONTROL SPECIALIST
Georgia Tech Sponsored Project at Logan Aluminum, Russellville, KY. ..... *2007 – 2008*

Project: ***Crane Manipulation System Development and Installation.***

Duties & Responsibilities:
- Integrate state-of-the-art technologies in machine vision, range sensing, oscillation suppression, positioning capabilities, and interface design into a unified crane manipulation system.
- Implement motion algorithms on a PLC-based automation platform.
- Develop interface software for communication between system components.
- Install system on 30-ton and 35-ton industrial bridge cranes.

Key Highlights:
Two industrial cranes at Logan Aluminum have been equipped with the developed crane manipulation system (CMS). This technology permits operators to drive the cranes in a swing-free manner, and simplifies precise positioning tasks. Beneficial attributes of the CMS-enabled cranes include increased safety and efficiency. Through facilitating the development of the CMS from concept, to design, to product, and finally to installation, I have gained a working competence in both control theory and automation mechatronics.

PROJECT ENGINEER
CH2M-Hill Hanford Group, Richland, WA..... *2003*

Project: ***Design of a Waste Packaging System for Hanford Transuranic Sludge Waste.***

Duties & Responsibilities:
- Collaborate with Pacific Northwest National Laboratory to obtain rheological and nuclear properties of transuranic waste.
- Develop dynamic model of transuranic slurry flow.
- Determine anticipated cesium concentration in residual waste streams.
- Determine critical transport velocities and corresponding waste dilution factors to insure fully suspended and transportable flow.

Key Highlights:
My efforts were directed at developing nuclear cleanup technologies for Hanford waste. This work was motivated by the need to accelerate tank waste cleanup for the purpose of quickly reducing environmental and human risk. My results were instrumental in producing two Hanford documents: The *Procurement Specification for CH-TRU Packaging Unit and Support Equipment*, and the *Interface Control Document for the TRU Waste Retrieval Systems and the Contact Handling Waste Packaging Subsystem*. This work represents my first involvement with industry after obtaining my undergraduate degree in mechanical engineering. It provided me with a level of competence at using fundamental engineering knowledge to solve unscripted and open-ended problems.

Project: ***Design of a Bulk Vitrification System for Hanford Salt-Cake Waste.***

Duties & Responsibilities:

- Develop conceptual design for the bulk vitrification demonstration facility.
- Collaborate with Pacific Northwest National Laboratory to identify toxic byproducts of vitrification process.
- Conduct a land survey for location of the demonstration facility.
- Author the Procurement Specification for the Demonstration Bulk Vitrification System.

Key Highlights:

While at Hanford, I assisted in the development of new bulk vitrification technology. Bulk vitrification allows for the glassification of waste inside a container suitable for land disposal. I authored the *Procurement Specification for the Demonstration Bulk Vitrification System*. The document communicates the functional, performance, interface, and system design requirements for the vitrification facility. The facility was used as a forum for enhanced testing capability, including the capability to test waste processing under radioactive conditions. This work provided me with greater understanding and appreciation for highly complex, multi-disciplinary projects that involve collaboration across industry partners, national laboratories, and governmental agencies.

SELECT RESEARCH ACTIVITIES

DYNAMICS & CONTROL OF LRAS FOR HAPTIC FORCE GENERATION

Google, Mountain View, CA ..... 2019 – Present

Fundamental Research Question:
Can Haptic Force Generation be Enhanced Through Improved Modeling and Control?

Activities:

- Developed novel haptic actuators capable of broad-spectrum resonance.
- Authored the *LRA Handbook of Modeling and Control* to support ongoing LRA research within Google.
- Developed multi-mode linear and nonlinear models of LRAs.
- Developed an LRA characterization framework and testing protocol.
- Developed novel haptic effects that exhibit force profiles that cannot be produced by standard haptic libraries.
- Developed software framework to facilitate rapid haptic profile development and testing.

Outcome and Value:
The range and diversity of appreciable forces generated by LRAs is extended. Billions of smart phones, smart watches, and other consumer devices that use LRAs can be enhanced.

ADAPTIVE MANUFACTURING

PaR Systems, Shoreview, MN ..... 2018 – 2019

Fundamental Research Question:
Can CAD-to-CAM Processes be Adapted for In-situ Parts that Diverge from CAD Models?

Activities:

- Developed methodology for morphing nominal CAD and machining data to in-situ parts.
- Developed and implemented computationally efficient software framework for executing morphing methodology.
- Oversaw proof-of-concept testing, and conversion of methodology into production solution.

Outcome and Value:
This R&D effort resulted in the development of state-of-the art adaptive manufacturing software. The capabilities of which are both pragmatic and unique, providing a significant technical differentiator for PaR Systems. A patent for this technology is currently pending.

AUGMENTED TELE-MANIPULATION

PaR Systems, Shoreview, MN ..... 2018 – Present

Fundamental Research Question:
Can Legacy Commercial Manual Tele-Manipulators be Augmented with Advanced Robotic Control Capabilities?

Activities:

- Oversaw development of electro-mechanical interface for legacy commercial manual tele-manipulators.
- Oversaw development of new kinematic/inverse kinematic and simulation models supporting effort.
- Directed prototyping efforts, algorithm development and implementation.

Outcome and Value:
Legacy manual tele-manipulators are prevalent within nuclear waste-stream processing facilities. This technology is facing obsolescence and supportability challenges that will significantly impact critical processes. Advanced robotic augmentation of these systems will enhance productivity, ergonomics, and ease-of-use, while also extending the serviceable life of these systems.

3D MACHINE VISION FOR ROBUST SEGMENTATION AND LOCALIZATION
PaR Systems, Shoreview, MN .....2017 – 2018

Fundamental Research Question:
Can 3D machine vision data be used to provide robust segmentation and localization of LDP payloads?

