CARLETON

FACULTY OF
Engineering and Design

Research Review

Research Review

How to Navigate

STUDENTS AND ACADEMICS

This publication introduces you to the department or school and then each faculty member's research areas, research applications, and their most recent activities. A comprehensive index can be found at the back of this publication to help guide you by specific areas of interest, as well as point out interdisciplinary topics and researchers.

Faculty members welcome enquires about their research and graduate supervision.

Visit the Faculty of Graduate studies and Postdoctoral Affairs at carleton.ca/fgpa for more information on programs and graduate studies at Carleton.

INDUSTRY LEADERS

This publication includes information regarding specific facilities, labs, and research areas of departments and schools as well as individual faculty members and researchers. A comprehensive index can be found at the back of this publication to help guide you by specific areas of interest, as well as point out interdisciplinary topics and researchers.

To discuss collaborative research projects or funding, please contact:
GradAdminEng@carleton.ca

MESSAGE
from the Dean

Carleton University's Faculty of Engineering and Design celebrated 50 years of excellence and achievement in 2013. We have long been innovators and trail blazers—and we continue to drive forward solutions and technological innovations that will shape the future. Here you will see the research and human strengths of the Faculty, and begin to explore our areas of focus.

In partnership with government and industry, Carleton researchers are engineering and designing a higher standard. We focus on educational and research opportunities that emerge from and anticipate the changing needs of society. As the demand continues to increase for environmentally friendly options, secure and reliable infrastructure, and fast analysis of "big data", Carleton's expertise in sustainability, infrastructure resilience, and data analytics continues to push research forward. Pioneering initiatives—including the first programs in aerospace engineering and communications engineering

We tackle the increasing demand for renewable energy, solutions for clean air and water, and more effective approaches for transportation. We make breakthroughs in health care through efficient and affordable diagnosis and therapeutic techniques. We put users at the centre of the rapid evolution in digital media and at the heart of the design of products and spaces.

Join us in our research endeavours. As a graduate student, faculty member, investor or industry partner, you can help to improve the global standard of living.

MESSAGE
from the Associate Dean of Research and Graduate Studies

In these pages, you will explore the wide-ranging research innovations and unique projects undertaken by our faculty members and graduate students. Prospective graduate students will find mentors and the research projects that inspire further discovery. Industry leaders will find the academic partners who can take their research further or open up new avenues of investigation and application. Public and private funders will see the impact of their investment on the research areas that matter most to Canadians.

Research is at the core of the Faculty of Engineering and Design. Our faculty members teach and inspire undergraduate students through their own research and in supporting the capstone design projects that educate the next generation of engineers and designers. Graduate students push the research enterprise further, crossing disciplines to find the best, most creative solutions. Faculty members conduct fundamental research in our established and traditional areas of strength, and advance emerging areas of concentration, such as "green" electronics; health-related, biomedical, sustainable and renewable energy engineering; infrastructure protection and international security; human-computer interaction; and architectural conservation and sustainability.

Recent investments in infrastructure have resulted in new and refurbished laboratories and research space for graduate and faculty research programs, while new measures to further support and enhance our faculty invigorate our research endeavours. This includes, since 2011, a full-time Research Facilitator responsible for identifying, promoting and managing high-value and -impact research opportunities within the Faculty.

The impact can be seen on a number of fronts:

- Our average annual operating research grant is approximately $11 million—about 50 percent of this funding originated from collaboration with provincial, national and international industrial research grants and projects.

- Our graduate student population has grown to approximately 1,000 students.

- Research quality is reflected in publications in leading international journals, presentations at major international conferences, and membership of our faculty on key editorial boards and conference organizing committees. Many faculty members also share their expertise in consulting roles with government and industry.

- Strong partnerships with leading government research laboratories and advanced technology private-sector companies in the National Capital Region are vigorously fostered. These partnerships expand opportunities for leading-edge research for our graduate students, faculty members, and our industrial and government collaborators.

I invite you to explore the snapshot of our current Faculty of Engineering and Design research activities provided in this Research Review. More detail on these activities can be found on our website **carleton.ca/engineering-design**.

Fred F. Afagh, PhD, PEng

Degrees

Our dynamic, research-intensive Faculty provides our graduate students with a unique opportunity to pursue leading-edge fundamental and applied research.

A long history of partnerships and collaboration with government and industry gives a strong practical emphasis to our research and provides unique opportunities for graduate students.

MASTER'S DEGREE

Architectural Studies (MAS) in:

The Culture of Practice

Architecture (MAS, MArch)
Architecture1 (MArch1)

Biomedical Engineering* (MASc) in:

Biomechanics and Biomaterials
Biomedical Image Processing
Medical Informatics and Telemedicine
Medical Instrumentation

Civil Engineering* (MASc, MEng) in:

Environmental Engineering
Fire Safety Engineering
Geotechnical Engineering
Structural Engineering
Transportation Engineering
Water Resources Engineering

Electrical and Computer Engineering*
(MASc, MEng) in:

Biomedical Engineering
Computer-Aided Design for Electronic Circuits
Computer and Software Engineering
Computer Communications, Multimedia and
  Distributed Systems
Digital and Wireless Communications
Integrated Circuits and Devices
Microwave and Electromagnetics
Photonics Systems
Signal, Speech and Image Processing
Systems and Machine Intelligence

Environmental Engineering* (MASc, MEng) in:

Air Pollution
Management of Solid and Hazardous Waste
Water and Wastewater Treatment
Water Resources and Groundwater Management

Human-Computer Interaction** in:

Human Perspective on Interacting with Computers (MA)
Technology for Human Interaction with Computers (MASc)
Software Design (MCS)

Industrial Design (MDes)

Infrastructure Protection and International
  Security*** (MIPIS)

Mechanical and Aerospace Engineering*
  (MASc, MEng) in:

Aeronautical and Space Engineering
Biomedical Engineering
Controls and Robotics
Materials and Manufacturing
Solid Mechanics and Design
Thermal and Fluid Engineering

Sustainable Energy Engineering (MASc, MEng) in:

Efficient Electrical Energy Systems
Mechanical Energy Conversion

Technology Innovation Management (MASc, MEng) in:

Communication Systems Engineering
Engineering Management Processes

Environmental Engineering* (PhD) in:

Air Pollution
Management of Solid and Hazardous Waste
Water and Wastewater Treatment
Water Resources and Groundwater Management

DOCTORAL DEGREE

Architecture (PhD) in:

The Culture of Practice

Mechanical and Aerospace Engineering* (PhD) in:

Aeronautical and Space Engineering
Biomedical Engineering
Controls and Robotics
Materials and Manufacturing
Solid Mechanics and Design
Thermal and Fluid Engineering

* Joint program between Carleton University and the University of Ottawa

** Joint program between the Schools of Information Technology and Computer Science and the Department of Psychology

*** Joint program between the Department of Civil and Environmental Engineering and the Norman Paterson School of International Affairs

Civil Engineering* (PhD) in:

Environmental Engineering
Fire Safety Engineering
Geotechnical Engineering
Structural Engineering
Transportation Engineering
Water Resources Engineering

Electrical and Computer Engineering* (PhD) in:

Biomedical Engineering
Computer-Aided Design for Electronic Circuits
Computer and Software Engineering
Computer Communications, Multimedia and
    Distributed Systems
Digital and Wireless Communications
Integrated Circuits and Devices
Microwave and Electromagnetics
Photonics Systems
Signal, Speech and Image Processing
Systems and Machine Intelligence

Research Faculty

Civil and Environmental Engineering	■	25
Electronics	■	23
Mechanical and Aerospace Engineering	■	38
Systems and Computer Engineering	■	33
Azrieli School of Architecture and Urbanism	■	17
School of Industrial Design	■	5
School of Information Technology	■	8
Total		**149**

Graduate Studies

The Faculty of Engineering and Design at Carleton University offers a full range of graduate programs in engineering, industrial design and architecture. Students have a choice between course-based or research-based master's programs and many are well funded through a combination of research assistantships, teaching assistantships, and scholarships.

Our graduate students benefit from a unique partnership with the University of Ottawa through the Ottawa-Carleton Joint Institutes. This provides access to a wide range of courses, expertise, research facilities and libraries, making our engineering graduate programs some of the largest in Canada.

With community, industry and government partners, our students do cutting-edge research to unravel difficult problems and develop innovative solutions.

For more information about graduate studies at Carleton, visit **graduate.carleton.ca**.

Research Facilities and Infrastructure

State-of-the-art facilities and infrastructure support the research of all departments and schools in the Faculty. These laboratories are housed in the Mackenzie Building, the Minto Centre for Advanced Studies in Engineering, the Azrieli Pavilion, the Azrieli Theatre, the Human-Computer Interaction/Visualization and Simulation (HCI/VSIM) Building and the Canal Building.

Canal Building (top), HCI/VSIM building (bottom).

