# Kartik V. Sastry

**Tel**: 330-475-2494 • **Email**: ksastry3@gatech.edu • **Web**: kartik.ece.gatech.edu • U.S. Citizen


## Objective

Pursue exciting and impactful opportunities in electrical and computer engineering and science with an emphasis on optimization, control systems, embedded systems, and intelligent systems.

## Education

**Georgia Institute of Technology, Atlanta, GA**

**Ph.D. Electrical and Computer Engineering**, Expected May 2024 **GPA: 4.0**
**Dissertation:** *Smart Charging of Electric Vehicles: Algorithms, Ramifications, and Hardware Development*
**Advisors:** Professor David G. Taylor (ECE), Professor Michael J. Leamy (ME)

**M.S. Electrical and Computer Engineering (Thesis Option)**, Received Dec. 2020 **GPA: 4.0**
**Thesis:** *Minimum-Time Control of the Damped Harmonic Oscillator via Multi-Mode PWM*
**Advisor:** Professor David G. Taylor

**B.S. Computer Engineering,** Received *with Highest Honors* Dec. 2018 **GPA: 4.0**

## Skills

- **Areas of Expertise (Theory and Practice):** Optimization, Optimal Control, Machine Learning, Digital Signal Processing, Control System Design, Embedded Systems
- **Programming:** C, C++, MATLAB, Python, Java, MIPS Assembly Language, VHDL.
- **Hardware Platforms:** Texas Instruments C2000-Family and MSP430 Microcontrollers, Xilinx Artrix-7 Series FPGA's, Altera Cyclone II FPGA, ARM mbed Microcontroller
- **Tools:** OpenDSS, Altera Quartus, Xilinx Vivado, AutoCAD, Autodesk Inventor, TI Code Composer Studio, LaTeX

## Relevant Experience

**Graduate Research Assistant (GRA),** Georgia Tech School of ECE Jan. 2020 – Jun. 2023, Jan. – May 2024

**Ph.D. Work:** Smart Charging of Electric Vehicles: Algorithms, Ramifications, and Hardware Development
**Sponsors:** National Center for Sustainable Transportation, Georgia Tech Strategic Energy Institute

- Developing smart (i.e., data-driven, optimization-based) charging strategies for regulating charging of electric vehicles (EVs) in both residential and fleet settings. Strategies incorporate interests of vehicle owners (e.g., minimizing cost, maximizing use of renewable energy) as well as grid operators (e.g., minimizing peak power levels). *Simultaneous satisfaction of competing interests* is a novel aspect of this work.
- Developing tools to assess the grid impacts of mass EV charging with high fidelity, by employing physics-based grid models and Monte-Carlo simulation techniques.
- Developing a prototype smart charging system to experimentally validate and refine smart charging strategies.
- **Work products:** (listed below) Publications 1, 2, 3, 4, and 6; Presentations 1, 2, and 3; Patent 1

**M.S. Work:** Short Distance Imaging and Tactile Sensing for Robotic Grippers
**Sponsor:** Texas Instruments

- Developed firmware to interface the PGA460 Ultrasonic Transducer Driver and Signal Processor to Texas Instruments C2000 and MSP430 Microcontrollers to enable rapid data collection and experimentation.
- Designed digital control algorithms to shut down undesirable ringing that occurs after an ultrasonic transducer is excited. Studied and validated algorithms via detailed simulations accounting for actuator saturation, model parameter error, and various aspects of microcontroller influence including discrete-time control update, sensor/actuator quantization, and PWM hardware operation.
- Developed multi-mode PWM, a novel method for realizing time-optimal control signals for second-order systems.
- **Work products:** (listed below) Publications 5, 7, and 8; Presentation 4

**Instructor,** Georgia Tech School of ECE Aug. – Dec. 2023

- **ECE 4550 – Control System Design:** See course description below. Taught 42 students, i.e., delivered lectures, developed various course materials (written notes, homework, lab exercise, exams, design challenge), graded exams, supervised two GTAs. End-of-semester student feedback is available upon request. Recognized as the 2023 Outstanding Graduate Student Instructor in ECE.

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**Graduate Teaching Assistant (GTA),** Georgia Tech School of ECE — Jan. – Dec. 2019, Jun. – Aug. 2023

- **ECE 4550 – Control System Design:** senior undergraduate course (lecture + lab) that incorporates physics, mathematics, digital design, circuit theory, signals and systems, embedded systems, and programming. Held weekly office hours to assist students with theoretical and lab aspects of the course. Co-supervised two weekly lab sessions focused on programming embedded systems to perform control-related tasks. Graded weekly homework. Delivered two lectures. Recognized as the 2019 Outstanding Graduate Teaching Assistant in ECE.