Activities:
- Developed robust segmentation and localization algorithms based on raw point-cloud data.
- Oversaw development and implementation of capabilities into production firmware.

Outcome and Value:
This R&D effort significantly enhanced the robustness of the LDP for identifying product in unstructured environments. Deploying this product enhancement resulted greater productivity and end-user satisfaction. The development was also a key driver in numerous after-market sales.

ON-LINE TIME-OPTIMAL TRAJECTORY SYNTHESIS FOR FLEXIBLE MACHINES
CAMotion Cranes, Atlanta, GA.....2011 – 2013

Fundamental Research Question:
Can time-optimal rest-to-rest trajectories for highly flexible robots be generated on-line?

Activities:
- Developed constraint framework for defining generalized spatial trajectories with obstacle avoidance.
- Incorporated ongoing developments in Command Shaping theory into constraint framework to account for flexible dynamics.
- Derived and implemented computationally efficient solution methodology.
- Investigated computational cost of solution method.

Outcome and Value:
This disruptive technology served as a keystone differentiator between the company's robotic solutions and conventional robotic automation products. The technology significantly reduces implementation costs of robotic material handling systems by 1) reducing integration time, and 2) increasing the available throughput of a given robot.

PRAGMATIC ROBUST-COMMAND SHAPING FOR INDUSTRIAL MACHINES
CAMotion Cranes, Atlanta, GA.....2008 – 2010

Fundamental Research Question:
Can robust command shaping be used to control flexible machines without detrimental latency and time-consuming frequency characterization?

Activities:
- Developed framework for defining command shaping constraint sets that are subsequently used for deriving time-optimal and robust command shapers.
- Architected numeric optimization algorithm for generating time-optimal and robust command shapers.

Outcome and Value:
The outcome of this effort resulted in the creation of a class of robust command shapers for industrial cranes and large Cartesian robots that have subsequently been deployed on hundreds of flexible machines throughout the world. This family of command shaping filters is unique in the field of flexible machine control. They represent a significant improvement in robustness and latency compared to conventional command-shaping filters. Furthermore, this research resulted in the creation of a development framework with which flexible machines not considered here can benefit. This technology has been the cornerstone of the Expertoperator™ product – a world-class crane control platform that has yet to be surpassed in terms of performance.

WORKSPACE-ACCESSIBLE COLLISION AVOIDANCE FOR HUMAN OPERATED CRANES
CAMotion Cranes, Atlanta, GA.....2008 – 2010

Fundamental Research Question:
Can a control strategy be developed that permits operators to access the entire workspace, avoid collisions between the load and surrounding obstacles, and permits the crane to react responsively to commands?

Activities:
- Conducted market study analyzing a 20-year span of crane accident reports from the primary metal industry.
- Developed first-of-kind stacker-crane collision avoidance system incorporating 3D-physics-based collision prediction and passive velocity constraint algorithms.

Outcome and Value:
These research efforts produced the most capable collision avoidance system for stacker cranes to date. While capable of mitigating over 90% of the historical collision types present in the primary metals industry, the system also permits 100% workspace access with no detrimental kinematic restrictions on crane speed or acceleration.

NONLINEAR INPUT SHAPING
Georgia Institute of Technology, Atlanta, GA .....2005 – 2008

Fundamental Research Question:
How do hard-nonlinearities affect the performance of input-shaped systems? How can detrimental effects be mitigated?

Activities:
- Developed deconvolution analysis technique for assessing vibration-inducing attributes of arbitrary commands.
- Used developed technique to evaluate effects of hard-nonlinearities on input-shaping filters.
- Derived and implemented strategies for mitigating the detrimental effects of rate limiting, dead-zone, backlash, and saturation on input-shaped signals.
- Developed theoretical construct called the *command space* for understanding the cause and mitigation of overcurrenting on system using negative input shapers.
- Evaluated oscillatory effects of finite-state actuation on input shaping.

Outcome and Value:
These research efforts represent the first thorough investigation of input shaping in the context of hard-nonlinearities. The theoretical foundations established provide a unified framework for analyzing input-shaped systems. The ubiquitous presence of nonlinear actuation within every facet of industry precluded a large number of systems from using ordinary input shaping techniques. Thus, the direct result of this research was to tremendously enlarge the application space of input shaping. This research is the capstone of my doctoral work, and serves to fulfill a personal desire instilled during my first research encounter: to create new and pragmatic knowledge.

ROBUST FIDUCIAL TRACKING USING MACHINE VISION
Georgia Institute of Technology, Atlanta, GA .....2003 – 2007

Fundamental Research Question:
Can the state-of-the-art in machine vision be used for high-speed fiducial tracking in unstructured environments?

Activities:
- Identified sampling limitations in industrial vision systems.
- Collaborative effort mitigated sampling limitations by dynamic adjustment of acquisition pixels.
- Supervised development of dynamically parameterizable blob-selection criteria.
- Supervised development of multi-blob fiducial for obstruction mitigation.

Outcome and Value:
During the course of this project I collaborated with researchers from the Zürich University of Applied Sciences, and Industry Partner, Logan Aluminum. Our joint efforts resulted in a fiducial tracking algorithm used for sensing hook swing on industrial bridge cranes. The utility of this sensing technology is that it is robust to visual obstructions, and highly reflective environments, where ordinary machine vision techniques fail. This work exposed me to research outside my field of controls, and thus served to broaden my research horizons. It also provided me valuable industry and academic ties. This research formed foundational pillars upon which Cranevision™ was developed. Cranevision™ is a world-class crane safety system deployed on hundreds of industrial cranes at world-wide.