The **Azrieli School of Architecture and Urbanism** maintains:

- the Carleton Immersive Media Studio with computer facilities for 3D real-time modeling, rendering and animation, 2D CAD, desktop publishing and illustration, and digital video, sound and image manipulation for research in architecture, urban design, heritage preservation, and related disciplines.
- the Carleton Solids and Tectonics Laboratory, dedicated to the study of materiality in architecture with research focused on secondary properties of materials and the combination of inorganic and organic materials.
- design/build studios and fabrication facilities for wood working, metal machining and welding, an assembly room for full-scale projects, a photographic studio, and video editing suites.

The **School of Industrial Design** has design studios, photographic facilities, modeling and testing laboratories, and a mass production/mould simulation laboratory and rapid prototyping equipment.

In 2001, Carleton was chosen by Alcatel as a Global Strategic Research Partner (one of only eight in the world). The **School of Information Technology** uses the Alcatel-Lucent Lab for research on mobile activity, mobile communications, flexibility enhancements for wireless communication networks, application domain, networking and optics. State-of-the-art labs offer the latest technology and industry-standard equipment for interactive multimedia and design, network technology and phototonics and laser technology, including

the Centre for Nanoscale Sensor Interface, the Human-Oriented Technology Lab, and the Carleton University Microfabrication Facility.

The **Department of Civil and Environmental Engineering** houses:

- a structures laboratory, centred on a strong floor facility used for stress testing of large structural components.
- the Advanced Geotechnical Research Laboratory, used to study the effects of earthquakes on building materials.
- the Environmental Engineering Laboratory for advanced approaches to wastewater treatment.

- the Delta Controls Laboratory for experimentation with building systems design.
- a fire research facility in partnership with the National Research Council Canada, which includes a fully instrumented burn-hall to study fire propagation.

Carleton is a full partner in the Canadian Photonics Fabrication Facility, a world-class facility for the fabrication of integrated optical and opto-electronic devices for research and prototyping. On campus, the **Department of Electronics** is home to:

- the Carleton University Microfabrication Facility, Canada's only flexible research laboratory capable of manufacturing silicon microelectronic components. It is used extensively to support research on integrated sensors and photonic devices.
- the Carleton Laboratory for Laser Induced Photonic Structures for the fabrication of fibre Bragg gratings and related devices. There is state-of-the art support for the design of integrated circuits, including the most advanced industrial simulation software, and comprehensive facilities for testing RF, analog and mixed-signal ICs at frequencies up to 20 GHz.
- the Dipak and Tara Roy Advanced Sensor Processing Laboratory for the collection and study of real-world sensor data to develop the next generation of radio frequency and acoustic multi-channel applications.

The **Department of Mechanical and Aerospace Engineering** maintains the Pratt and Whitney Canada High-Speed Wind Tunnel for testing rotors for helicopters and wind turbines; a Bridgman vacuum furnace; servo-hydraulic materials testing equipment; and extensive computer-controlled machine shop capability. Dedicated laboratories enable the study of the mitigation of pollutants generated in combustion and microscale electrical co-generation. The Jo Yung Wong Laboratory for Terrestrial and Extraterrestrial Mobility,

Guidance and Control enables research for Earth-bound off-road vehicles and extraterrestrial rovers. The H.I.H. Saravanamuttoo Gas Turbine Laboratory, with operational gas turbine engines, enables research into structural, aerodynamic and combustion technologies.

The **Department of Systems and Computer Engineering** is home to:

- the Texas Instruments Embedded Processing Lab for the development of medical, sustainable energy and smart grid, automotive and home automation systems;
- the Advanced Real-Time Simulation Laboratory;
- the Carleton University Biomedical Engineering laboratory;
- the Broadband Communications and Wireless Systems Centre;
- the Network Management and Artificial Intelligence Laboratory; and
- the BlackBerry Teaching and Collaborative Research Centre for the development of mobile technology and wireless communication.

The departments of Mechanical and Aerospace Engineering and Systems and Computer Engineering are partners in the Centre for Advanced Visualization and Simulation. Our departments also share extensive state-of-the-art research facilities in biomedical engineering and renewable energy, including the Hydro Ottawa Laboratory for Smart Grid Technologies.

All the departments and schools of the Faculty of Engineering and Design maintain high-performance computer networks based on powerful engineering workstations, providing excellent computing, CAD, and computer visualization facilities specific to their research needs.

More information on facilities can be found in the department and school sections.

Research Chairs

The federal government's Canada Research Chairs program aims to make Canada one of the world's top countries in research and development by investing in research professorships. Canada Research Chairs are dedicated to excellence and innovation in Canadian research and development.

Andy Adler Canada Research Chair in Biomedical Engineering (Tier II)	**Jacques Albert** Canada Research Chair in Advanced Photonic Components (Tier I)	**Ian Beausoleil-Morrison** Canada Research Chair in Innovative Energy Systems for Residential Buildings (Tier II)	**Alex Ellery** Canada Research Chair in Space Robotics and Space Technology (Tier II)	**Matthew Johnson** Canada Research Chair in Energy and Combustion Generated Pollutant Emissions (Tier II)
Peter X. Liu Canada Research Chair in Haptics Technologies (Tier II)	**Banu Örmeci** Canada Research Chair in Wastewater Treatment Engineering (Tier II)	**Abhijit Sarkar** Canada Research Chair in Uncertainty Quantification with High Performance Computing Applications (Tier II)	**Winnie N. Ye** Canada Research Chair in Nano-scale Integrated Circuit Design for Reliable Opto-electronics and Sensors (Tier II)	**George Hadjisophocleous** NSERC* Industrial Research Chair in Fire Safety Engineering

*The Natural Sciences and Engineering Research Council of Canada (NSERC) Industrial Research Chairs develop research efforts in fields for which there is an important industrial need and provide an enhanced training environment for graduate students.
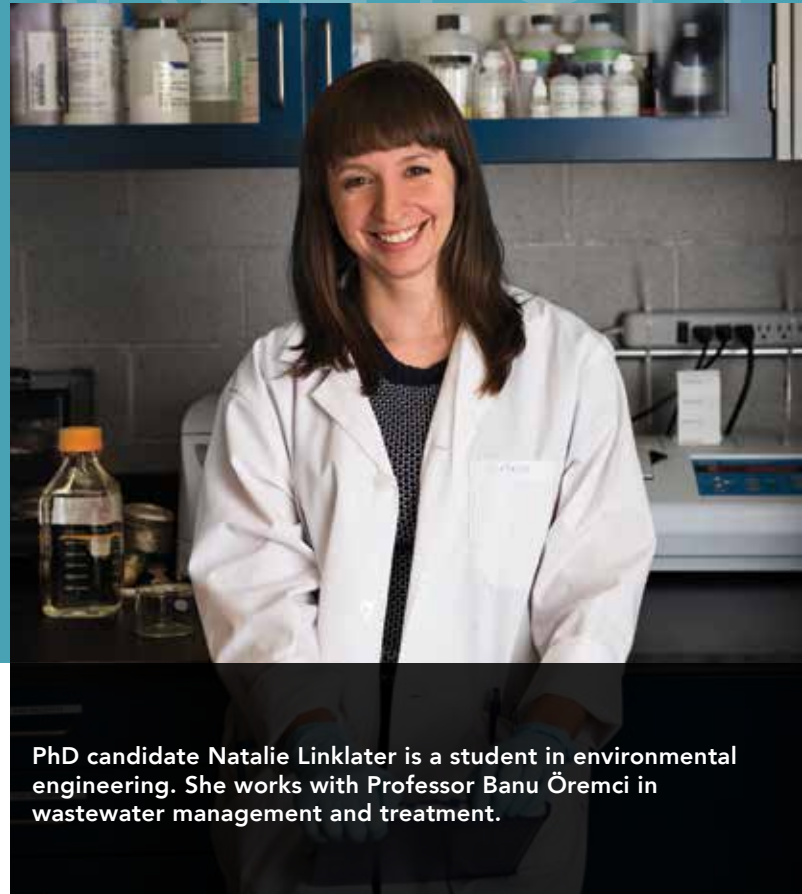
DEPARTMENT OF
Civil and Environmental Engineering

CARLETON

A leader in critical areas of civil and environmental engineering research, the department has an integrated research enterprise that addresses important quality-of-life issues. Under the supervision of expert faculty members, more than 125 graduate students study complex problems and design innovative solutions clustered around core themes.

PhD candidate Natalie Linklater is a student in environmental engineering. She works with Professor Banu Öremci in wastewater management and treatment.

Core Themes

- **Engineering for public safety, health and security** research focuses on the performance-based design of built facilities, health issues associated with air and water quality, and the safety of infrastructure and transportation systems in the face of natural and human threats, such as fire.