**Mixed-Signal Systems Intern,** Texas Instruments – Kilby Labs — May – Aug. 2021, May – Jul. 2022

- Developed a novel, impedance-based temperature estimation method for battery cells. Outperformed existing techniques, achieving a worst-case estimation error $< 1\,^{\circ}\mathrm{C}$ over a wide temperature range ($-30\,^{\circ}\mathrm{C}$ to $55\,^{\circ}\mathrm{C}$) on a 25 Ah EV battery cell.
- Extracted predictive information from raw impedance measurements (feature engineering). Designed, trained, and validated machine learning model (polynomial regression, minimized worst-case absolute error) in MATLAB for temperature estimation.
- **Work product:** (listed below) Patent 2

**Resident Advisor**, Georgia Tech Department of Housing — Aug. 2016 – May 2020

- Ensured safety of residents during normal operation and emergency events. Supported resident needs, managed and resolved interpersonal conflicts, inspected facilities, organized and led activities to build a strong community. Mentored younger students in the position. Counseled a new supervisor in final year. Recognized as the 2018 Woodruff Student Staff Member of the Year.

**Applied Research Intern,** Georgia Tech Research Institute, ELSYS Laboratory — May – Aug. 2017

- Designed, implemented, and validated special-purpose precision delay circuit using VHDL and Xilinx Vivado Design Suite. Integrated this circuit as an I/O device with Microblaze processor IP and deployed the system on the Artix-7 FPGA. Developed firmware in C for a TCP host on the FPGA and a standalone GUI using C++ and Qt to enable users to change delay parameters in real-time. Documented design and prepared user-manual.

**Undergraduate Teaching Assistant,** Georgia Tech School of ECE — Aug. – Dec. 2017

- ECE 2031 - Digital Design Laboratory: sophomore undergraduate lab course on digital logic (theory and practice), design thinking, rapid prototyping, and FPGA-based design. Co-supervised weekly lab sessions.

**Undergraduate Intern**, University of Akron — May – Aug. 2016

- Augmented a MATLAB codebase for particle tracking to record the location of nanoscale particles in viscous fluids and compute material properties. Conducted experiments to capture the Brownian motion of nanoscale particles in polymer solutions using high-speed video microscopy and characterize the polymer solutions.

## Publications

Publications are accessible via https://kartik.ece.gatech.edu/selected-work/

1. **K. V. Sastry**, D. G. Taylor, and M. J. Leamy, "Decentralized Smart Charging of Electric Vehicles in Residential Settings: Algorithms and Predicted Grid Impact," *IEEE Transactions on Smart Grid*, 2023.
2. **K. V. Sastry**, S. Holla, S. Tater, E. Gustafson, D. G. Taylor and M. J. Leamy, "Design and Demonstration of a Smart Charging System for Plug-in Electric Vehicles," *IEEE Transportation Electrification Conference & Expo*, 2023.
3. **K. V. Sastry**, T. F. Fuller, S. Grijalva, D. G. Taylor and M. J. Leamy, "Grid-Favorable, Consumer-Centric, On/Off Smart Charging of Electric Vehicles in a Neighborhood," *VPPC 2022 – 2022 IEEE Vehicle Power and Propulsion Conference*, 2022.
4. J. Fernandez, **K. Sastry**, S. Grijalva, M. Leamy, D. Taylor, and T. Fuller, "Sequential Energy Scheduling Approach to Support Decentralized Smart Charging of Electric Vehicles," *NAPS 2022 – 54th North American Power Symposium*, 2022.
5. A. B. Balasubramanian, **K. V. Sastry**, D. P. Magee and D. G. Taylor, "Transmitter and Receiver Enhancements for Ultrasonic Distance Sensing Systems," *IEEE Sensors Journal*, 2022.
6. **K. V. Sastry**, T. F. Fuller, S. Grijalva, D. G. Taylor and M. J. Leamy, "Electric Vehicle Smart Charging to Maximize Renewable Energy Usage in a Single Residence," *IECON 2021 – 47th Annual Conference of the IEEE Industrial Electronics Society*, 2021.
7. A. B. Balasubramanian, **K. V. Sastry**, D. P. Magee and D. G. Taylor, "Time Optimal Operation of Flexural Ultrasonic Transducers For Enhanced Ranging," *IECON 2021 – 47th Annual Conference of the IEEE Industrial Electronics Society*, 2021.
8. **K. V. Sastry**, "Minimum-Time Control of the Damped Harmonic Oscillator via Multi-Mode PWM," M.S. thesis, School of Electrical and Computer Engineering, Georgia Institute of Technology, Atlanta, GA, 2020.