OPERATIONAL EFFECTS OF CRANE INTERFACE DEVICES
Georgia Institute of Technology, Atlanta, GA .....2005 – 2008

Fundamental Research Questions:
What is the influence of conventional interfaces on the operational performance of dynamically compensated cranes? In light of dynamic compensation, can a more efficient crane interface be developed?

Activities:
- Constructed cognitive operator model, and human-in-the-loop model for identifying shortcoming of conventional interface devices.
- Developed a visual human/machine interface for simplifying crane-positioning tasks.
- Developed framework to classify crane trajectories.
- Utilized framework to assess efficiency effects of developed and conventional interface devices.

Outcome and Value:
The results of these tasks were used to produce a commercially available human/machine interface for crane positioning. The technology was installed on a 35-ton crane at industry partner, Logan Aluminum. Significant efficiency advantages of the developed visual interface were demonstrated in an industrial setting. The work expanded my research experience to the field of human factors. I am more keenly aware of the issues involved with integrating automation technology with human control.

COMBINING INPUT SHAPING AND FEEDBACK CONTROL FOR INCREASING POSITIONING PRECISION ON SYSTEMS WITH FLEXIBLE DYNAMICS
Georgia Institute of Technology, Atlanta, GA .....2003 – 2005

Fundamental Research Question:
Can closed-loop input shaping be used advantageously to control a nonlinear and non-collocated system?

Activities:
- Developed analytical model of vector drive and induction motor actuation systems.
- Theoretical foundation established for quantifying effects of nonlinearities on input shaping.
- Conducted simulated and experimental stability analysis of closed-loop input shaping architecture.
- Implemented closed-loop input shaping control on 10-ton bridge crane.

Outcome and Value:
The direct result of these efforts was a control architecture enabling precise positioning, disturbance rejection, and motion-induced oscillation suppression on non-collocated systems with flexible dynamics. Significant headway was made in forming a framework for the stability analysis of shaper-in-the-loop systems. Principles were established for understanding the detrimental effects of nonlinearities on input shaping. This research resulted in a granted US patent for the control architecture. Questions arising from this research helped me to identify the scope of my Ph.D. dissertation. I also gained valuable hands-on experience in control implementation on industrial PLC's, vector drives, and induction motors.

ELIMINATING HEAD-LOSS IN HYDRAULIC VANE PUMPS
Walla Walla University, College Place, WA 2002

Fundamental Research Question:
Can the efficiency of hydraulic vane pumps be significantly increased?

Activities:

- Developed analytical and empirical models of fluid flow for commercial vane pumps.
- Identified and quantified sources of energy loss in typical pump designs.
- Mitigated head-loss through novel kinematic and geometric redesign.
- Developed analytical and empirical models in conjunction with computer simulations of new pump design to verify specification compliance.
- Performed vibration, failure, and manufacturability analyses on developed pump design.

Outcome and Value:
I was first made aware of the need for high efficiency hydraulic pumps while investigating alternatives to traditional automobile transmissions. It was from that initial exposure, and subsequent study into the subject of innovative continuously variable transmissions that prompted my examination into the development of a high-efficiency vane pump. Research findings were presented at my local ASME student chapter, as well as the ASME Region VIII Student Conference in 2003. This work constituted my first formal research project, and sparked my desire to pursue graduate school where I could be involved in other research endeavors.

TEACHING ACTIVITIES

ADJUNCT ASSOCIATE PROFESSOR & PART-TIME INSTRUCTOR
Georgia Institute of Technology, Atlanta, GA ..... 2010 – Present

Advanced Mechatronics (Graduate Course)
The focus of this course is a semester-long team project emphasizing design methodology and industrial best practices in the creation of a sophisticated mechatronic system. Systems include a variety of sensing modalities, actuators, micro controllers, and rapid prototype mechanical components. Issues of product liability, intellectual property, and safety are a part of the curriculum.

Advanced Control Design & Implementation (Graduate Course)
One objective of this course is to learn advanced control techniques such as: optimal control, tracking control, repetitive control, adaptive control, linear and nonlinear command shaping. A second objective is to implement these control technique both on simulated and real mechatronic systems.

Creative Decisions and Design (Undergraduate Course)
The objective of this course is to learn the fundamental principles of the design process. This is accomplished through lectures in a lecture hall setting, and practice through lab work. Properly learning the design process and how to use it is essential for solving unstructured and open-ended problems.

Dynamics of Rigid Bodies (Undergraduate Course)
The objective of this course is to learn kinematics and kinetics of particles and rigid bodies in one, two, and three dimensions. Topics include Particle Motion, Planar Kinematics, Newton-Euler Analysis, Angular Velocity/Accelerations in Three Dimensions, Euler Angles, Rotation Matrices, Angular Momentum, Inertia Properties, Principal Moments & Axes of Inertia, Impact/Impulse/Momentum Principles, Work-Energy Analysis of Conservative & Non-conservative Bodies.

Value
A core component of my teaching philosophy is put into practice and refined during my teaching, namely, my focus on interjecting real-world engineering practice into the class room. Pragmatically, this focus results in student application of course content onto current or recent industrial projects at CAMotion Cranes & PaR Systems.

PH.D. TEACHING PRACTICUM
Georgia Institute of Technology, Atlanta, GA .....Fall 2006

Course Instructor: Dr. Farrokh Mistree (Woodruff Zeigler Outstanding Educator 2001)
Practicum Adviser: Dr. Aldo Ferri (Roane Beard Outstanding Teacher 2008)

The teaching practicum is a formal investigation and practice of the fundamental aspects of engineering education. Grant proposal composition, student advising, course development, student evaluation, professional development, professional service, industry and academia relationships, and teaching/learning styles comprise the topical framework of the course. A knowledge base of these subjects is obtained through class lectures and discussion, then pragmatic/experiential knowledge is gained though collaborative involvement with a sponsoring Adviser.