- **Hazard mitigation and risk assessment** encompasses a range of approaches from experimental and numerical hazard modeling and risk assessment to mitigation measures for earthquakes, landslides, fires, transportation of dangerous goods and hazardous materials, blasts and high-impact loads, soil liquefaction, and environmental health risks.

- **Infrastructure engineering and sustainability** reflects the unique responsibility of civil engineers to build lasting, functional and aesthetic infrastructures at optimum life-cycle cost. Research on advanced materials, sensor technologies for structural health monitoring, energy-efficient building simulation, secured energy infrastructure, intelligent transportation systems, civil engineering applications of GIS and GPS, infrastructure rehabilitation and asset management, advanced compaction techniques for highway and airfields pavement, and durability of construction materials are part of this theme.

- **Environmental sustainability** is a driver in integrating research from multi-mode transportation systems to life-cycle analysis of construction materials to management of groundwater resources to bio-based technologies as the building blocks of a sustainable development strategy.

- **Historic site recording, conservation and sustainability** is focused on the documentation and restoration of historic structures and the retrofit and upgrading of existing structures to reduce their carbon footprint and energy use. Collaborative research projects in Canada and around the world are conducted in collaboration with leading organizations such as the Heritage Conservation Directorate in Canada, the Getty Conservation Institute and ICOMOS.

Within civil engineering, the primary areas of research include geotechnical, structures, transportation, construction materials, fire safety, risk analysis, and safety and security of civil engineering infrastructures.

Within environmental engineering, the primary areas of research include air pollution, waste management, subsurface contamination, water and wastewater treatment and environmental impact assessment.

Through the bachelor degree in Architectural Conservation and Sustainability Engineering, the department has research strength in the area of historic site recording, documentation and restoration, and energy-efficient building simulation of new and historic buildings.

Research Facilities

- **Structures Laboratory**, with an 11- by 27-metre strong floor, for testing of large structural components.
- **Advanced Geotechnical Research Laboratory** to study the effects of earthquakes on buildings.
- **Environmental Engineering Laboratory** to develop innovative solutions to environmental problems.
- **Fire Research Facility**, with a 10-storey atrium, a burn hall and 50-metre tunnel, replicates full-scale fires in tunnels and commercial buildings for analysis of human safety, and the impact of fire on building structures, contents and the environment. Test data is used to develop new, and validate existing, computer models to evaluate fire safety levels in buildings.
- **Canal Building Simulation Lab** provides real-time and historical data for the building's performance at 7,000 measurement points, including temperature, occupancy, relative humidity, carbon dioxide, lighting and power use. These data, combined with detailed dynamic simulations, allow students and researchers to study and optimize building operations for comfort and energy use.

Research Groups and Focus Areas

AIR QUALITY

Collaborative research with Environment Canada's Emissions Research and Measurement Division at the Thornton Environmental Technology Centre in Ottawa involves projects that:

- characterize volatile organic compound and particulate matter emissions from motor vehicles; and
- develop an Ottawa microenvironment database for air pollutants outdoors and in vehicles.

CENTRE FOR ADVANCED ASPHALT RESEARCH AND TECHNOLOGY

The centre has generated $1,420,000 in research grants and contracts over the past decade. The centre has been involved in the development of the third and final prototype of the AMIR asphalt compactor for commercial use on Canadian roads and airports in cooperation with Ontario Ministry of Transportation (MTO), IRAP-NRC, and private companies including paving contractors and consulting firms. The final product is expected to revolutionize the compaction process of asphalt mixes and improve the long-term performance of asphalt pavements. Research projects include:

- developing the final AMIR roller including field demonstrations and validations, with support from NSERC, private industry, MTO and NRC; and
- developing in-situ permeability criteria for hot mix asphalt pavements in Ontario, with support from MTO.

CENTRE FOR GEOSYNTHETICS RESEARCH INFORMATION AND DEVELOPMENT

Geotechnical, transportation and structural engineers integrate research activities on geosysnthetics applications for reinforced systems in soil, concrete, asphalt and pipeline systems. Recent research projects include field and laboratory testing of steel-reinforced concrete slabs with secondary polymeric reinforcement to impact loads including blast and explosive, and development of suppressive shields for safe explosives transport. The centre has generated more than $2,500,000 in research grants and contracts since its establishment.

INDUSTRIAL WASTE

Hard rock and oil sands mining are key industries in the Canadian economy facing substantial challenges to their sustainability. Carleton researchers are leaders in minimizing impacts from residuals (tailings) of hard rock and oil sands mining. The scale of tailings impoundments is vast, as are the challenges associated with potential impacts, such as water recovery from the tailings, contamination of groundwater and surface waters, and reclamation of impoundment footprints.

Researchers are working with hard rock and oil sands mining operations run by Canadian companies in Alberta, Africa, South America and Australia. A large collaborative research project jointly funded by the oil sands industry consortium, Canada's Oil Sand Innovation Alliance and the federal government, aims to accelerate reclamation of tailings impoundments. This will substantially contribute to improving the sustainability of the oil sands industry.

INFRASTRUCTURE PROTECTION AND INTERNATIONAL SECURITY

In collaboration with the Norman Paterson School for International Affairs, engineers conduct research to increase Canada's preparedness, resiliency to, and recovery from an attack on or natural disaster affecting national critical infrastructure.

Research areas include:

- blast and impact load effects on infrastructure systems;
- hazard mitigation and threat risk assessment methodologies;
- storage and transportation of energetic materials;
- vulnerability assessment of critical infrastructure systems; and
- public health safety and real-time monitoring of water delivery and distribution networks and systems.

OTTAWA-CARLETON BRIDGE RESEARCH INSTITUTE

This integrated, multi-disciplinary research unit of Carleton and the University of Ottawa explores all aspects of bridge engineering, with emphasis on problems related to material performance, durability, and structural and geotechnical engineering. Projects include:

- long-term monitoring of the Confederation Bridge to study ice forces, thermal effects, traffic, wind and earthquake activity, and develop structural health monitoring technologies for bridge management and decision support, with the University of Calgary.

- techniques and procedures for remote, networked, hybrid testing of large-scale bridge structures using Internet-based, multi-site virtual laboratory testing and simulation techniques with the National Center for Research on Earthquake Engineering (NCREE), Taiwan.

Funding and sponsorship: NSERC, PWGSC, MTO, SCBL and private industry partners. Research collaboration: NCREE, NRC, PWGSC, NSC.

OTTAWA-CARLETON EARTHQUAKE ENGINEERING RESEARCH CENTRE

North American and global earthquake engineering problems are explored through links to scientists and research institutions worldwide, and university, industry and government agencies in Canada. Research topics include earthquake engineering ground motions, dynamics of structures, advanced structural systems and design for earthquake resistance, and seismic design code and standard development.

OTTAWA-CARLETON GEO-ENGINEERING RESEARCH CENTRE

A collaborative venture between Carleton and the University of Ottawa, the centre furthers knowledge in geotechnical and geoenvironmental engineering through research projects with industry. Members are involved in research in soil mechanics, rock mechanics, foundation engineering, geoenvironmental engineering, municipal- and mine-waste management, hydrogeology, soil and foundation dynamics, earthquake engineering and urban geotechnical engineering.

TRANSPORTATION RESEARCH CENTRE

Building intelligent transportation systems that incorporate advanced traffic control and traveler information systems into highway infrastructure is one way researchers make roads, cars and drivers smarter with tools that improve planning, traffic control and vehicles. Travel demand management, the land-use impacts of telecommuting, energy and environmental factors in urban transportation, and sustainable transportation reflect the diversity of research projects.

Sponsors include the Ontario Ministry of Transportation, Transport Canada and AUTO21, a federal Centre of Excellence, and more than 120 industry, government and institutional partners.

Architectural conservation and sustainability engineering students working with Professor Mario Santana Quintero traveled to Ouarzazate, Morocco, as part of project to develop and apply a methodology for the documentation, emergency stabilization, and integrated conservation planning for the rehabilitation of earthen architecture settlements.

Carleton served as co-leader of the Canadian Automobile Research Simulation (CARS) project as a part of the research network in Intelligent Systems and Sensors, testing extensive navigation assistance and complex driver information systems with simulated road, driver and vehicle conditions. The centre has completed sponsored projects worth more than $1.5 million.

WASTE MANAGEMENT

Developing innovative and alternative waste management strategies reduces our environmental footprint and greenhouse gas emissions. Researchers are improving waste management practices by developing and enhancing waste-to-energy alternatives and through a life-cycle assessment approach to evaluate waste management strategies.

WATER AND WASTEWATER TREATMENT

Safe and efficient drinking water and wastewater treatment are among the most pressing issues for cities and towns across Canada. Researchers, collaborating with municipalities and consulting companies, are improving the performance of treatment processes and developing new treatment technologies for water and wastewater by examining:

- the fate and persistence of pathogens and chemicals during treatment processes;
- fouling rates of bioreactor membrane systems;
- removal of endocrine disrupters, pharmaceuticals and recalcitrant compounds;
- ultraviolet disinfection and advanced oxidation processes; and
- treatment and disposal of biosolids.

