Industrial and Systems Engineering

Chair

- Yong Chen

Undergraduate major: industrial engineering (BSE)

Graduate degrees: MS in industrial engineering; PhD in industrial engineering

Faculty: https://engineering.uiowa.edu/people/ise-people

Website: https://engineering.uiowa.edu/ise

Facilities

The following facilities and laboratories are operated by faculty in the Department of Industrial and Systems Engineering and may employ undergraduate and graduate students. For information about laboratories affiliated with core courses coordinated by other College of Engineering departments, see those departmental catalog sections.

Design for Manufacturing Laboratory

The Design for Manufacturing Laboratory provides students with experience in computer-aided design and computer-aided manufacturing (CAD/CAM) systems. It is equipped with three-axis computer numerical control (CNC) mills (Haas and Tormach), a CNC metal lathe (Haas), a manual vertical mill, a manual lathe, a drill press, a plastic injection molder, band saw, disc sander, bench grinder, polishing wheel, hand drill, foot shear, and plastic 3D printers. The lab has the latest software technology, including Creo Parametric.

Driving Safety Research Institute

The Driving Safety Research Institute (DSRI) is home to the National Advanced Driving Simulator—one of the world's largest and most realistic driving simulators—as well as a fleet of on-road research vehicles and a collection of other driving simulators. For the last 30 years, the University of Iowa has conducted advanced research and development to make roads safer and move vehicle and simulation technology forward. Most importantly, DSRI serves as a place where students can learn firsthand about how innovation occurs in science and engineering.

Major areas of research include driving behavior, drowsy and distracted driving, effects of drugs on driving, connected and automated vehicle technologies and how drivers use those technologies, simulation science, and safety and crash data analytics. Faculty, staff, and students at DSRI collaborate with nearly all UI colleges in their automotive safety research, and staff researchers have a range of backgrounds from psychology, engineering, computer science, and more. Research at DSRI is funded by government agencies and industry leaders for the public and private sectors. DSRI works with undergraduate, graduate, and doctoral students in driving research studies. Many of these studies include the use of the DSRI miniSim, which offers a range of high-performance driving simulators from desktop versions to half cabs. Students are often hired to help build custom miniSims for clients around the world and can work on both the software and hardware side of development

Automated vehicle technology is revolutionizing transportation, and DSRI is at the forefront of this research. The UI was the first in the world to test a highly automated vehicle on gravel roads, all while looking to improve accessibility for people living in rural areas. Their on-road vehicles are all instrumented to collect data and are also used for researching how drivers use advanced vehicle safety features and for analyzing driving performance in novice drivers, older drivers, or those with medical conditions.

Graphical Representation of Knowledge Lab (GROK)

The GROK Lab develops technologies to help scientists and doctors improve their understanding and control of complex systems such as robots, distributed sensor networks, and augmented-reality systems. The lab designs and builds software, electronic circuits, and mechanical devices that create or modify complex systems and that extend scientists' understanding of how to make these systems perform their intended tasks better.

The lab has a variety of software development platforms and manufacturing tools, including computer numerical control (CNC) machines and supplies for casting and molding, as well as a suite of equipment for circuit design, testing, and assembly. The GROK lab has developed technologies used by NASA to control robots exploring South America and Mars. Its most recent projects have focused on using distributed wireless sensor networks to monitor factory-related health hazards and on developing surgical simulators to better train orthopedic surgeons.

Intelligent Factory Operations & Manufacturing Automation Lab (INFORMAT)

The Intelligent Factory Operations & Manufacturing Automation (INFORMAT) Lab is a cutting-edge facility dedicated to advancing research and education in smart manufacturing and automation. Envisioned as a futuristic factory and production platform, this wet-lab space integrates collaborative robotic systems, advanced manufacturing processes, state-of-the-art sensing technologies, and data analytics to enable in situ monitoring and self-correcting handling and manufacturing of novel materials. The lab provides students with hands-on learning opportunities in manufacturing, robotics, simulation, and AI applications, preparing them to address the evolving challenges of modern manufacturing industries.