During the teaching practicum, I collaborated with Dr. Alto Ferri for the course ME 2016 – Computing Techniques. I selected a partnership with Dr. Ferri because he possesses an extraordinary ability for imparting knowledge, and personal responsibility to his students. Dr. Ferri imbues his students with personal ownership for one's own learning. Personal ownership fosters disciplined academic behavior. He is also able to impart a depth and breadth of subject matter that is cohesive, thorough, and inextricably linked with prior knowledge. The keystone of his teaching ability is scrupulous organization that serves students in two ways; first, by helping them to connect new information with prior knowledge; and second, by demonstrating good dissemination practices.

Value
I worked closely with Dr. Ferri during the semester to plan course content, create new lecture material, and

prepare and present class lectures. The value of conducting these activities in collaboration with Dr. Ferri is that I obtained pragmatic knowledge of engineering education that was shaped by expert oversight.

NSF STUDENT & TEACHER ENHANCEMENT PARTNERSHIP FELLOW
Marietta High School, Marietta, GA .....2005 – 2006

The Student and Teacher Enhancement Partnership (STEP) program seeks to improve mathematics and science performance of Atlanta-area high school students, while at the same time enhancing the teaching-related communication and leadership skills of Georgia Tech students. This is accomplished by partnering Georgia Tech students who possess scholarly expertise with partner high schools.

As a STEP fellow, I participated in training workshops covering learning pedagogy, classroom management, and learning/lecturing styles. During the 2005-2006 academic year, I collaborated with math and science teachers at Marietta High School to develop lecture material, conduct student instruction, mentoring, and tours of Georgia Tech facilities. I also instituted an after-school engineering club where participants learned about fundamental engineering principles through activity-based team projects and competitions. 15-20 students regularly attended the weekly club events.

Value
A key element of my teaching ability was refined during this experience. I developed my ability to assess the initial knowledge state of my students. This is a critical step toward a principal goal of imparting knowledge in a manner that is connected to prior knowledge. I also became more clearly aware of the distinction between teaching students information, and teaching students how to learn.

GRADUATE TEACHING ASSISTANT
Georgia Institute of Technology, Atlanta, GA .....Fall 2003

System Dynamics and Controls (ME 3015)
Dr. Aldo Ferri (Roane Beard Outstanding Teacher 2008)
My principal responsibility as a teaching assistant was to provide out-of-class tutoring to students. I also developed and delivered in-class lectures, and graded homework assignments.

Value
As a tutor, I assisted students in a one-on-one, or small-group setting. These opportunities allowed me to better understand the difficulties some students face when learning challenging material. I learned that difficult material is more easily assimilated when it is presented in its greater context. This means that both the utility and objective of using the material should be communicated.

DIRECTOR OF ROCK CLIMBING & BACKPACKING PROGRAMS
Glacier View Ranch, Ward, CO .....1998 – 2002

As the director of the rock climbing and backpacking programs at Glacier View Ranch, my principal responsibility was to teach rock climbing and backpacking skills to course participants. During my five three-month summer terms between 1998 and 2002, I taught 20 1-week courses to approximately 300 participants ranging in age from 10 to 18 years old. The programs were activity-based, and involved backpacking and rock climbing expeditions in the mountains of Colorado. My other responsibilities included training and supervising assistants, ensuring compliance with the American Camping Association, and managing inventories.

Value
As a director of high-risk activities for adolescent and teenage youth, I have assumed weighty responsibilities for participant safety, while at the same time facilitating an exciting and challenging learning environment. This endeavor required a clear vision of course objectives and educated foresight of potential risk in order to provide an enjoyable and safe learning experience. Conducting these activity-based lessons forged my abilities to communicate, manage personnel, achieve objectives, and teach, while assuming the tremendous responsibility of ensuring safety.

ADVISING ACTIVITIES

INTERNATIONAL BACHELORS THESIS STUDENTS

Christoph Staheli	*Fiducial Tracking in Presence of Parametric Noise*	2004
Rolf Weiss	*Multi-Dot Fiducial Positioning Algorithm*	2005
Stefan Locher	*STL to SCL Crane Controller Transition*	2006
Jurg Suter	*Mobic Touch Screen Crane Interface*	2006
Johannes Fisch	*Robust Fiducial Tracking Algorithm*	2007
Philipp Andersch	*R-Analysis of Hard-nonlinearities on Input Shapers*	2007 – 2008
Martin Utz	*Virtual Safety Walls for Cartesian Robots*	2008
Martin Schibli	*Testing of a Siemens Embedded Controller*	2009

UNDERGRADUATE STUDENTS

April Pritchard	*Nonlinear Crane Drive Identification*	2004
Terry Hall	*Touch Screen Interface Accuracy Evaluation*	2005
Jonathan Fonseca	*Crane Operator Experiments*	2006 – 2007
Joshua Spiers	*Crane Operator Experiments, Effects of Backlash*	2006 – 2007
Brandon Terrell	*Detrimental Effects of Saturation on Input Shaping*	2007
Animesh Aga	*3D Crane Simulation*	2007
Vig Kalyanasundaram	*3D Bridge Crane Simulation*	2007
Aayush Daftari	*Command Space Experiments for UMZV Shaping*	2007 – 2008
Paul Jurek	*Obstacle Avoidance for Cartesian Robots*	2009