Graduate Programs

graduate.carleton.ca/programs

The MEng, MASc, and PhD in civil engineering and in environmental engineering are offered jointly with the University of Ottawa through the Ottawa-Carleton Institute for Civil Engineering and the Ottawa-Carleton Institute for Environmental Engineering.

A. O. Abd El Halim, PEng, FCSCE, FCAE

Professor

Read more

RESEARCH

Safety and security of transportation infrastructure; improving the engineering resistance of civilian critical infrastructure to blast loads and attacks; analytical and theoretical modeling of asphalt pavement systems; experimental and laboratory investigations; field evaluation and assessment; use of geosynthetics to reinforce civil engineering systems; life-cycle analysis and economics of transportation.

APPLICATION

Development of protective shields for transporting hazardous materials, enhancing the resistance of concrete structures to blast loading through the use of steel/polymer grids. Assessment of the critical oil infrastructure. Design and development of the AMIR asphalt compactor and the In-SIST field testing facility.

ACTIVITIES

- Director, Infrastructure Protection and International Security program
- Chair, Transportation Division Sandford Fleming Award, Canadian Society of Civil Engineers, completed (2010)
- Member, technical committees in TRB, CSCE and CTAA

Onita Basu, PEng

Assistant Professor

Read more

RESEARCH

Impact of integrated processes in dynamic systems; optimization of full-scale systems, investigation of alternative disinfection technologies; study of nutrient phase separation; kinetic analysis of treatment-associated water quality parameters, biofiltration and membrane systems.

APPLICATION

Membrane research investigating fouling control through various operational and cleaning strategies. Cold water research associated with biofiltration and membrane systems.

ACTIVITIES

- Session Co-Chair, OWWA Drinking Water Annual Conference – University Research Forum (2013)
- Member, Stakeholders Review Group, Ministry of the Environment Guidance Manual for Optimization of Sewage Treatment Plants (2009-10)

Abass Braimah, PEng

Assistant Professor

Read more

RESEARCH

Blast load effects on structures; critical infrastructure protection; structural response to extreme loads; impact load effects on structures; and use of advanced composite materials in civil engineering structures.

APPLICATION

Blast risk and vulnerability assessment of critical infrastructure. Development of blast mitigation strategies for critical infrastructure protection.

ACTIVITIES

- Chair, sub-committee on CSA A279, Blast Resistant Buildings
- Member, ASCE Technical Committee on Blast, Shock, and Impact

Jeffrey Erochko
Assistant Professor

Read more

RESEARCH

Wood/timber engineering; high-performance seismic-resistant systems; self-centering systems for buildings; passive damping and isolation of structures; rehabilitation of wood structures; hybrid wood/steel and wood/concrete structures; non-linear dynamic modeling.

APPLICATION

Development of strategies for the seismic design of mid-rise wood buildings. Numerical analysis of wood and hybrid structures and connections to develop prototypes for new design details and construction methods. Applications for high-performance, self-centering, seismic-resistant systems in wood buildings.

ACTIVITIES

- Reviewer, *Earthquake Spectra, Earthquake Engineering and Structural Dynamics* and *Journal of Earthquake Engineering*

George Hadjisophocleous, PEng, FSFPE
NSERC Industrial Research Chair in Fire Safety Engineering; Professor

Read more

RESEARCH

Fire risk analysis; fire and smoke movement modeling; computational fluid dynamics; response of timber-frame walls and floors to fire; connections in fire, design fires; occupant response and evacuation in fires; atrium smoke exhaust; fire safety in tunnels and transportation facilities.

APPLICATION

Fire safety in buildings, performance-based codes, fire safety in tunnels and subway stations, and smoke management in atria.

ACTIVITIES

- Member, IAFSS Executive Committee
- Member, Editorial Board, *Fire Technology*
- Coordinator, CIB W-14 Fire

Amir Hakami
Assistant Professor

Read more

RESEARCH

Air quality modeling; forward and adjoint sensitivity analysis; air pollution economics; uncertainty analysis; data assimilation; inverse modeling; satellite observations of atmospheric composition.

APPLICATION

Air pollution exposure and health effects, air pollution decision support, air quality and climate change, and optimal design of control strategies. Integration of satellite observations with models, inverse modeling of emission inventories, and air quality forecasting.

ACTIVITIES

- Member, CMAS, UNC external advisory board

Yasser Hassan, PEng
Associate Chair (Graduate Studies); Professor

RESEARCH

Modeling of roadway alignments; effect of driver perception and behaviour; probabilistic highway design; reducing collision risk through better design and consideration of human factors; design consistency and its relation to traffic safety.

ACTIVITIES

- Member, Transportation Research Board Committee on Operational Effects of Geometrics (AHB65)
- Associate Editor, *Canadian Journal of Civil Engineering*
- Member, Editorial Board, *International Journal of Advances in Transportation Studies*

Neal Holtz
Associate Professor

RESEARCH

CAE; design codes and standards; software development; computer-aided learning; 3D computer graphics modeling; databases and Internet-based information services with a focus on computer-based representation of technical documents such as building codes and standards, and the integration of these with applications software.

Jagmohan Humar, PEng, FCAE, FCSCE, FEIC
Distinguished Research Professor

RESEARCH

Dynamics of structures; response of structures to seismic ground motion; analysis of soil-structure interaction and dam-reservoir-foundation interaction under dynamic loading; dynamic response of bridges; displacement-based seismic design.

APPLICATION

Development of national code for earthquake resistant design.

ACTIVITIES

- Editorial board member, *International Journal Structural Dynamics and Earthquake Engineering* (2008-present)
- Member, Canadian Standing Committee on Earthquake Design (1995-present)
- Member, Executive of Canadian Association for Earthquake Engineering (2003-present)

O. Burkan Isgor, PEng
Associate Professor

RESEARCH

Durability of concrete structures; theory and modeling of corrosion of steel in concrete; service-life prediction of reinforced concrete structures; computational material science (continuum and ab initio approaches); non-destructive and model-assisted testing; use of sustainable and recyclable materials in construction.

APPLICATION

Corrosion and its prevention in structures; investigation of performance of coatings using electrochemical impedance spectroscopy; nanoscale investigation of passivity of steel in highly alkaline environments using FIB/TEM and XPS; use of recycled aggregate concrete as a structural material.

ACTIVITIES

- Vice President (Technical Division), Canadian Society for Civil Engineering (2009-11)

Karim Ismail, PEng
Assistant Professor

RESEARCH

Modeling of sustainable and non-motorized modes of transportation: crowd dynamics, application of computer vision technologies for data collection and behavioural analysis; road safety analysis: surrogate safety measures, vision-based road safety analysis and holistic safety analysis with focus on sustainable modes of transportation; highway design: development of probabilistic standards for highway geometric design, reliability and risk analysis; modeling and evaluation of intelligent transportation systems with focus on freight: simulation of cargo and carrier movements at border and inland inspection stations.

ACTIVITIES

- Invited Member, Transportation Research Board Pedestrian Committee (2011)
- Member, Transportation Research Board Surrogate Safety Measures Subcommittee (2010)
- Outstanding Paper Award (ANF10), Transportation Research Board 89th Annual Meeting (2010)
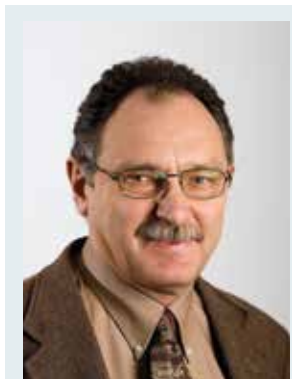
Deniz Karman, PEng
Professor

RESEARCH

Measurement, characterization and modeling of motor vehicle emissions; dispersion and receptor modeling for the impact of industrial sources and motor vehicle emissions on air quality; life-cycle analysis for alternative transportation fuels and technologies; industrial greenhouse gas emissions.

APPLICATION

Emission characteristics and performance evaluation of gasoline-electric hybrid and plug-in hybrid vehicles under Canadian conditions. Source apportionment and intra-urban variability of PAHs in Ontario sites using receptor models. Emission modeling for on-road vehicles with temporal and spatial resolution in Edmonton.

ACTIVITIES

- Working Group for Monograph 105, Carcinogenicity of diesel-engine and gasoline-engine exhausts and some nitroarenes (World Health Organization, International Agency for Research on Cancer)
- Review of selected chapters, Health Risk Assessment of Biodiesel Production and Use in Canada (Health Canada)
- Critical review of the air quality assessment studies, Canadian Cement Manufacturing and Primary Aluminum Sectors (Health Canada)

Shawn Kenny, PEng (Newfoundland and Labrador)

Associate Professor

RESEARCH

Computational mechanics examining problems with stress concentrations, large deformations, strain localization events and propagation of instabilities within the fields of geotechnical and pipeline engineering; centrifuge and physical modeling; pipeline/soil interaction; local buckling; fatigue.

