Mechanical Engineering

Chair

- Ching-Long Lin

Undergraduate major: mechanical engineering (BSE)

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

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

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

Facilities

Undergraduate Instruction

Departmental Instructional Facilities

The Department of Mechanical Engineering maintains five laboratories for undergraduate student learning, which consist of the Advanced Manufacturing Laboratory; the Control, Automation, and Robotics Laboratory; the Engineering Manufacturing Laboratory; the Ralph and Barbara Stephens Experimental Engineering Laboratory; and two design project laboratories developed to facilitate collaboration on senior design projects and communication with project sponsors.

Advanced Manufacturing Laboratory

The Advanced Manufacturing (AM) Laboratory supports the elective mechanical engineering undergraduate course ME:4116 Manufacturing Processes Simulations and Automation. The laboratory includes a variety of machine tools and instruments for students to practice nontraditional material processes and controls. Facilities and instrumentation include a three-axis CNC laser cutter (Bodor laser), an ultrasonic metal seam welder (Branson), an ultrasonic metal spot welder (Branson), and a 25-programmable logic controller (Divelbiss). The facility uses the latest software technology, such as Abaqus, MATLAB, and EZ Ladder.

Control, Automation, and Robotics Laboratory

The Control, Automation, and Robotics (CAR) Laboratory is located in the Seamans Center for the Engineering Arts and Sciences and is managed by the Department of Mechanical Engineering. It provides students with experience in advanced control, robotics, and autonomous systems. The lab is equipped with one industrial 6-axis robotic arm, two Kuka mobile robots (KMR iiwa and KMP) with collaborative robotic arms, a desktop computer, two Roboception cameras, one co-act and one suction grippers, and four Quanser rotary servo base units. The facility has the latest software technology, such as LabVIEW and KUKA.Sim. The Quanser units are used in the laboratory assignments in ME:3600 Control of Mechanical Engineering Systems, while the robotic systems are used in ME:4140 Modern Robotics and Automation. In fall 2019, two control laboratories were developed based on two Quanser base units. The control laboratories were developed and tested in CAR and set up to accommodate a large class size. Later, two additional base units and three accessory modules were purchased to expand the control laboratories. In addition, the robotics systems are used in ME:4111 Scientific Computing and Machine Learning and ME:4150 Artificial Intelligence in Engineering to assist in the instruction of relevant course materials. The CAR laboratory also is used by students who have permission to work in the lab on honors and research projects.

Design Project Laboratories

The department also maintains two design project laboratories to support student teamwork on capstone design projects: the Design Lab and the MEDP/PEDE room. The Design Lab supports students taking the ME:4086 Mechanical Engineering Design Project and ME:4186 Enhanced Design Experience sequence in the Program for Enhanced Design Experience (PEDE) and Virtual International Project Teams (VIPT), whereas the MEDP/PEDE room is occupied by students completing the single-semester ME:4086 Mechanical Engineering Design Project (MEDP) course, as well as for PEDE and VIPT students. The Design Lab contains four workstations with large monitors for collaborative design and analysis activities, as well as tables and chairs for group discussions. An integrated teleconferencing room is enclosed with glass windows so students can communicate with project sponsors. The teleconferencing room contains a 4K LED smart TV connected to a desktop computer, as well as a video camera, microphone, speaker, and speakerphone for video conferencing and phone calls. The MEDP/PEDE room contains six computer workstations with four large computer monitors and two large TV monitors. There are four additional tables without workstations, two mobile whiteboards, and a sofa and mobile chairs for project design and collaborative activities.

Engineering Manufacturing Laboratory

The Engineering Manufacturing Laboratory is located in the Seamans Center for the Engineering Arts and Sciences. The laboratory provides students with experience in advanced CAD/CAM systems. It is managed by the Department of Mechanical Engineering and the Department of Industrial and Systems Engineering. The lab is equipped with three-axis CNC mills (Haas and Tormach), a CNC router (Techno-CNC), a CNC lathe (Haas), a drill press, a plastic injection molder, thermoforming machine, a band saw, a disc sander, a bench grinder, polishing wheel, hand drill, sandblasting cabinet, a press, and a three-in-one shear/break/roll machine. The facility has the latest software technology, such as Creo Parametric and Rhinoceros 4.0. The machinery is used in laboratory assignments in ME:2300 Manufacturing Processes. The room is extensively used near the end of each semester for the course project. It also is used by students who have permission to work in the lab on their honors and research projects.

Ralph and Barbara Stephens Experimental Engineering Laboratory

The Ralph and Barbara Stephens Experimental Engineering Laboratory supports required mechanical engineering undergraduate courses ME:3351 Engineering Instrumentation and ME:4080 Experimental Engineering.

