Advanced Engineering Materials Facility

Director:

Christopher K. Y. LEUNG, BSc *Hong Kong*; MS *Univ of California, Berkeley*; PhD *Massachusetts Inst of Tech*
(Professor of Civil Engineering)

Associate Director:

Stephen K. L. LEE, BS *Manitoba*; MS *Ottawa,* PhD *Southampton*

Established in 1994, the Advanced Engineering Materials Facility is a multi-disciplinary central research facility located at Hong Kong University of Science and Technology. Its mission is to provide state-of-the-art research equipment and technical expertise for HKUST as well as Hong Kong industries to develop advanced engineering materials technology and their applications. Research areas of the Facility include processing, microstructural design and new materials development, non-destructive testing and failure analysis, applied mechanics and testing methodology.

The Facility engages in the training of graduate students and researchers in advanced materials technology, and in international exchanges. It also organizes seminars, workshops and conferences to disseminate knowledge of recent developments in the latest materials technology to the industry.

Animal and Plant Care Facility

Director:

Raymond S. C. WONG, Dip *Hong Kong Baptist Coll*; MSc, PhD *South Dakota State*
(Adjunct Associate Professor of Biochemistry)

The Animal and Plant Care Facility (APCF) is located on the seventh floor of the Laboratory Wing. It is a facility mainly for holding and selected breeding of various species of laboratory animals needed for experiments. The total area dedicated for the animal care is about 600 square meters. The Facility has ten animal holding rooms, an operation theater for surgery, a procedure room for preparation, a nude mice room, a quarantine room, and area for cage washing, bedding dispensing, diet storage. The Facility provides professional and humane handling of animals selected for biomedical research activities at HKUST. The high standard of care and treatment as well as the experimental protocols are controlled and approved by the Animal Care Advisory Committee of the University. APCF supplies and maintains several common strains of mice, rats, rabbits, frogs and chicks. The technical staff is well trained and ready to provide services and advices to all users with respect to animal experimentations.

In addition, APCF also provides support for various research projects using plants or components derived from plants. There are twelve environmental chambers/ incubators of various sizes for growing and conditioning of whole plants, tissues or cells. As well, an open area of five 6x10 square meters space can be used to accommodate outdoor planting.

CLP Power Wind/Wave Tunnel Facility

Director:

Kenny Chung-Sau KWOK, BE, PhD *Monash*
(Professor of Civil Engineering)

Associate Directors:

Chun-Man CHAN, BSc, MSc *Massachusetts Inst of Tech*; PhD *Waterloo*
(Associate Professor of Civil Engineering)

Peter HITCHCOCK, BE, PhD *Sydney*

The Wind/Wave Tunnel Facility was established with a substantial donation from CLP Power Co Ltd. Its mission is to provide a physical modeling capability to Hong Kong for designing tall buildings and bridges against wind induced vibrations; prediction of air pollutant dispersion in complex terrains and studies of wind/wave effects on off-shore structures.

The tunnel consists of two main sections: high speed and low speed sections. The high speed section is used for wind engineering studies. The maximum wind speed attainable is 25 m/s. The dimensions of the test section are 29.2m x 3m x 2m (length x width x height) with computer controlled turntable and roughness elements. The low speed section is used for atmospheric dispersion studies and bridge model tests. The dimensions are 41m x 5m x 4m. The lowest steady wind speed attainable is less than 1 m/s. By raising the tunnel floor of the low speed section, the tunnel is converted to a wind-wave facility. The water tank has the same length and width as the low speed section while the water depth is 3m. Wave makers will be installed. An up-to-date array of flow velocity, pressure, force, concentration and wave measurement equipment are available. With a long test section the behavior of a neutral atmospheric boundary layer wind can be accurately simulated.

The Facility is also used to train undergraduate and postgraduate students for use of physical modeling techniques in the field of wind, environmental and off-shore engineering. Fundamental research on generic (as opposed to site specific) problems in the above areas are conducted by faculty and PG students. Workshops and seminars are organized to train practising engineers in using physical modeling to assist their planning and development of infrastructures.

Design and Manufacturing Services Facility

Director:

Li-Long CAI, BEng *Tianjin*; PhD *Toronto*
(Professor of Mechanical Engineering)

Associate Director:

Kai TANG, BSE *Nanjing Inst of Tech*; PhD *Michigan*
(Associate Professor of Mechanical Engineering)

The role of the centrally based Design and Manufacturing Services Facility (DMSF) is to provide technical expertise and support for research and teaching related areas.