APPLICATION

Onshore and offshore pipeline transportation systems may be subject to large deformation geotechnical hazards; such as ice gouging, frost heave, and slope movement. Accurate and reliable prediction of the load effects and pipeline mechanical performance is critical to promote safe designs and operations.

ACTIVITIES

- Chair Offshore Pipelines Subcommittee K110.60 Canadian Standards Association (CSA) Z662 Oil and Gas Pipeline Systems (2008–present)
- Associate Editorial Board, *Journal of Pipeline Engineering* (2008–present)
- Session Chair, International Pipeline Conference (2004–present)

Ata Khan, PEng, FITE, FCSCE

Professor

Read more

RESEARCH

Intelligent transportation-cognitive vehicle; modeling and simulation; policy and planning; engineering economics; safety, efficiency, sustainable development; energy and environmental factors in transportation.

APPLICATION

Urban and intercity transportation. Multimodal transportation. Traffic management and control. Road safety. Sustainable development. Urban planning.

ACTIVITIES

- PEO Infrastructure Panel (2010)
- TV Panel Discussion (2013, 2010)

Heng Aik Khoo, PEng

Associate Dean (Student Affairs); Associate Professor

Read more

RESEARCH

Steel structures and pipelines; modeling and testing to predict the performance of steel pipelines and structures subjected to different loading conditions; ductile fracture and low cycle fatigue; constitutive relationship.

APPLICATION

Evaluate the performance of and develop design guidelines for steel structures and pipelines.

ACTIVITIES

- Executive Council Member, CSCE, Mechanics and Materials Division
- Member, CSCE Annual Conference organizing committee (2011)
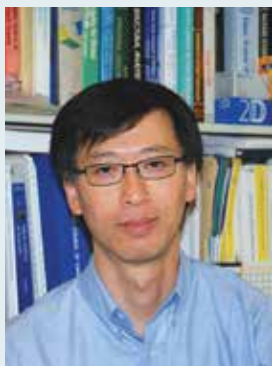
David Lau, PEng, FCSCE
Professor

Read more

RESEARCH

Structural dynamics and earthquake engineering; structural health monitoring and assessment of bridge structures; development of intelligent systems for infrastructure asset management and decision support; application of information technologies in structural engineering; rehabilitation of existing bridges, liquid storage tanks and other infrastructure; seismic application of advanced composite materials.

ACTIVITIES

- Chair, Seismic Working Group and Member, ISO Offshore Structures, Harmonized Canadian Advisory Committee
- Member, Seismic Activities on Non-Structural Components in Building Applications, ISO Technical Committee
- Member, Seismic Risk Reduction of Operational and Functional Components of Buildings, Canadian Standards Association

---

William (Liam) O'Brien
Assistant Professor

Read more

RESEARCH

Field studies and modeling of occupant behaviour to support better building design; building performance simulation-supported design; solar buildings; building controls and operations; visualization of building performance data; daylighting and shading devices.

APPLICATION

The design of buildings that are more comfortable for occupants while saving energy.

Using simulation techniques to assess the potential impacts of occupant behaviour in order to develop better buildings and operations, especially related to daylighting.

ACTIVITIES

- Conference Chair, SimAUD (2013) and eSim (2014)
- Vice President, IBPSA-Canada (International Building Performance Simulation Association)

Banu Örmeci
Canada Research Chair in Wastewater Treatment Engineering (Tier II); Associate Professor
labs.carleton.ca/ormeci/

RESEARCH

Wastewater treatment; biosolids treatment; disinfection of drinking water and wastewater; advanced ultraviolet processes; fate of pathogens through treatment processes; removal of emerging contaminants; nutrient removal and recovery; bioenergy from wastewater and sludge; real-time monitoring.

APPLICATION

Optimization of wastewater and biosolids treatment processes. Development and commercialization of innovative treatment technologies. Wastewater and biosolids treatment in cold and remote regions. Protection of public health and environment.

ACTIVITIES

- Chair, International Water Association (IWA) Specialist Group on Sludge Management
- President and board member, Women in Science and Technology (WISE) Ottawa Chapter
- Editorial Board Member, *Journal of Residuals Science and Technology*

Mohammad T. Rayhani, PEng

Assistant Professor

Read more

RESEARCH

Soil and foundation improvement solutions for seismic-resistant design, advanced foundation engineering, geotechnical implications of climate change, geotechnical aspects of landfill design.

APPLICATION

Earthquake-resistant design, seismic retrofitting techniques for foundations, infrastructure development in the North (pipelines, bridges, airports and highways), municipal solid waste management, and tailing dams.

ACTIVITIES

- Member, Educational and Research Committee, Canadian Society for Civil Engineers

Mario Santana Quintero

Assistant Professor

cims.carleton.ca

RESEARCH

Architectural conservation; recording, documentation and information systems in cultural heritage resources; advanced 3D surveying and visualization techniques; risk assessment of heritage places; preventive maintenance.

APPLICATION

Architectural heritage conservation. 3D surveying and modeling of built heritage structures, development of capacity-building strategies for built heritage conservation and documentation.

ACTIVITIES

- President, International Scientific Committee for Heritage Documentation (CIPA-ICOMOS)
- Evaluator, European Research Executive Agency
- Advisor, International Association of World Heritage Professionals

Abhijit Sarkar, PEng

Canada Research Chair in Uncertainty Quantification with High Performance Computing Applications (Tier II); Associate Professor

Read more

RESEARCH

Uncertainty quantification (to predict malfunctioning of engineering systems under catastrophic conditions, e.g. explosion, earthquake); risk analysis (implications for risk assessment projects in aerospace and petroleum industries, risk modeling for defence initiatives); nonlinear, stochastic and chaotic vibration; structural acoustics and fluid structure interaction; stochastic finite element; flow through disordered porous media; domain decomposition of stochastic PDEs, data assimilation and parallel computing for large-scale stochastic system.

ACTIVITIES

- Member, Probabilistic Methods Committee, American Society of Civil Engineers
- Member, Dynamics Committee, American Society of Civil Engineers

Edward Sherwood

Associate Professor

RESEARCH

Reinforced and pre-stressed concrete structures; masonry structures; integration of modern materials, rehabilitation techniques and analytical methods with current concrete design practices; design methods for structures incorporating fibre-reinforced concrete, high-performance concrete and high-strength reinforcement; shear behaviour of large, lightly reinforced concrete structures; applications of advanced composite materials in concrete construction; concrete durability and corrosion; design and upgrading of concrete infrastructure for extreme events such as blast, impact and fire.

Paul H. Simms, PEng

Associate Professor

RESEARCH

Unsaturated soil mechanics; microscale modeling of porous media; evaporation and cracking in porous media; rheology of non-Newtonian fluids; coupled analysis of fluid flow, heat flow, and volume change in porous media.

APPLICATION

Mine waste management, including hard rock mining and oil sands surface mining. Specific topics include surface deposition of thickened tailings, underground backfill, unsaturated flow modeling, and reclamation cover design for waste impoundments. Other applications include shallow geothermal energy, and sensor design for unsaturated soils.

ACTIVITIES

• Short course leader (2010)

Siva Sivathayalan, PEng

Associate Professor

RESEARCH

Geotechnical earthquake engineering; liquefaction; laboratory testing; constitutive relations; geosynthetics and geofoams; design of foundations, slopes, and retaining walls.

ACTIVITIES

• Sections Representative, Executive Committee, Canadian Geotechnical Society
• Secretary, Canadian Foundation for Geotechnique

Paul J. Van Geel, PEng
Chair; Professor

Read more

RESEARCH

Hydrogeology; groundwater; contaminant transport; movement, distribution and remediation of immiscible fluids like oil, gasoline and solvents that enter the subsurface due to spills, leaking storage facilities or improper disposal; transport of landfill leachate, petroleum hydrocarbons and chlorinated solvents in the subsurface environment; multiphase flow; waste management; bioreactor landfill design and optimization; waste-to-energy alternatives; life-cycle assessment of waste management strategies; biological clogging of unsaturated soils; septic systems; groundwater resources protection and management.

APPLICATION

Assessment and clean-up of contaminated sites (brownfields). Design of bioreactor landfills and alternative waste management facilities. Compare waste management strategies using LCA to assess costs, energy use and environmental impacts. Design of septic systems to treat wastewater from homes and small commercial/industrial facilities.

ACTIVITIES

- Associate Editor, *Journal of Contaminant Hydrology*
- Member, CNSC Canadian GeoScience Advisory Group

Ehab Zalok, PEng
Associate Chair (Undergraduate Studies); Assistant Professor

Read more

RESEARCH

Fire-structure interaction; reinforced concrete and steel structures; evaluation of structural aspects of fire safety in buildings using experimental work and computer modeling; identification of fire hazard in buildings by analyzing thermal response of structures and fire resistance of building elements under different fire scenarios; and developing performance-based fire-structural designs, design fires and fire scenarios in buildings using modeling approach.

