Edge-AI for Secure Cyber-Physical Manufacturing Systems
University of South Carolina

Job Title	Edge-AI for Secure Cyber-Physical Manufacturing Systems
Department	Mechanical Engineering
Institution	University of South Carolina Columbia, South Carolina
Date Posted	Jun. 3, 2025
Application Deadline	Open until filled
Position Start Date	Available immediately
Job Categories	Graduate Student
Academic Field(s)	Mechatronics Mechanical Engineering Manufacturing & Quality Engineering Computer Engineering Aerospace/Aeronautical/Astronautics
Apply By Email	

Job Description

U.S. citizens are strongly encouraged to apply

The Adaptive Real-Time Systems Laboratory (ARTS-Lab) at the University of South Carolina invites applications for a fully funded Ph.D. research assistant position devoted to advancing artificial-intelligence and machine-learning methods on small, power-constrained hardware—edge AI—for real-time, in-situ manufacturing. Our group develops novel sensors for metal and polymer additive-manufacturing (AM) processes and couples them with embedded AI to detect, diagnose, and ultimately prevent defects as parts are being built. The successful candidate will help design secure sensing pipelines, craft physics-aware ML models that ingest vibration, acoustic, thermal, LiDAR, and event-

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camera streams, and deploy those models on microcontrollers, FPGAs (including side-channel-resistant and cyber-hardened implementations), and emerging neuromorphic chips. Cybersecurity is a first-class concern: you will explore lightweight encryption, anomaly detection, and trusted-execution primitives so that edge devices remain resilient against tampering and data exfiltration even in harsh industrial environments. Although the initial emphasis is on AM, the resulting secure edge-AI framework will extend to civil-infrastructure monitoring, hydrology, and geotechnical systems already studied in our lab.

We are looking for an intensely curious researcher who is comfortable straddling the physical and cyber domains—someone eager to prototype sensors, build hardware, and at the same time write efficient code, compress neural networks, and deploy reinforcement-learning controllers. A master's degree (or an exceptional bachelor's record) in mechanical, civil, electrical, computer engineering, computer science, or a related field is required, along with solid programming experience in Python plus at least one low-level language. Familiarity with topics such as time-series analysis, sensor fusion, topological data analysis, FPGA or embedded-system design, event-camera perception, neuromorphic computing, large-language-model workflows, or reinforcement learning will strengthen an application, but we do not expect any single candidate to command the entire list—we value potential and a demonstrated drive to learn.

Because the position sits at the intersection of sensing physics and AI algorithms, we ask prospective students to read several recent papers that showcase the lab's direction before applying:

- Yanzhou Fu, Austin R.J. Downey, Lang Yuan, Hung-Tien Huang, and Emmanuel A. Ogunniyi. Simulation-in-the-loop additive manufacturing for real-time structural validation and digital twin development. Additive Manufacturing, 98:104631, January 2025. doi:10.1016/j.addma.2024.104631 https://cse.sc.edu/~adowney2/publications/Journal_publications/Fu2025SimulationLoopAdditive/Fu2025
- Yanzhou Fu, Austin R.J. Downey, Lang Yuan, and Hung-Tien Huang. Real-time structural validation for material extrusion additive manufacturing. *Additive Manufacturing*, page 103409, feb 2023. doi:10.1016/j.addma.2023.103409 https://cse.sc.edu/~adowney2/publications/Journal_publications/Fu2023RealTimeStructural/Fu2023Real
- Yanzhou Fu, Matthew Whetham, Austin R. J. Downey, Lang Yuan, and Gurcan Comert. A study of online melt pool, plume, and spatter tracking in laser powder bed fusion using DBSCAN. In Christopher Niezrecki and Saman Farhangdoust, editors, Digital Twins, AI, and NDE for Industry Applications and Energy Systems 2025, page 21. SPIE, May 2025. doi:10.1117/12.3051110 - https://cse.sc.edu/~adowney2/publications/conference/Fu2025StudyOnlineMelt.pdf
- Josh McGuire, Joud N. Satme, Daniel Coble, Austin R. J. Downey, Jason Bakos, Ryan Yount, and Arion Pons. Rank reduction of LSTM models for online vibration signal compensation on

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edge computing devices. In Defense and Commercial Sensing. SPIE, May 2025 https://cse.sc.edu/~adowney2/publications/conference/McGuire2025RankReductionLstm.pdf

- Ryan Yount, Joud N. Satme, David Wamai, and Austin R. J. Downey. Edge processing for frequency identification on drone-deployed structural health monitoring sensor nodes. In Paul L. Muench, Hoa G. Nguyen, and Robert Diltz, editors, *Unmanned Systems Technology XXVI*. SPIE, June 2024. doi:10.1117/12.3013712 https://cse.sc.edu/~adowney2/publications/conference/Yount2024EdgeProcessingFrequency.pdf

If this blend of hardware prototyping, edge computing, and machine intelligence excites you, please email Prof. Austin Downey (austindowney@sc.edu) using the subject line “Edge-AI for Secure Cyber-Physical Manufacturing Systems Ph.D. Application.’’ Attach a curriculum vitae, a cover letter that explicitly connects your experiences to the themes above, unofficial transcripts, and any additional materials that strengthen your case (e.g., publications, code repositories, GRE or TOEFL/IELTS scores—optional). You will enroll in either the Mechanical Ph.D. program at USC.

ARTS-Lab values diversity of background and thought, prizes intellectual independence, and provides ample opportunities for publication, industry collaboration, and hands-on experimentation.

Contact Information

Please reference Academickeys in your cover letter when applying for or inquiring about this job announcement.

Contact Austin Downey
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