Collegiate Instructional Facilities

Fluid Mechanics Laboratories

The College of Engineering and IIHR—Hydroscience and Engineering have a long history of excellence in fluid mechanics education dating back to the 1920s, when IIHR developed the fluids laboratory as a hands-on learning environment for fluids-related disciplines within the College of Engineering. The long success of the institute's education program is due in large part to a new curriculum

emphasizing scientific principles rather than merely practice in manipulating equipment.

IIHR is now modernized, expanded, and was relocated to the laboratory facilities, which were distributed throughout IIHR research facilities at the south end of the campus to the new Seamans Center Annex, where it occupies a 3,300 square foot laboratory suite. The laboratory suite comprises three distinct, but connected laboratory spaces. The Fluids Fundamentals Laboratory houses experiments that directly support formal laboratory instruction in College of Engineering courses. Through the lab-development project, existing experimental facilities were modernized, refurbished, installed, and additional experiments were developed. The laboratory has a large, reconfigurable open space in which different experiments and furnishings can be set up to support a variety of instructional activities.

The Fluids Workshop is the venue through which students can advance to independent and inquiry-driven, course-related, and extracurricular projects. The lab also supports the activities of College of Engineering student organizations. Advanced measurement instrumentation, computational hardware, and resources for developing experiments are available to students in the lab. Tables around the perimeter of the room contain additional PCs and Linux workstations for numerical computations, data analysis, and visualization.

The Advanced Measurements Laboratory houses major facilities supporting both instructional and inquiry-driven student activities. It contains three facilities that have been upgraded and relocated through this project: the vertical wind tunnel, the visualization water channel, and a towing tank whose functionality has been expanded to also serve as an open channel flume. The laboratory, which is also designed to facilitate the safe use of laser-based instrumentation, is located behind the two front laboratories and is accessible from both rooms.

The fluids laboratories support formal laboratory activities for several courses taken by students in the biomedical, civil and environmental, and mechanical engineering departments, including ENGR:2510 Fluid Mechanics, CEE:3371 Principles of Hydraulics and Hydrology, CEE:5380 Fluid Flows in Environmental Systems, ME:4125 Biomimetic Fluid Dynamics, and ME:4176 Experimental Naval Hydrodynamics.

Additionally, it has been used as a resource in many other courses, including BME:4920 Biomedical Engineering Senior Design II, ECE:4890 Senior Electrical and Computer Engineering Design, ME:4080 Experimental Engineering, ME:4086 Mechanical Engineering Design Project, ME:4098 Individual Investigations: Mechanical Engineering, and ME:4186 Enhanced Design Experience.

Graduate Facilities

Fluid Mechanics

The program in fluid mechanics is conducted in close collaboration with IIHR—Hydroscience and Engineering. The equipment available to graduate students includes several wind tunnels and hydraulic flumes, an environmental flow facility, a towing tank, two special low-temperature flow facilities for investigation of ice phenomena, hot-wire and laser anemometer systems, particle-image velocimetry systems, and computer-based data acquisition systems. Facilities available in the department include a flow visualization and imaging system with charge-coupled devices (CCD) camera and a low-speed wind tunnel. IIHR and College of Engineering shops provide the necessary support. In addition to using in-house workstations and computers, the department's faculty members and students make extensive use of supercomputers at national centers.

Mechanical Systems

Computer-based simulation research activities in the mechanical systems area are carried out mainly in the Iowa Technology Institute. It maintains a variety of high-performance computer systems in support of its technology research and development efforts. General computing services are supported by a number of Linux and Windows application servers connected to centralized file servers. Computer-aided design/computer-aided engineering (CAD/CAE), software development, virtual prototyping, and virtual environment development applications are hosted on numerous high-performance workstations. Standard desktop, multimedia, and office productivity applications are hosted on a network of more than 40 workstations.

Thermal Sciences

Facilities for research in the thermal sciences and systems consist of a low-pressure combustion chamber, a high-pressure continuous flow combustion chamber, a high-pressure chamber for atomization study, a test rig for heat transfer to near supercritical fluids, a diffusion flame test rig, an enclosed laminar flame test rig, air atomization spray apparatus, test stands for melting and solidification studies, various optical measurement systems, and two fuel cell test rigs. Laser-based diagnostics (e.g., laser-induced fluorescence, imaging, and laser Doppler anemometry) are available for solidification, turbulent flow, heat transfer, and combustion studies. Flow visualization and imaging by CCD camera are available for the study of complex fluid motion, heat convection, and combustion flows.