APPLICATION

Investigating research opportunities in Canada for the integration of building information models with fire simulation software to improve the understanding of fire-damaged structures and behaviour of structural and combustible materials under actual use conditions.

DEPARTMENT OF
Electronics

CARLETON

Carleton is a leader in advanced components for communications, computing, and sensing applications. Our emphasis on hardware development and verification, our ability to fabricate innovative foundation technologies in Canada's only campus clean room, and our powerful modeling and CAD tools allow us to address the complex and multidisciplinary issues related to the design, integration and testing of advanced components.

Electronics students developed a prosthetic hand using components from a 3D printer to reduce costs.

The Department of Electronics research focuses on three core areas.

ADVANCED COMPONENTS FOR COMMUNICATIONS, COMPUTING AND SENSING APPLICATIONS

Research focuses on advanced components to boost speed, efficiency, accessibility and agility of communications and information processing systems. Applications are geared to enhancing the performance-to-cost ratio with innovative technologies to reduce power consumption, interference and manufacturing costs, and to improve process tolerance. Two concepts being pursued are:

- System on a chip: advanced multi-functional components with automated manufacturing processes. Research involves miniature complementary metal oxide semiconductor (CMOS) radio transmitter chips with embedded antennas.

- System in a package: mixed technology integration combined with optical and opto-electronic components.

Carleton also has expertise in micro-electro-mechanical (MEMS) systems-based circuits, which integrate micro-mechanical elements and sensors with electronics on silicon chips.

COMPUTER-AIDED DESIGN FOR VERY LARGE SCALE INTEGRATION (VLSI)

We develop next-generation CAD algorithms and design automation tools for efficient and accurate modeling, analysis and optimization of electronic circuits and interconnects, and high-speed components and systems, from wireless to optical systems in photonics. Special areas involve simulating radio frequency circuits and MEMS to predict system response. New neural-network-based algorithms are used for fast modeling and optimization of microwave circuits and devices. Powerful CAD tools and methodologies are developed for analysis of signal integrity in high-speed VLSI systems.

MICRODEVICE FABRICATION AND GREEN ELECTRONICS

A combination of sensing, communication and self-powering capabilities is merged into high-speed electronics on silicon chips. Research explores opportunities to integrate photonic, electronic and micro-mechanical devices onto a single platform at our on-site fabrication facilities. Applications cover telecommunications, microelectronics, biophotonics, and chemical and mechanical sensor manufacture. Specific projects include integration of optical communication components with the widely used CMOS semiconductor and silicon sensors for X-rays in biomedical applications. Greater functionality, while preserving low fabrication costs, allows wider application of photonic devices in biomedical diagnostics, environmental testing and communications. In addition, polymer-based devices and nanotechnology are being investigated to allow energy harvesting and storage for a variety of eco-friendly applications.

Research Facilities

COMPUTER-AIDED ENGINEERING RESEARCH LABORATORY

Next-generation CAD algorithms and design automation tools for efficient and accurate modeling, analysis and optimization of electronic circuits and interconnects are developed here. Research focuses on issues common to high-speed circuits and interconnects:

- signal integrity,
- modeling and simulation,
- design tools for radio frequency and wireless applications,
- design tools for MEMS and opto-electronic applications, and
- mixed-domain simulation.

Research also covers the optimum use of multiple CPU cores and multiple-thread algorithms for efficient computational effort.

Jacques Albert, Canada Research Chair in Advanced Photonic Components (right), and PhD student Alexander Beliaev (left) are using standard optical fibre to develop a device that can quickly detect toxins in drinking water or diseases in humans.

NEUROMODELER LABORATORY

Researchers are using advanced neuromodeling techniques for computer-aided design of high-frequency electronic circuits.

- Dynamic neural-network-based techniques are being used for behavioural modeling of non-linear circuits directly from external data with applications in optimizing high-speed, high-frequency IC packages and receiver/transmitter circuits.
- Fast neural-network-based models are developed for high-frequency components, both linear and nonlinear, using EM-based training for passive component models and physics-based training for active device models.
- Techniques for circuit design and yield optimization use passive/active neural models.

CMC INTEGRATED CIRCUIT DESIGN LABORATORY

This lab has the capability for design, optimization and layout of analog ICs, mixed-signal and digital ICs, radio frequency/microwave ICs, monolithic microwave ICs, electro-optic and photonic devices. Researchers work with some of the latest computer workstations capable of computationally intensive CAD simulations. Industry standard IC simulation and design software includes HP ADS, Cadence Design Systems, Matlab, HSPICE, Spectre, Sonnet and HFSS. Software for simulation of photonic devices includes OptiBPM, OptiFDTD, FEMLAB and APSS.

BROADBAND INTEGRATED CIRCUIT MEASUREMENT LABORATORY

Research includes analog and radio frequency (RF) integrated circuit design with applications in cell phone components such as amplifiers to help pick up very faint signals; computer applications, such as components to enable wireless hook-up to the Internet; or wireless medical applications, such as heart-rate monitors. The lab has test capability for:

- RF circuits, such as oscillators and low-noise amplifiers, and RF passive components;
- broadband and electro-optical circuits;
- analog, mixed signal and digital circuits including processors and controllers used in a system on a chip; and
- wafers, using a probe station.

MICROWAVE AND ELECTROMAGNETICS LABORATORY

To investigate microwave devices and circuits for communications applications, the lab is equipped for RF-, microwave- and millimetre-wave testing of packaged or on-wafer devices and components. Active opto-electronic devices and circuits can be characterized along with RF, MEMS, antennas, multi-layer circuits, on-wafer and packaged devices. The lab is equipped with a probe station with four positioners and high-frequency probes and a large anechoic chamber with associated signal sources and components for accurate, fully automated antenna characterization.

CARLETON UNIVERSITY MICROFABRICATION FACILITY (CUMFF)

The seamless monolithic integration on a single chip of photonic, electronic and micro-mechanical functionality will have a significant impact on industries such as telecommunications, microelectronics, biophotonics, and chemical and mechanical sensor manufacture. Silicon-based photonics, in particular, has the potential to reshape the opto-electronics industry.

Winnie N. Ye, Canada Research Chair in Nano-scale Integrated Circuit Design for Reliable Opto-electronics and Sensors, uses Carleton's clean room to fabricate silicon-based photonic devices.

Research focuses on system-on-a-chip integration of sensor functions and photonic devices with control electronics. CUMFF is the only Canadian research laboratory in university, government or industry capable of integrating CMOS electronics with sensors or other devices in silicon. Building on more than 25 years of experimental research on mainstream micro-electronics applications (including process technology, device physics and innovative circuit techniques), CUMFF supports projects on silicon photonics, biomedical devices, wireless communication and MEMS integrated with CMOS. The lab is also used to enhance with additional components the capabilities of commercial CMOS and BiCMOS chips through post-processing.

ADVANCED PHOTONIC COMPONENTS LABORATORY

Researchers in this lab deal with novel devices and systems based on photonic waveguides made of glass, in fibre or planar configurations. The main fields of application focus on optical sensing, and active devices in glass for lasers and modulators.

CANADIAN PHOTONICS FABRICATION CENTRE (CPFC)

Carleton is a full partner in the CPFC, located at the National Research Council Canada (NRC), which draws on facilities and research expertise in photonic materials and devices at the NRC's Institute for Microstructural Sciences. Carleton researchers have access to equipment, research activities and incubation facilities for projects at a national level and in concert with photonics technology clusters within Canada. Projects involve silicon on insulator (SOI) and control of stress-induced birefringence, where splitting of light in SOI waveguides improves component functionality in telecommunications systems. Other research covers very fast switching of optical signals in indium phosphide devices.

Partners and Collaborators

Close ties provide rich research opportunities with partners such as Ericsson, IBM, Best Medical Canada, PMC Sierra, the federal Communications Research Centre, Department of National Defence and the National Research Council Canada. Academic alliances reach across the country and around the world: from the University of Arizona and Georgia Institute of Technology to l'*Institut National des Sciences Appliquées de Toulouse* and Finland's University of Oulu. CUMFF is run with industry and government collaborating partners including Thomson-Neilsen Electronics, NRC, CRC, IBM, SciSense, Gennum, Celestica, and Group IV Semiconductor.

Funding and Sponsorship

The Natural Sciences and Engineering Research Council of Canada (NSERC) funds major research in the form of Strategic Research and Special Research Opportunity grants. Other sponsors are Ontario Centres of Excellence, Canadian Microelectronics Corporation (CMC Microsystems) and Canadian Institute for Photonic Innovations. Joint initiatives involve academics, industry partners such as Alcatel, Peleton Photonic Systems and LxSix Photonics, and government scientists with ties to global corporations and international organizations. The scientific community has benefited from photonics expertise at Carleton as the university is an active partner in the Ottawa region's high technology research clusters, including the Ottawa Photonics Cluster and is a member of the Ottawa Photonics Research Alliance.

