



EMBEDDED SYSTEMS
MASTER'S IN

Did you know

a modern car has as many as 100 microprocessors operating simultaneously?

- » These microprocessors take input from 200+ onboard sensors, measuring everything from tire pressure to engine temperature.
- » After analyzing these, the microprocessors control between 2,000 and 3,000 software functions.

Did you know

there are about 10 million lines of computer code in the modern automobile?

- » That is more code than in Windows XP.
- » If that code were lined up end-to-end, it would take 21 hours of driving at 60 mph to travel that distance (assuming 12pt font and 80 characters/line).
- » Consider that without that code, the trip would take considerably longer and be more dangerous.

Did you know

commercial airplanes practically fly themselves?

- » Commercial airplanes depend on a highly complex system of processors, sensors, communication buses, and feedback controllers to help takeoff, navigate, and land.
- » Modern pilots are practically programmers, controlling the plane via electronic interfaces rather than physically manipulating control devices.
- » Modern planes are capable of completely automated landings, and the functionality is increasingly used when facing poor weather or heavy turbulence.

The next generation of these systems is expected to be more intelligent, dynamic, and adaptive. Despite active research on real-time and embedded systems over the past decades, ensuring the safety of current and future real-time embedded systems remains a challenge due to their rapidly growing complexity and need to adapt to novel environments.

TRAINING

About the Master's of Science in Engineering in Embedded Systems

The cornerstone of PRECISE's educational mission is the Master's of Science in Engineering in Embedded Systems (EMBS). The EMBS degree is the first graduate program in the country giving students the specialized knowledge required to work with embedded systems. Other institutions offer coursework in embedded systems, generic electrical engineering, and computer science. However, these degrees do little to prepare students for the rapidly evolving and highly specialized CPS job market.

Curriculum

PRECISE's groundbreaking curriculum covers every aspect of CPS development, from theoretical fundamentals to state-of-the-art hardware and software technologies. For example, students will be able to design, model, and implement embedded systems using industry-standard formal methodologies – and then verify, evaluate, and deploy these systems in real-world scenarios. The core curriculum can be complemented with elective courses from computer science, computer engineering, and/or robotics.

Distinctive Qualities of the Program

EMBS enrollment is highly competitive. A small enrollment promotes a cohesive and collaborative learning environment, and allows for greater faculty involvement in student education and advising. Students are actively involved in large-scale CPS research opportunities with our world-renowned faculty. Limited financial support is available in the form of research assistantships.

Potential Employers

- » Automotive: Toyota, Honda, GM, Tesla Motors, etc.
- » Aerospace: Boeing, Lockheed Martin, etc.
- » Other: U.S. Air Force, BOSCH, NEC, Honeywell, GE, Qualcomm (and many, many more!)



FUTURE

Academic Highlights

Research Output

- » A cardiac pacemaker system model that showcases the use of formal methods for the development of high confidence and defect-free medical device software.
- » Smart-alarms and clinical decision-support systems for hospital settings. Taking medical device data as input, these systems apply machine learning to predict trends in patient health. This allows for proactive treatment and less analysis by healthcare professionals.
- » A protocol so medical devices can communicate and coordinate with one another. Consider the number of devices to which a surgery or ICU patient is connected. Taking X-rays may require some of these devices to be temporarily disabled. Our protocol does this in an automated fashion rather than relying on error-prone humans.
- » An open automotive architecture with Plug-n-Play services, enabling vehicles to be extensible, programmable, and customizable with new technology over the lifetime of the vehicle.

Class Projects

- » A virtual heart model that emulates patients' conditions in order to provide a framework for the FDA and manufacturers to test and verify pacemakers.
- » A smart-light controller which automatically modulates the light level of a room based on the number of occupants in that room. The automatic controller enabled 40 percent power savings by reducing light levels when the room was not fully utilized.
- » A "black box" (like those providing information about airline crashes) for automobiles that interfaces with automotive electronic control units to enable data acquisition and status monitoring.
- » A custom quadrotor (helicopter) that is capable of autonomous indoor flocking, search-and-rescue, and/or sensor deployment.

Application Requirements

MS in Embedded Systems – Minimum Qualifications

- » Background
 - Computer science and electrical engineering undergraduates
 - OR –
 - Practicing industry professionals
- » Solid technical background in systems design, development, and programming
- » Passionate about embedded systems topics and a desire to turn this passion into a career

MS in Embedded Systems – Required Documents

- » Official GRE scores
- » Official TOEFL score (international students)
- » Official undergraduate transcripts
- » Letters of recommendation (2)
- » Personal statement
- » Online application form

For more information:
precise@seas.upenn.edu



LEADERS