GRADUATE STUDENTS

Patrick (Will) Cross	*Effects of Dead-Zone on Input Shaping*	2006
Shashvat Prakash	*Effects of Dead-Zone on Input Shaping*	2006
Sebastian Sachse	*Graphical Interface for Commanding Crane Motion*	2008
James Potter	*Trajectory Generation for Cartesian Robots*	2009
Chen (Kelvin) Peng	*Robust Input Shapers for Cranes*	2010
Ehsan Maleki	*Control of Human-Operated Machinery with Flexible Dynamics (PhD Thesis)*	2013
Yashdeep Narkhede	*Polygon Offsetting & Crane Automation*	2015
Christopher Adams	*Modeling and Control of Backdrivable Flexible Systems (PhD Thesis)*	2017
Arnoldo Castro	*Control of a Two Wheeled Inverted Pendulum Transporter (PhD Thesis)*	2019
Henry Luk	*Survey of Haptic Control & Actuators*	2020
Alison Jenkins	*Human Factors in Haptics*	2020 – 2021
Colin Lyman	*Dynamics and Control of Haptic Motors*	2020
Joo-Won Kang	*Dynamics and Control of Haptic Motors*	2020
Ryan Schmidt	*Modeling of Linear Resonance Actuators*	2020 – 2021
Tyler Rome	*Discrete Input Shaping*	2021– 2022

PUBLICATIONS ARISING FROM COLLABORATION

Numerous refereed publications have been produced from these collaborative efforts. These publications are included in the *Publications* section of this document.

PUBLICATIONS

REFEREED JOURNAL ARTICLES

W. Singhose, J. Lawrence, **K. Sorensen**, and D. Kim, "Applications and Educational Uses of Crane Oscillation Control," *FME Transactions*, vol. 34, pp. 175-183, 2006.

K. L. Sorensen, W. E. Singhose, and S. Dickerson, "A Controller Enabling Precise Positioning and Sway Reduction in Bridge and Gantry Cranes," *Control Engineering Practice*, vol. 15, pp. 825-837, 2007.

J. R. Huey, **K. L. Sorensen**, and W. E. Singhose, "Useful Applications of Closed-Loop Signal Shaping Controllers," *Control Engineering Practice*, vol. 16, pp. 836-846, 2008.

K. L. Sorensen and W. E. Singhose, "Command-Induced Vibration Analysis Using Input Shaping Principles," *Automatica*, vol. 44, pp. 2392-2397, 2008.

K. L. Sorensen, A. Daftari, W. E. Singhose, and K. Hekman, "Negative Input Shaping: Eliminating Overcurrenting & Maximizing the Command Space," *ASME Journal of Dynamic Systems, Measurement, and Control*, vol. 130, pp. 0610121-0610127, 2008.

K. L. Sorensen, K. Hekman, and W. E. Singhose, "Finite-State Input Shaping," *IEEE Transactions on Control Systems Technology,* vol. 18, pp. 664-672, 2010.

K. L. Sorensen, P. W. Cross, W. E. Singhose, S. Prakash, "Vibration Analysis and Mitigation of Dead-Zone on Systems Using Two-Impulse Zero Vibration Input Shaping," *ASME Journal of Computational and Nonlinear Dynamics*. vol. 6, pp. 011011-1-7, 2011

K. L. Sorensen, J. Danielson, S. Dickerson, W. E. Singhose, H. Fisch, and U. Glauser, "An Industrial Bridge Crane Manipulation System with Multiple Human Interfaces," *International Journal of Control, Automation, and Systems*. (Submitted).

K. L. Sorensen, R. Schmidt, A. Jenkins, C. Lyman, W. Singhose, F. Schlagenhauf, and K. Dobson, "Eletromagnetic Model of Linear Resonant Actuators," *ASME Journal of Dynamic Systems, Measurement, and Control*. (Accepted).

REFEREED CONFERENCE PROCEEDINGS

K. Sorensen, W. Singhose, and S. Dickerson, "A Controller Enabling Precise Positioning and Sway Reduction in Cranes With On-Off Actuation," Proceedings of the *16th IFAC World Congress*, Vol. 16-1, Prague, 2005.

K. Hekman, C. Staheli, **K. Sorensen**, and W. Singhose, "Measuring Crane Payload Swing Angle Through Computer Vision," Proceedings of the *International Symposium on Flexible Automation*, Osaka, Japan, 2006.

W. Singhose and **K. Sorensen**, "Manipulation of Flexible Space Structures: Effects of Command Shaping and Human Interfaces," *ICRA Workshop on Space Robotics*, Rome, Italy, 2007.

K. Sorensen and W. Singhose, "Oscillatory Effects of Common Hard Nonlinearities on Systems Using Two-Impulse ZV Input Shaping," Proceedings of the *American Control Conference*, pp. 5539-5544, New York City, NY, 2007.

K. L. Sorensen, J. B. Spiers, and W. E. Singhose, "Operational Effects of Crane Interface Devices," Proceedings of the *2nd IEEE Conference on Industrial Electronics and Applications*, pp. 1073-1078, Harbin, China, 2007.

J. Suter, D. Kim, W. Singhose, **K. Sorensen**, and U. Glauser, "Integrating A Wireless Touchscreen Into A Bridge Crane Control System," Proceedings of the *IEEE/ASME International Conference on Advanced Intelligent Mechatronics*, pp. 1-6, Zürich, Switzerland, 2007.

K. L. Sorensen, P. W. Cross, W. E. Singhose, and S. Prakash, "Analysis and Mitigation of Dead-Zone Effects on Systems Using Two-Impulse ZV Input Shaping," Proceedings of the *ASME IDETC/CIE 6th International Conference on Multibody Systems, Nonlinear Dynamics, and Control*, Las Vegas, USA, 2007. DETC2007-35592.