Graduate Programs

graduate.carleton.ca/programs

The MASc, MEng, and PhD in Electrical and Computer Engineering are offered through the Ottawa-Carleton Institute for Electrical and Computer Engineering, a joint institute with the Department of Systems and Computer Engineering and Department of Electronics at Carleton University, and the School of Electrical Engineering and Computer Science at the University of Ottawa. This arrangement offers our students access to a wide range of graduate courses in ECE.

Ramachandra Achar, PEng, IEEE Fellow

Professor

Read more

RESEARCH

Signal and power integrity; circuit modeling, simulation and optimization; high-speed interconnects; parallel algorithms; model-reduction techniques; CAD for RF, MEMS, wireless and opto-electronic applications; EMC/EMI; mixed-signal analysis; non-linear circuit analysis/modeling.

APPLICATION

Next-generation design automation algorithms to handle the emerging requirements of managing the complexity of high-speed and mixed-domain modules spanning various design domains of chip, package, PCBs and systems.

ACTIVITIES

- Distinguished Lecturer (DLP), IEEE Circuits and Systems Society (2011, 2012)
- Guest Editor, IEEE *CPMT Transactions* (2012-13)
- General Chair, IEEE HPCPS-2012, 2013, Ottawa, Canada

Jacques Albert, ING (Quebec)

Canada Research Chair in Advanced Photonic Components (Tier I); Professor

photonics.carleton.ca

RESEARCH

Design, fabrication and characterization of photonic components; fibre lasers; optical fibre sensors; photosensitivity; photonic packaging; state-of-the-art laser irradiation facilities to design, fabricate and characterize optical components and sub-systems.

APPLICATION

Nanophotonic and plasmonic coatings on optical fibers to develop advanced new devices for applications in biomedical instrumentation, oil and gas exploration and exploitation, structural and environmental sensing, and telecommunications.

ACTIVITIES

- Associate Editor, *Optics Express* (2007-12)
- Guest Editor, optical fiber sensors, IEEE *Journal of Lightwave Technology* (2012); optical fiber sensors, *Optical Fiber Technology* (2013)
- Member, Physics Evaluation Group, NSERC (2011-13); Section Chair (2013), and Member, Electrical Engineering Grant selection committee FQRNT (2013)

Robert Gauthier, PEng

Associate Professor

Read more

RESEARCH

Photonic crystals and photonic quasi-crystals bandgap and defect state engineering; laser trapping, manipulation, orientation and ablation of micron-sized objects; simulation software development for physics and engineering applications.

APPLICATION

Photonic crystal and quasi-crystal research focuses on integrated optic device designs for optical communications and biosensing applications as well as fundamental research in theoretical foundations of bandgaps in circularly symmetric dielectric structures.

ACTIVITIES

- Editorial board member, *Journal Optics and Laser Technology*

Pavan Gunupudi, PEng
Associate Professor

Read more

RESEARCH

Multi-disciplinary system simulation; parallel circuit/system simulation; signal integrity; design automation of high-speed VLSI and RF circuits; simulation of silicon-photonics and microwave photonics circuits and systems; electrical and optical device modeling; model-order reduction, electrical/optical interconnects; artificial neural networks, design centering and optimization, electromagnetic compatibility.

APPLICATION

High-speed VLSI circuits; signal integrity; RF and microwave circuit analysis and simulation; silicon-photonics and microwave-photonics; yield analysis for ICs.

ACTIVITIES

- Member, Technical Program Committee, IEEE Workshop on Signal Propagation on Interconnects

Robert G. Harrison, IEEE Life Senior Member
Distinguished Research Professor

Read more

RESEARCH

A novel positive-feedback theory based on both quantum and classical physics provides accurate modeling of major and minor hysteresis-loop phenomena up to high order, in numerous ferromagnetic materials, taking into account temperature, Barkhausen and stress effects.

APPLICATION

Development of general-purpose design software for magnetics-based systems and mechanisms, such as electric vehicles, wind-turbine generators, power-grid transformers, and linear actuators.

Tad Kwasniewski, ING (Quebec)
Professor

Read more

RESEARCH

20 Gigabit per second and higher serial data communications circuits, including digital CDR, equalization and transmitter/receiver design; millimeter Wave Frequency Synthesizer Circuits; Fractional-N DLL synthesizer.

APPLICATION

Integrated circuits for wireline communications, frequency synthesis, and wireless communications.

ACTIVITIES

- Collaboration with South-East University in Nanjing and Nanjing University of Technology

Leonard MacEachern, PEng (Nova Scotia)

Associate Chair (Graduate Studies); Associate Professor

Read more

RESEARCH

Microelectronics; mixed-signal circuits and opto-electronics; predistortion; calibration methods for analog circuits; RF integrated circuits; analog-to-digital converters.

APPLICATION

Low-power ADCs, distributed linearized CMOS amplifiers, radio-over-fibre, and biomedical circuits.

ACTIVITIES

- Carleton CMC Representative
- Carleton emSYSCAN director

Ralph Mason, PEng

Associate Professor

Read more

RESEARCH

RF and mixed-signal IC design; analog IC design techniques, tools, circuit and systems; volume manufacturing and low-power circuits.

APPLICATION

Low-power wireless ICs, and low-noise digital PLLs.

Steven McGarry, PEng

Associate Professor

Read more

RESEARCH

Organic and hybrid organic/inorganic semiconductor device physics and technology, including device design, characterization, fabrication processes, modeling; complex electronic/ionic systems using organic and hybrid materials; nanostructured and nanocomposite materials and their applications.

APPLICATION

Design and fabrication of neuromorphic devices and systems. Generation, modulation and detection of optical signals. Power generation and integrated storage using novel photovoltaic device structures and polymer super/ultracapacitors. Applying "soft technologies" to flexible or conformal devices and systems.

Michel Nakhla, PEng, IEEE Life Fellow

Chancellor's Professor

Read more

RESEARCH

Parallel processing, modeling and simulation of high-speed interconnects; signal integrity; packaging; non-linear circuits; multidisciplinary optimization; model-reduction techniques; statistical analysis; wavelets and neural networks; opto-electronic systems; design centering; thermal design; electromagnetic radiation and interference.

APPLICATION

Design of RF and VLSI high-speed circuits and systems.

ACTIVITIES

- Associate Editor, IEEE *Transactions on Components, Packaging and Manufacturing Technology*
- Member, Executive Committee, IEEE International Signal Propagation on Interconnects Workshop (SPI)
- Member, CAD committee (MTT-1), IEEE Microwave Theory and Techniques Society

Calvin Plett, PEng

Chair; Professor

Read more

RESEARCH

Analog, mixed signal RF, and microwave integrated circuits in CMOS, BiCMOS, or SiGe; fully integrated, low-power radio with on-chip antennas; fully integrated frequency synthesizers with wider tuning range and lower noise.

APPLICATION

Analog and radio-frequency integrated circuits for wireless and wireline communications and for wireless biomedical sensor applications.

ACTIVITIES

- Senior Member, IEEE
- Tutorial Committee, NEWCAS
- Session Chair, ISCAS

John W. M. Rogers, PEng

Associate Professor

Read more

RESEARCH

RF integrated circuits; fractional-N frequency synthesizers; wireless applications including ultra wide band and wireless local area networks; wireless and coaxial TV tuners.

APPLICATION

Low-power, miniature IC chips for wireless communications.

ACTIVITIES

- Senior Member, IEEE

Langis Roy, PEng

Associate Dean (Planning), Faculty of Graduate and Postdoctoral Affairs; Professor

Read more

RESEARCH

Monolithic integrated Si/GaN/GaAs circuits; high-performance microwave circuit packaging; integrated antennas; wireless sensor devices; opto-electronic interfacing; system on chip; system on package; low temperature co-fired ceramics; MEMS; RF; millimeter-waves.

APPLICATION

Wireless electronic devices that communicate faster than currently available products, yet are smaller, reconfigurable, more efficient and equipped with sensing capabilities. Integration of antennas directly on–or in the same package as–the transmitter and receiver chips, enabling transmission of high-definition sensor data via a wireless link.

ACTIVITIES

- Member, Carleton Research Advisory committee (2011-13)
- Session co-chair and organizer, ACES Conference, Williamsburg, VA (2011)

Maitham Shams, PEng

Associate Professor

Read more

RESEARCH

High-speed and low-power circuits; system on chip; delay estimation and optimization; modern asynchronous circuits; arithmetic blocks; energy estimation and optimization; RF logic circuits; computer architecture; logical balance; CMOS logic styles; DSP and wireless.