The Facility focuses on multidisciplinary and application-oriented research programs that will create impact on the design and manufacturing industries in Hong Kong and the neighboring regions. It provides stimulus for collaboration and interaction between HKUST, local industries and international bodies.

The Facility maintains a range of state-of-the-art equipment to promote research in the area of design and manufacturing. These include measurement equipment such as Co-ordinate Measuring Machine (CMM), Nano Indenter, three-dimensional profiler and three-dimensional laser scanning system. The Facility has a number of Computer Numerical Control (CNC) machines, rapid prototyping machine, robots and computer aided design systems for providing a platform for CAD/CAM integration. It has a strong capability in Computer-Aided-Engineering with a full range of analysis and simulation software. The Facility also supports the repair and maintenance of sophisticated scientific instruments. It fabricates mechanical parts/systems and special purpose electronic circuits, which are not commonly available in the market, for both teaching and research activities.

Embedded Systems Facility

Director:

David K. K. YOUNG, BS, MS, PhD *Univ of Illinois, Urbana-Champaign*
(Adjunct Professor of Electronic & Computer Engineering)

"An embedded system is a special-purpose system in which the computer is completely encapsulated by the device it controls. Unlike a general-purpose computer, such as a personal computer, an embedded system performs one or a few pre-defined tasks, usually with very specific requirements. Since the system is dedicated to specific tasks, design engineers can optimize it, reducing the size and cost of the product. Embedded systems are often mass-produced, benefiting from economies of scale." This definition of an embedded system is extracted from Wikipedia, the Internet free encyclopedia. Physically, embedded systems range from portable devices, such as MP3 players and mobile phones, to large stationary installations, e. g., manufacturing process automation controllers.

With the rapidly changing industrial environment and intensified global competitions, manufacturers of electronic products in Hong Kong and Pearl River Delta (PRD) are striving to improve their competitiveness by designing and developing products which require advanced embedded systems know-how. High demand for and scarcity of experienced embedded systems development professionals have handicapped Hong Kong industrialists' ability to exploit high added value market potentials in embedded systems products. HKUST responded to the emerging market needs and demands by establishing the Embedded Systems Institute (ESI) in April 2004, centrally located and operated from Nansha, Guangzhou, and with support from the Clear Water Bay (CWB) Campus.

In December 2006, Embedded Systems Facility (ESF) is established as one of the central research facilities, signifying HKUST's further commitment to the promotion of and training for embedded system technologies in Hong Kong and the PRD region. The facility operates in the Clear Water Bay (CWB) Campus, and also under the HKUST Fok Ying Tung Graduate School in Nansha, Guangzhou. The mission of ESF is to support faculty and students to conduct teaching, research, and industrial services, that is, to support R&D activities related to embedded systems and to develop teaching curriculum and training courses in embedded systems, in cooperation with academic departments, and in both CWB and Nansha campuses. The facility is in partnership with key technology companies such as ARM, Intel, and Microsoft. At present, ESF also know as ESI, is recognized as an ARM Approved Training Center, Intel Multi-core Processor Technology Laboratory, training partner with Intel Software College, and Microsoft Windows Embedded Training Partner.

Geotechnical Centrifuge Facility

Director:

Charles W. W. NG, MSc *Southampton*; PhD *Bristol*
(Professor of Civil Engineering)

Associate Director:

Limin ZHANG, BSc, MSc, PhD *Sichuan*
(Professor of Civil Engineering)

The Geotechnical Centrifuge Facility (GCF) is unique in Hong Kong. Its missions are to conduct fundamental and applied research to advance scientific knowledge and to assist in the economic and social development of Hong Kong. The facility is unique and perhaps is one of the most advanced geotechnical centrifuge in the world. In addition to its relatively large testing capacity, the GCF possesses two distinctive and exciting features: the world's first bi-axial shaking table, which can simulate earthquake effects on soil structures such as dams; and the state-of-the-art 4-axis robotic manipulator that enables detailed simulations of construction activities in-flight such as pile driving and tunneling. Moreover, and internet telepresence portal has been developed to permit users to view tests from any part of the world at almost real time via the Internet.

The geotechnical centrifuge has a rotating arm of approximately 9 meters in diameter, and is designed for an elevated gravity field 150 times that of the Earth's gravity. Geotechnical structures are built in model boxes with maximum dimensions of 1.5m x 1.5m on plan, and 1.0m high. The maximum payload capacity of the model package is 400 g-ton. The centrifuge is equipped with a unique bi-axial (2-D) shaking table to simulate earthquake-induced effects. In addition, a state-of-the-art 4-axis robotic manipulator is developed to simulate various construction activities inflight. With our advanced data acquisition system, test data can be transmitted to any part of the world via internet at almost real time.