Intelligent Systems Laboratory

The Intelligent Systems Laboratory conducts research in data science and computational intelligence leading to applications in manufacturing, energy, service industry, and health care. The current project focuses on smart manufacturing, digital industry, cloud and edge modeling, service manufacturing, and autonomous systems. Many of the intelligent manufacturing concepts pursued globally have originated in the laboratory. The pioneering research has been marked with the publication of the textbook *Intelligent Manufacturing Systems* (Prentice Hall) and the Journal of Intelligent Manufacturing.

Laboratory for IoT-Enabled Data Analytics and System Informatics

The lab utilizes high-performance computing workstations to model uncertainty quantifications and complex variable relationships. The aim is to develop engineering-guided statistical techniques to facilitate the interpretability, real-time monitoring, and root cause analysis of complex systems. The lab focuses on developing and applying data analytics tools to various promising areas, including advanced manufacturing systems, driver simulation and monitoring systems, and water and hydrology modeling systems. The research in the group requires algorithm development, hardware design, theoretic analysis, and simulation and emulation.

Operator Performance Laboratory

The Operator Performance Laboratory (OPL) is a flight test organization at the University of Iowa. The lab specializes in civilian and military flight testing and assessment of technologies in operational contexts, such as flight in degraded visual environments and GPS-denied environments. One area of focus is the quantification of data link and sensor performance for manned and unmanned aircraft in such an operational context. OPL develops, tests, and evaluates helmet-mounted displays (HMDs), synthetic vision systems, live virtual constructive (LVC) training systems, physiological-based workload measurement systems, pilot spatial orientation enhancement systems, and embedded flight simulation capabilities.

Unmanned aircraft operations include test flights supporting commercial unmanned aircraft systems (UAS) autonomy, 5th- and 6th-generation manned-unmanned teaming (MUMT) concepts, and the extension of LVC toward MUMT. The OPL team developed the Cognitive Assessment Tool Set (CATS), which is able to accurately quantify human cognitive workload using a flight-approved sensor package. CATS has been used in many flight tests as the data collection and analysis tool for pilot behavior in real-world flight environments. OPL pioneered the development and testing of LVC technology that blends ground-based battlespace simulations with airborne testbeds equipped with radar and weapons simulators that can employ simulated ordnance for effect in distributed simulation environments. This capability has been demonstrated many times, including at the Interservice/Industry Training Simulation Education Conference. In 2004, the OPL team developed and tested a synthetic vision system that was subsequently commercialized by Dynon Avionics under the brand name Skyview. This system has sold over 10,000 units and is flying in thousands of aircraft.

OPL has performed many flight test projects on its fleet of aircraft, exceeding a total 2,400 flight hours of developmental test and evaluation and operational test and evaluation data collection. OPL has 10 instrumented research aircraft. These include two L-29 fighter jet trainers, two MI-2 twin-turbine helicopters, one A-36 Bonanza, one Cessna 172, three TBM 3M UAS (62 lbs), and one Vapor 55 (55 lbs). The OPL L-29s are the only tactical jet research aircraft that are equipped with the F-35 HMD. The OPL MI-2 is a one-of-a-kind sensor platform with a conformal HMD using full-color symbology to show threats and obstacles acquired by its suite of onboard sensors. Each OPL aircraft is also a flight simulator. Additionally, the OPL has a Boeing 737-800 full flight deck simulator, an unmanned aerial vehicle (UAV) ground control station simulator, a fast jet simulator, and deployable command and control (C2) bus as well as a C2 high mobility multipurpose wheeled vehicle for use as a forward command node in rugged terrain. OPL has an extensive deployable telemetry infrastructure. OPL's flight support system is also deployable using mobile tool control, spares, jigs, and jacks, among other means.

Science of Next-Generation (SONG) Manufacturing Laboratory

The SONG lab focuses on the design, manufacturing, and diagnostics of extreme materials—particularly ceramics, composites, and energetics—that operate under high-temperature and high-strain-rate conditions. Their research aims to leverage novel far-from-equilibrium conditions for the assembly and manufacture of extreme materials. Their work employs multi-scale in-situ experimental tools, including high-strain-rate dynamic testing, high-speed optical imaging, and high-speed thermometry to probe processing and material dynamics under extreme conditions.