P. Andersch, **K. Sorensen**, and W. E. Singhose, "Effects of Rate Limiting on Common Input Shaping Filters," Proceedings of the *10th WSEAS International Conference on Automatic Control, Modelling and Simulation*, Istanbul, Turkey, 2008.

K. Sorensen, H. Fisch, S. Dickerson, W. Singhose, and U. Glauser, "A Multi-Operational-Mode Anti-Sway & Positioning Control for an Industrial Bridge Crane," Proceedings of the *17th IFAC World Congress*, Seoul, Korea, 2008.

K. L. Sorensen, J. Danielson, and W. E. Singhose, "Anti-Sway and Positioning Control for an Industrial Bridge Crane with Multi-Mode Dynamics," Proceedings of the *International Symposium on Flexible Automation*, Atlanta, GA, USA, 2008.

J.J. Potter, **K. L. Sorensen**, and W. E. Singhose, "Efficient Method for Generating Pick-and-Place Trajectory over Obstacles," Proceedings of the *IASTED Technology Conferences*, Cambridge, MA, USA, 2010.

K.C.C Peng, **K. L. Sorensen**, W. E. Singhose, and J. Danielson, "Sway Control of a Relay-Driven Crane with Asymmetrical Acceleration and Deceleration," Proceedings of the *IASTED Technology Conferences*, Cambridge, MA, USA, 2010.

A. Castro, W. Singhose, X. Liu, **K. Sorensen**, and E. C. Kwak, "Modeling and Experimental Testing of Hoverboard Dynamic Behavior," Proceedings of the *ASME Dynamic Systems and Control Conference*, Tysons Corner, VA, USA, 2017.

K. Sorensen, W. Singhose, "Wheeled Inverted Pendulum Control and Slip Dynamics," Proceedings of the *IEEE International Conference on Control and Automation*, Anchorage, AK, USA, 2018.

M. J. Kim, **K. Sorensen**, "Comparison of Coulomb and Brush Tire Models for Characterizing Tractive Force in WIP Systems," Proceedings of the *IEEE International Conference on Control and Automation*, Anchorage, AK, USA, 2018.

F. Schlagenhauf, W. Singhose, **K. Sorensen**, K. Dobson "Command-Shaping Control of Linear Resonant Actuators for Haptic Force Generation," Proceedings of the *21st IFAC World Congress*, Berlin, Germany, 2020.

T. Rome, W. Singhose, K. Dobson, **K. Sorensen**, F. Schlagenhauf, J. Kang "Impact of Input Shaper Discretization on Linear Resonant Actuators for Haptic Feedback," Proceedings of the *IEEE International Symposium on Industrial Electronics*, Anchorage, Alaska, 2022.

REFEREED INDUSTRIAL CONFERENCE PROCEEDINGS

K. Sorensen, "Expert Operator Control for Increasing Safety, Productivity, and Operability of Cranes," *AISTech Conference Proceedings*, Atlanta, GA, USA, 2012.

K. Sorensen, "Snagging Incidents and Prevention for EOT Cranes – A Case Study," *AISTech Conference Proceedings*, Cleveland, OH, USA, 2020. (Accepted).

PATENTS

K. L. Sorensen, W. Singhose, and S. Dickerson, "Combined Feedback and Command Shaping Controller for Multistate Control with Application to Improving Positioning and Reducing Cable Sway in Cranes," International Patent No. WO/2006/115912, 2006.

K. L. Sorensen, W. Singhose, "Crane Motion Control," US Patent No. 9,776,838, 2017.

K. Sorensen, M. Adam, C. Miles, B. Halonen, "Sway Mitigation for Material Handling," US Application 16/088385, 2021.

THESES

K. L. Sorensen, "A Combined Feedback and Command Shaping Controller for Improving Positioning and Reducing Cable Sway in Cranes," *Woodruff School of Mechanical Engineering*, Masters Thesis. Atlanta: Georgia Institute of Technology, 2005.

K. L. Sorensen, "Operational Performance Enhancement of Human Operated Flexible Systems," *Woodruff School of Mechanical Engineering*, PhD. Thesis. Atlanta: Georgia Institute of Technology, 2008.

JOURNAL PEER REVIEW

Mechatronics. A Journal of the International Federation of Automatic Control (IFAC).

International Journal of Control, Automation, and Systems.

Robotics and Automation Letters. A Journal of the IEEE Robotics & Automation Society.

Control Theory & Applications. A Journal of the Institution of Engineering and Technology (IET).

Journal of Dynamic Systems, Measurement, and Control. A Journal of the ASME.

Transactions on Mechatronics. A Journal of IEEE & ASME.

Transactions on Human-Machine Systems. A Journal of IEEE.

Journal of Measurement. A Journal of the Int. Measurement Confederation (IMEKO).

Journal of Engineering Science and Technology.

Engineering Science and Technology, an International Journal.

Soil and Tillage Research, an International Journal.

CONFERENCE PEER REVIEW

Asian Control Conference

IEEE/ASME International Conference on Advanced Intelligent Mechatronics.

IEEE International Conference on Robotics and Automation.

AACC American Control Conference.

IASTED Conference on Intelligent Systems and Control.

ASME Conference on Engineering Systems Design and Analysis.

CONFERENCE SESSION CHAIR

Session Co-Chair. “Industrial Control Systems,” *IEEE International Conference on Control and Automation*, Anchorage, AL, USA, 2018.

SCHOLARSHIPS, FELLOWSHIPS, AWARDS, & HONORS

Effective Teacher Commendation 2020
- Woodruff School of Mechanical Engineering Annual Teaching Evaluation.
- Received Effective Teacher Ratings of 4.6 and 4.5. Scores are "very good and above average for GWW School instructors overall."