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## Patents

1. M. Leamy, **K. Sastry**, D. Taylor, S. Holla and S. Tater, "Electric Vehicle Smart Charging Algorithms and Hardware Prototype," *filed 2022* (pending).
2. D. Magee and **K. Sastry**, "Temperature Estimation Using Electrochemical Impedance Spectroscopy," *filed 2021* (pending).

## Presentations

Presentations are accessible via https://kartik.ece.gatech.edu/selected-work/

1. "Development and Demonstration of a Smart Charging System for Plug-in Electric Vehicles" – 2023 IEEE Transportation Electrification Conference & Expo
2. "Grid-Favorable, Consumer-Centric, On/Off Smart Charging of Electric Vehicles in a Neighborhood" – 2022 IEEE Vehicle Power and Propulsion Conference
3. "Electric Vehicle Smart Charging to Maximize Renewable Energy Usage in a Single Residence" – 47th Annual Conference of the IEEE Industrial Electronics Society
4. "Time-Optimal Control of an Ultrasonic Sensor" – 2019 Southeast Controls Conference

## Significant Projects

- **Path Planning Software for Unmanned Ground Vehicles (Capstone Design):** Developed software (C++) to perform automated path planning for unmanned ground vehicles subject to mobility constraints. Processed noisy three-dimensional point cloud data describing 500 square meters of terrain into a representative graph model. Employed the A* search algorithm to compute shortest-distance mission paths, subject to mobility constraints of the vehicle. Served as the team leader, and contributed heavily to ideation, mathematical modelling, and software development. Sponsored by Harris Corporation; advised by Prof. Erik Verriest.

- **Course Projects (Details Available Upon Request):** Machine Learning, Data and Visual Analytics, Advanced Computer Architecture, Statistical Machine Learning, Fourier Techniques and Signal Analysis, Digital Image Processing, Power System Control and Operation, Introduction to Automation and Robotics, Data Analytics for Engineers, Control System Design, Embedded System Design, Architecture Concurrency and Energy in Computation, Digital Design Laboratory

## Students Mentored

1. Shashank Holla (M.S. Electrical and Computer Engineering, 2023; now at NVIDIA)
   **Project:** Development and Testing of Software for a Smart Charging System for Plug-In Electric Vehicles
2. Shreyas Tater (M.S. Electrical and Computer Engineering, 2022; now at Apple)
   **Project:** Development and Testing of Hardware for a Smart Charging System for Plug-In Electric Vehicles
3. Eric Gustafson (B.S. Mechanical Engineering, 2024)
   **Project:** Development and Testing of an Enclosure for a Smart Charging System for Plug-In Electric Vehicles
4. Devon Boatright (B.S. Chemical and Biomolecular Engineering, 2022; now at Southern Power)
   **Project:** Modeling and Analysis of Battery Degradation During Electric Vehicle Charging

## Awards and Honors

1. 2023 Outstanding Graduate Student Instructor for ECE (GT School of ECE, Center for Teaching and Learning)
2. 2023 Travel Grant (IEEE Transportation Electrification Conference & Expo)
3. 2022 Dissertation Grant (National Center for Sustainable Transportation)
4. 2019 Outstanding Graduate Teaching Assistant for ECE (GT School of ECE, Center for Teaching and Learning)
5. 2019 Herbert P. Haley Fellowship (GT School of ECE)
6. 2019 ECE Senior Scholar Award (GT School of ECE)
7. 2018 Resident Advisor of the Year (GT Department of Housing)
8. 2016 – 2018 Faculty Honors (GT)

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## Memberships in Professional Organizations

**Institute of Electrical and Electronics Engineers (IEEE):** Power and Energy Society (PES), Computer Society (CS), Robotics and Automation Society (RAS), Vehicular Technology Society (VTS)

## Service

- (2024 - Present) Reviewer for *IEEE Transactions on Industrial Informatics* (Journal)
- (2024 - Present) Reviewer for *IEEE Transactions on Smart Grid* (Journal)
- (2023 - Present) Reviewer for *IEEE Transportation Electrification Conference (ITEC)*
- (2023) Invited Judge for HackGT
- (2022 - Present) Reviewer for *IEEE Sensors* (Journal)
- (2021 - Present) Judge for Fulton County Regional Science and Engineering Fair
- (2020 - Present) Judge for Georgia Tech Capstone Design Expo

## References

1. **Prof. David Taylor**
   Professor
   School of Electrical and Computer Engineering
   Georgia Institute of Technology
   Email: david.taylor@gatech.edu

2. **Prof. Michael Leamy**
   Professor, Director of Graduate Studies
   School of Mechanical Engineering
   Georgia Institute of Technology
   Email: michael.leamy@me.gatech.edu