Since the official opening of the GCF in April 2001, demands from the local industry and international clients have increased steadily, including the Geotechnical Engineering Office of CEDD, and Housing Department of HKSAR; National Chiao-Tung University, Taiwan; and Nanjing Hydraulic Research Institute, China for their projects of centrifuge modeling tests of soil-nailed fill slopes, earthquake effects on dams and rainfall effects on clay slope stability, respectively.

Materials Characterization and Preparation Facility

Director:

Kwok-Kwong FUNG, BS *Cornell*; MS, PhD *Bristol*
(Senior Lecturer of Physics)

Associate Director:

Ning WANG, BSc, PhD *Univ of Sc & Tech*, *Beijing*
(Professor of Physics)

The Materials Characterization and Preparation Facility (MCPF) is a central facility for the synthesis, characterization, and testing of new and advanced materials. MCPF houses and operates a wide range of state-of-the-art, sophisticated instrumentation that have wide usage in materials related research. The Facility also organizes workshops on new advances in characterization and preparation techniques and/or instrumentation and conducts training sessions. The mission of the Facility is to serve academics in all the science and engineering departments as well as researchers in research centers by providing them with access to materials preparation/analytical techniques that are not available in their own laboratories. Normally, job requests from users are carried out by the Facility's own staff. However, some facilities are accessible to qualified users who have been certified and authorized by the Facility's senior staff. By arrangement, the services provided by MCPF are also available to researchers from other Hong Kong tertiary institutions, government departments, industrial and commercial sectors.

The Facility occupies about 4,000 square meters of specialized laboratories. Instrumentation is available for various types of thermal, spectroscopic, electrical, and magnetic characterization, and for the preparation of materials by sputtering and evaporation. Equipment for microanalysis includes field emission scanning electron microscopes, high-resolution transmission electron microscopes, atomic force microscopes, a magnetic force microscope, imaging SIMS systems for surface and depth profiling analysis, and a multi-technique surface analysis system (XPS, Auger, SIMS, etc.). These are supported by more standard types of electron-beam analytical instrumentation. MCPF also has a state-of-the-art computer controlled liquid helium liquefier module that is capable of supplying up to 480 liters of liquid helium per day to academics and research units that require liquid helium to operate specialized equipment to carry out their experiments. Additionally, the Facility operates a helium gas recovery system to retrieve helium boil-off from users' instruments for recycling. A complete list of the equipment available in MCPF can be found in its Website, *http://www.mcpf.ust.hk*.

Nanoelectronics Fabrication Facility

Director:

Johnny K. O. SIN, BS, MS, PhD *Toronto*
(Professor of Electronic and Computer Engineering)

Associate Director:

Mansun J. CHAN, BS *Univ of California, San Diego*; MS, PhD *Univ of California, Berkeley*
(Associate Professor of Electronic and Computer Engineering)

The Nanoelectronics Fabrication Facility (NFF) of the Hong Kong University of Science and Technology (HKUST) is the first nanoelectronics laboratory established at a tertiary institution in Hong Kong. The mission of NFF is to provide facilities for faculty and students of HKUST to conduct teaching, research and industrial services. Currently, there are over 200 projects covering the following areas: Micro/Nano-Electro-Mechanical systems (M/NEMS), flat panel displays, biochips, advanced Ultra-Large Scale Integrated (ULSI) circuit devices and technologies, RF and power semiconductor devices and integrated circuits, advanced electronic packaging, nanoscience and technology, sensors and actuators, and compound semiconductor devices and technologies.

The Facility had been planned in two phases. Phase I laboratory provides about 247 square meters with Class 1000 clean room. Since April 1997, the technical capabilities of NFF has been further upgraded with completion of its Phase II laboratory, which occupies an area of 750 square meters with some sections providing Class 100 environment. A complete 4" silicon wafer processing line has been installed, which provides photolithography, thermal diffusion, thin-film deposition, dry/wet etching, metallization, implantation and mask making services. These also include a E-beam Direct Write System which facilitates sub-quarter-micron patterning and enables nano-structure research. With the additional capabilities and capacity, NFF has extended its service to other tertiary institutions and the private sector through various technical collaborations.