Interviewed Contributor for *Hoist* Magazine 2019
- Contributed technical and industry insights for the article "Sway Away", June 19, 2019.
- Article featured Expertoperator™ anti-sway technology.

Named One of 125 SAU Alumni Who Made a Difference in the World 2017
- Featured Alumnus in *Columns*, the magazine of Southern Adventist University.
- Named one of 125 alumni who made a difference in the world since schools inception in 1892.

Effective Teacher Commendation 2017
- Woodruff School of Mechanical Engineering Annual Teaching Evaluation.
- Received Effective Teacher Rating of 4.76. Score is "very good and well above average for GWW School instructors overall."

Featured Alumnus in *By Design*, a publication of the Walla Walla University School of Engineering 2014
- Article "Sorensen Advances Industrial Crane Technology Throughout the World."

Control Engineering Practice Most Cited List 2012
- 2nd Most Cited Between 2007 – 2012 for Article Entitled *A Controller Enabling Precise Positioning and Sway Reduction in Bridge and Gantry Cranes.*

AIST Certificate of Recognition 2012
- In appreciation for the presentation entitled Expert Operator Control for Increasing Safety, Productivity, and Operability of Cranes.

ARCS Foundation Scholar 2007
- Recognition of contributions to the advancement of science and technology.
- $6K per year – renewable.

IEEE Conference on Industrial Electronics & Applications. Best Paper Finalist 2007
- Top 5 papers selected as finalists from over 1000 submissions.

NSF Student & Teacher Enhancement Partnership (STEP) Fellow 2006
- Selected to improve math and science performance of Atlanta-area high school.
- Facilitates student instruction, enrichment and mentoring, and teacher professional development.
- $30K/year award.

IFAC Best Application Paper 2005
- Best application papers selected from among conference submissions.
- Paper published in special issue of Control Engineering Practice for best application papers.

1st Place: Regional ASME Old Guard Oral Competition 2003
- 20 Minute technical presentation of research activities delivered.
- Judging criteria based on well-developed content, organization, delivery, effectiveness, and discussion.

USAA National Collegiate Engineering Award 2002
- Award based on academic performance, dependability, leadership, enthusiasm, dedication to self-improvement, attitude, and responsibility.
- Nominated by Walla Walla College engineering faculty.

National Dean's List 2002
- Students previously awarded "Dean's List" status eligible.
- Recognition of outstanding academic and community achievement.

Who's Who Among Students in American Universities 2002, 2003
- Service to school and community.
- Curricular and extra-curricular excellence recognized.

WWC Distinguished Dean's List 2001, 2002
- Recognition for perfect grade point average.

WWC GPA Transfer Scholarship 2000, 2001
- High GPA-based award made available to incoming transfer students.
- $2K per year – renewable.

Kenneth Schmidt Scholarship 2000, 2001
- Based on scholarship, citizenship, spirituality, and extra-curricular activities.
- $1K per year.

Youth Service Organization Scholarship 2000
- Recognition of 10-month missionary service.
- $3K per year.

SAU Calculus Sequence Award 1999
- Students who have completed Calculus I-III and Differential Equations eligible.
- Selected by math faculty.
- Student with highest grade average throughout the calculus sequence awarded.

SAU Distinguished Dean's List 1998, 1999
- Recognition for perfect grade point average.

Christian Service Volunteer Scholarship 1998 – 2002
- Recognition of charitable service conducted between academic years.
- $1K per year.

SAU Calculus I Award 1998
- Freshman Calculus I students eligible.
- Selected by math faculty.
- Top Calculus student.

SAU ACT Renewable Scholarship 1997, 1998
- High ACT-score-based award made available to incoming freshmen students.
- $3K per year – renewable.

President's Award for Educational Excellence 1997
- High grade point average.
- High achievement in national standardized tests.

USAA All-American Scholar 1996

- Exceptional academic achievement.
- Well balanced involvement with extra-curricular activities.

John Philip Sousa Band Award 1996

- Excellence in musical achievement.
- Recognizes outstanding dedication and superior musicianship.

Frederick Chopin Piano Award 1995, 1996

- Excellence in piano performance.

SPEAKING ENGAGEMENTS

Invited Talk – Overhead Crane and Hoist Innovation Virtual Conference — Oct – 2020
"Anti-Sway and Beyond: Advanced Motion Control"

Invited Course Instructor – Huazhong University of Science & Technology — Apr – 2019
Taught 1-week intensive "Mechatronics Creative Decisions & Design" course.

Invited Talk – American Society of Safety Professionals, Tuscaloosa Chapter, Tuscaloosa, AL — Nov – 2018
"Human Factors & Crane Safety"

Academic Conference – IEEE Int. Conference on Control and Automation, Anchorage, AK — Jun – 2018
"Comparison of Coulomb and Brush Tire Models for Characterizing Tractive Force in WIP Systems"

Academic Conference – IEEE Int. Conference on Control and Automation, Anchorage, AK — Jun – 2018
"Wheeled Inverted Pendulum Control and Slip Dynamics"

Invited Talk – Honda Manufacturing of America, Marysville, OH — Jun – 2018
Presentation of Safety Technologies by Designated SMEs on Crane Safety & Control

Professional Conference – Manufacturing in America Conference, Detroit, MI — Mar – 2018
"Crane Safety, Productivity, & Ease of Use with Expert Motion Technology"

Invited Talk – American Society of Safety Engineers, Alabama Chapter, Birmingham, AL — Feb – 2018
"Motion Control for Enhanced Crane Safety"

Guest Lecturer – Georgia Institute of Technology, Atlanta, GA — Feb – 2018
Advanced Mechatronics ME 6408
"Slip Dynamics & Control of Wheeled Personal Transporters"

