Industrial and Systems Engineering

Chair

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Undergraduate major: industrial engineering (B.S.E.)
Graduate degrees: M.S. in industrial engineering; Ph.D. in industrial engineering
Faculty: https://ise.engineering.uiowa.edu/people
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Facilities

The following facilities and laboratories are used by undergraduate and graduate students. For information about laboratories affiliated with core courses coordinated by other College of Engineering departments, see those departmental Catalog sections.

Additive Manufacturing-Integrated Product Realization Laboratory (AMPRL)

Researchers at AMPRL focus on studying how material forming processes that occur in nature can be utilized to enable next-generation additive manufacturing (AM) technologies. Current research includes the design and development of next-generation AM technologies, AM process modeling and optimization, and the advancement of novel applications of new AM technologies. The lab applies its technological developments in a diverse array of fields, including tissue engineering, sensing, energy harvesting, and robotics. The lab is furnished with state-of-the-art material preparation, processing, and characterization equipment, as well as several custom 3D printers invented and developed by the group.

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 4-axis computer numerical control (CNC) mills (Haas and Tormach), CNC router (Techno-CNC), CNC metal lathe (Haas and Techno-CNC), drill press, plastic injection molder, thermoforming machine, band saw, disc sander, bench grinder, polishing wheel, hand drill, sandblasting cabinet, press, foot shear, and welding station. The lab has the latest software technology, including Pro/ENGINEER and Rhinoceros.

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.

Information and Cognitive Systems Research Group

Research in the Information and Cognitive Systems Engineering Research Group focuses on design and analysis of cognitive work and information systems in real-world domains. Current emphasis is on cognitive work in health care systems.

The research group conducts studies in usability testing, process mapping, cognitive walkthroughs, dynamic systems simulation, and interface design, prototyping, and evaluation. The research facility houses state-of-the-art qualitative field data collection equipment and data analysis tools, programming tools for dynamic systems simulations, and design, prototyping, and usability testing hardware and software tools for interface and display design. The facility also employs data modeling tools and diagramming tools.

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 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, 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.

National Advanced Driving Simulator Laboratory (NADS)

The NADS laboratory is home to the nation’s first and largest public simulator of its kind in the world. For the last 25 years, the University of Iowa has conducted advanced research and development in support of saving lives, improving quality of life, advancing technology, and improving efficiency and productivity of the automotive and supporting industries. Most importantly, NADS serves as a place where students can

learn firsthand about how innovation occurs in science and engineering.

From drug research to automated vehicles, NADS is dedicated to engaging in a broad, holistic approach. Faculty, staff, and students at NADS collaborate with nearly all UI colleges in their automotive safety research. Human factors research at NADS is funded by government agencies and industry leaders for the public and private sectors. NADS supports undergraduate, graduate, and doctoral students in driving research studies. Many of these studies include the use of the NADS miniSimTM, a portable, high performance driving simulator based on NADS state-of-the-art driving simulation technology developed through decades of research. In-house workstations and computers equipped with software such as MATLAB, Visual Studio, R, and SAS are available to students with approved access to the facility.

Automated vehicle technology is revolutionizing transportation and mobility unlike any other technology of the past several decades. Vehicles, and their underlying technologies, are changing at a rapid pace. Many of the advanced driver assistance technologies and vehicle safety systems have been in research and development programs at the UI. The UI specializes in driver performance and behavior and how to optimally design the user interface of such systems. As vehicles become increasingly automated, the College of Engineering is leading a number of advanced research projects in automated and connected vehicles, funded by government and industry. Together with industry partners, the automated vehicles division is being built with a broad range of capabilities. These vehicles will be used to collect data for research programs funded through industry and government contracts.

Operator Performance Laboratory (OPL)

The OPL is a flight test organization at the UI. The lab specializes in civilian and military flight testing and assessment of technologies in operational contexts, such as flight in degraded visual environments (DVE) and GPS-denied environments. Quantification of data link and sensor performance for manned and unmanned aircraft in such operational context is an area of focus. OPL develops, tests, and evaluates helmet-mounted displays (HMDs), synthetic vision systems (SVS), 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 (I/ITSEC). 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 (DT&E) and operational test and evaluation (OT&E) 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 (62lbs), and one Vapor 55 (55 lbs). The OPL L-29's are the only tactical jet research aircraft that are equipped with the F-35 helmet-mounted display (HMD). The OPL MI-2 is a one-of-a-kind sensor platform with a conformal HMD using full-color symbology showing threats and obstacles acquired by its suite of onboard sensors. Each OPL aircraft also is a flight simulator. Additionally, the OPL has a Boeing 737-800 full flight deck simulator, an unmanned aerial vehicle (UAV) Ground Control Station (GCS) simulator, a fast jet simulator, and deployable command and control (C2) bus as well as a C2 high mobility multipurpose wheeled vehicle (HMMWV) for use as a forward command node in rugged terrain. OPL has an extensive telemetry infrastructure that is deployable. OPL’s flight support system also is deployable using mobile tool control, spares, jigs, and jacks, among other means.

Visual Intelligence Laboratory

The Visual Intelligence Laboratory is a research group at the Iowa Technology Institute. The lab conducts fundamental research to bridge the state-of-the-art computational geometry, vision, and machine learning technologies to real-world industrial applications such as computational human factor, autonomous driving, image-guided radiotherapy, medical image analysis, computational design and fabrication, and so on. The lab is interested in discovering new mathematical theories and algorithms allowing the description, comparison, and algebraic (de)composition of shapes and visual features. Such mathematical understanding of shapes enables computers to see and understand the world, and thus become smarter assistants to humans.

The Visual Intelligence Laboratory has a variety of imaging devices to obtain 2D/3D geometric information for various objects. The lab’s imaging capacity includes the Studio360, a state-of-the-art imaging facility comprised of over 100 digital single-lens reflex (DSLR) cameras mounted on a 20-foot diameter geodesic dome. The Studio360 can capture time-synced photos/videos of dynamic objects (e.g., a person performing a motion) from multiple perspectives and reconstruct 3D models of the objects. The lab also owns a high performance computing server, with eight NVIDIA GeForce 1080 Ti GPUs and two Intel Xeon E5 CPUs (total 48 threads), designated for massive-scale image/geometry processing and deep learning.

The lab has established a broad academic research partnership with a variety of entities across campus, including the National Advanced Driving Simulator (NADS), the Iowa Neuroscience Institute (INI), and University of Iowa Hospitals & Clinics (UIHC). In addition, the lab has been involved in a number of research projects sponsored by government and industry partners, including the U.S. Department of Transportation, the U.S. Department of Defense, Hyundai Motors, and many others.