Professional Conference – Automotive Safety Forum, Nissan, Murfreesboro, TN — Sep – 2017
"Expertoperator™: Motion Control for Safety"

Professional Conference – Manufacturing in America Conference, Detroit, MI — Mar – 2017
"Pragmatic Applications of Advanced Motion Control for Robots and Cranes"

Guest Lecturer – Georgia Institute of Technology, Atlanta, GA — Feb – 2017
Advanced Mechatronics ME 6408
"Mechatronic Considerations of Unstable Two Wheeled Personal Transporters"

Invited Talk – TVA Crane & Rigging Coordinator Conference, Chattanooga, TN — Dec – 2016
"Controls for Crane Safety"

Guest Lecturer – Georgia Institute of Technology, Atlanta, GA — Feb – 2016
Advanced Mechatronics ME 6408
"Design Methodology & Practice"

Guest Lecturer – Georgia Institute of Technology, Atlanta, GA — Feb – 2015
Advanced Mechatronics ME 6408
"Non-Collocated Control of System with Hard Nonlinearities"

Invited Talk – Robotic Ally Conference, Minneapolis, MN — Sep – 2014
"Advanced Motion Control Technology & Industrial Material Handling"

Guest Lecturer – Georgia Institute of Technology, Atlanta, GA — Jun – 2014
Creative Decisions & Design ME 2110
"Intellectual Property in Engineering"

Guest Lecturer – Georgia Institute of Technology, Atlanta, GA — Mar – 2014
Advanced Mechatronics ME 6408
"Industrial Mechatronic Design"

Guest Lecturer – Georgia Institute of Technology, Atlanta, GA — Nov – 2013
Advanced Controls and Implementation, ME 6404
"Pragmatic Control Architecture Synthesis"

Invited Talk – 20th Annual AIST Crane Symposium, Pittsburgh, PA — Jun – 2013
"Collision Protection for Industrial Cranes"

Guest Lecturer – Georgia Institute of Technology, Atlanta, GA — Feb – 2013
Advanced Controls and Implementation, ME 6404
"Position Control of Machines with Input Shaping"

Invited Talk – AISTech, Atlatna GA — May – 2012
"Expert Operator Control for Increasing Safety, Productivity, and Operability of Cranes"

Guest Lecturer – Walla Walla University, Walla Walla, WA — Nov – 2011
Introduction to Engineering
"The Design Process in Industry"

Guest Lecturer – Walla Walla University, Walla Walla, WA — Nov – 2011
Kinematics
"Multi-Mode Vibration Suppression"

Invited Talk – ASME Chapter at Georgia Institute of Technology, Atlanta, GA — Jan – 2011
"The Design Process in Industry"

Invited Talk – RIA, AIA, & MCA Joint Conference, Orlando, FL — Jan – 2011
"Advanced Control & the Role of Machine Vision"

Invited Talk – Southern Adventist University, Collegedale, TN — Jan – 2011
Engineering Convocation
"From Research to Industry – A Path to Commercialization"

Academic Conference – IASTED Technology Conference, Cambridge, MA — Nov – 2010
"Efficient Method for Generating Pick-and-Place Trajectory over Obstacles"

Guest Lecturer – Massachusetts Institute of Technology, Cambridge, MA — Nov – 2010
Graduate Level Course on Advanced Vibration Control
"Mitigating the Detrimental Effects of Rate Limiting on Command Shaping"

Invited Talk – 17th Annual AIST Crane Symposium, Pittsburgh, PA — Jun – 2010
"Advanced Control Technology for Industrial Cranes"

Invited Talk – ASME Chapter at Georgia Institute of Technology, Atlanta, GA — Feb – 2010
"From Research to Industry – A Path to Commercialization"

Guest Lecturer – Georgia Institute of Technology, Atlanta, GA — Nov – 2009
Advanced Controls and Implementation, ME 6404
"Zero-Phase Error Tracking Control"

Invited Talk – Kyung Hee University, Gyeonggi-do, Korea — Oct – 2009
"Applications and Commercialization of Crane Control Research"

Invited Talk – Korea Atomic Energy Research Institute, Daejeon, Korea — Oct – 2009
"Advanced Crane Control for Nuclear Applications"

Invited Talk – Kumoh National University of Technology, Gumi, Korea — Oct – 2009
"Applications and Commercialization of Crane Control Research"

Guest Lecturer – Georgia Institute of Technology, Atlanta, GA — Sep – 2009
Advanced Controls and Implementation, ME 6404
"Command-Induced Vibration Analysis using Input Shaping Principles"

Guest Lecturer – Georgia Institute of Technology, Atlanta, GA — Aug – 2009
Advanced Controls and Implementation, ME 6404
"Victor Diagrams for Vibration Analysis of Input Shapers"

Guest Lecturer – Georgia Institute of Technology, Atlanta, GA — Jun – 2009
Creative Decisions and Design, ME 2110
"Customer Driven Crane Control Design"

Academic Conference – Int. Symposium on Flexible Automation, Atlanta, GA — Jun – 2008
"Anti-Sway and Positioning Control for an Industrial Bridge Crane with Multi-Mode Dynamics"

Academic Conference – ASME IDETC/CIE 6th Int. Conference on Multibody Systems, Nonlinear Dynamics, and Control, Las Vegas, NV — Sep – 2007
"Analysis and Mitigation of Dead-Zone Effects on Systems Using Two-Impulse ZV Input Shaping"

Academic Conference – American Control Conference, New York City, NY — Jul – 2007
"Oscillatory Effects of Common Hard Nonlinearities on Systems Using Two-Impulse ZV Input Shaping"