APPLICATION

Microprocessors and ASICs; DNA detection; artificial eyes, artificial organs.

ACTIVITIES

- Member, Carleton Senate

Tom Smy, PEng

Professor

Read more

RESEARCH

Physical simulation of thin film processing, and thermal, electrical, and electromagnetic phenomena; the development of a multi-energy domain opto-electronic simulator (Optispice) in collaboration with Optiwave (Ottawa).

APPLICATION

The SIMBAD simulation suite has been widely applied in the development of silicon chip technology and in the creation of nano-structured thin films. Optispice has a wide variety of applications in optical, sensor and telecommunications systems.

Alan Steele, PEng

Special Assistant to the Provost for Student Academic Engagement; Associate Professor

Read more

RESEARCH

Non-linear optical fibre; optical switching; optical bistability and instabilities; fibre gratings; mode-locking of fibre lasers; simulation of photonic systems. Engineering education research.

APPLICATION

Non-linear properties of optical fibre that provide a route to optical pulse generation and shaping; fibre structures that allow further control and manipulation of optical pulses; uses in optical communications or optical sensors. The use of new technology in teaching, project work, and design education.

ACTIVITIES

- Provost Teaching Fellow – awarded (2011)
- Founding member, Canadian Engineering Education Association (2010)

Barry Syrett, PEng

Associate Chair (Undergraduate Studies); Professor

Read more

RESEARCH

Photonic devices: modeling and design of novel photonic switches, attenuators and modulators especially for planar optical integrated circuits; RF/microwave devices and circuits: modeling of electronic devices and circuit design (microwave and monolithic microwave integrated circuits) at RF and microwave frequencies for wireless applications; optical control of microwave circuits: use of optics to tune and control microwave devices and circuits.

R. Niall Tait, PEng

Professor

Read more

RESEARCH

Micro-fabrication and micro-electro-mechanical systems (MEMS); thin film processing materials and technologies; silicon and MEMS sensors and sensor integration; infrared sensing and imaging; silicon photonic and plasmonic devices; amorphous semiconductor devices; micro-fluidic effects and devices.

APPLICATION

MEMS devices offer high performance and highly integrated solutions with wide ranging applications. MEMS and plasmonic devices are being developed for gas sensing and biosensing with potential applications such as environmental monitoring, blood analysis, and pathogen detection in food and water.

ACTIVITIES

- PEO technical examiner (2013)
- Technical Program Committee, CMBEC36-APIBQ42 (2013)

N. Garry Tarr, PEng
Chancellor's Professor

Read more

RESEARCH

Silicon semiconductor device physics and technology: device design, fabrication processes, characterization, modeling and application in integrated circuits and opto-electronics; monolithic integration of optical components with CMOS electronics for sensing and communications; integrated waveguide optical devices in silicon-on-insulator; silicon sensors for ionizing radiation for biomedical applications; silicon photovoltaics.

APPLICATION

Silicon-based biomedical sensors; components for optical telecommunications and optical interconnect, and photovoltaics.

Xiaoyu Wang, PEng (Alberta)
Assistant Professor

Read more

RESEARCH

Power system analysis; integration of renewable and distributed energy resources; power quality; power system real-time simulation; power electronics; smart grid application.

APPLICATION

Distributed generation anti-islanding protection. Hybrid storage units for grid-connected photovoltaic systems.

ACTIVITIES

- Session chair, International Conference on Advanced Power System Automation and Protection, Beijing, China (2011)
- Visiting professor, University of Alberta (2012)
- Member, IEEE task forces on Interfacing Techniques for Simulation Tools, Modeling and Analysis of Rotating Machine Based DR, Dynamic Average Modeling, and Real Time Simulation of Power and Energy Systems

---

Jim Wight, PEng
Chancellor's Professor

Read more

RESEARCH

Adaptive antenna structures for carrier-grade Wi-Fi; artificial microwave volume hologram antennas for low-profile apertures; GaN HEMT based high-power multi bit phase shifter circuits; lower-ground coplanar waveguide transmission lines for millimeter-wave silicon-based IC; GaN power-amplifier linearization circuits; hybrid RF/digital feed-forward filters for frequency agile base-station transceivers; multilateration, Time Difference of Arrival, and MIMO surveillance radar processors; spoofing and anti-spoofing of synchronization circuits in GPS receivers.

APPLICATION

Wireless and satellite communications; radar surveillance, tracking and imaging; GPS and radio navigation.

Winnie N. Ye, PEng

Canada Research Chair in Nano-scale Integrated Circuit Design for Reliable Opto-electronics and Sensors (Tier II); Associate Professor

Read more

RESEARCH

Design, fabrication and characterization of silicon-based photonic devices; nano-scale integrated circuit design for opto-electronic sensors; athermal photonic integration design; thin film silicon-based and plasmonic-enhanced solar cells; subwavelength devices design.

APPLICATION

Biomedical and environmental sensing, biophotonic diagnostic tools, telecommunications, and photovoltaics.

ACTIVITIES

- Sessional Chair and Technical Program Committee member, SPIE Photonics North 2013, Ottawa, Canada
- Chair, Scientific Committee, International Conference on Electrical and Computer Systems, Ottawa, Canada
- Chair, IEEE Women in Engineering Ottawa Chapter (2012-present)
- Senior Member, IEEE
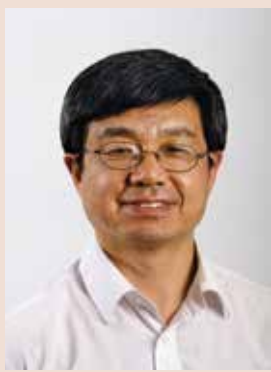
Q. J. Zhang, PEng, IEEE Fellow

Professor

Read more

RESEARCH

Electronic CAD; neural networks; optimization; high-frequency electronic/electromagnetic modeling and design; methodologies and tools for designing high-speed/high-frequency electronic circuits in wireline and wireless electronic systems.

APPLICATION

Microchip design, electronic packaging design, and wireless front-end design.

ACTIVITIES

- Member, Editorial Board, IEEE *Transactions on Microwave Theory and Techniques*
- Member, Technical Committee on CAD (MTT-1) of the IEEE MTT Society
- Member, Technical Program Review Committee, IEEE MTT-S International Microwave Symposium, Seattle, Washington (2013)

DEPARTMENT OF
Mechanical and Aerospace Engineering

CARLETON

Faculty lead cross-disciplinary research endeavours aimed at specific application issues and development of the fundamental governing principles of mechanical and aerospace engineering systems and applications.

Richard Beranek and Aliasgar Morbi with an early prototype of their robotic walker. The graduate students founded GaitTronics Inc., a rehabilitation robotics company, based on their work in the Advanced Biomechatronics and Locomotion Laboratory.

Nearly 40 years of research associated with advancing gas turbine technology is an example of our enduring application-based, cross-disciplinary research, which also includes innovative developments and designs in unmanned aerial vehicles, flight simulators, and rotorcraft and wind-turbine structures.

Our researchers advance aerodynamics, vehicle dynamics and simulation technologies, biomedical engineering and design of devices, convective heat transfer characteristics in supercritical fluids with application to nuclear-reactor cooling, robotics, navigation, combustion, and the development of sustainable energy sources.

Complementing extensive experimental research, the department is at the leading edge of the development and application of innovative analytical and numerical techniques for problems in the fields of solid mechanics, fracture mechanics and fluid mechanics. Cutting-edge work involves development of the Quasicontinuum Method, the Boundary Integral Equation Method, Finite Element Methods for solid-mechanics applications and computational fluid dynamics algorithms.

Research Facilities

Our transonic to low-speed wind tunnels, large-scale water channel, unique material processing and surface-coating equipment laboratories, and extensive computational facilities for parallel computing support our extensive programs related to internal aerodynamics, aeroelasticity, combustion, system design and performance, high-temperature materials and coatings, and repair and overhaul technologies.

- These facilities, and the H.I.H. Saravanamuttoo Gas Turbine Laboratory, support one of the largest university-based gas turbine technology research groups in Canada.

- A whirl tower housed at the National Research Council of Canada supports the experimental rotor programs of the Rotorcraft Research Group.

- Researchers in sustainable energy conversion have access to supercritical water thermohydraulics loop, aerosol generators, combustion facilities, and a gas turbine engine modified for alternative fuel combustion research.
- Materials and manufacturing processes researchers benefit from our high-temperature vacuum Bridgman furnace, air plasma spray facility, welding equipment, optical and scanning electron microscopes and vacuum treating furnace.
- Researchers in structures and materials have access to several Instron material testing machines.
- Space system design researchers use the Jo Yung Wong Laboratory for Terrestrial and Extraterrestrial Mobility, Guidance and Control.

Research Focus

AERODYNAMICS

Focused on gas-turbine internal flows, aerodynamics of lift-generating surfaces on fixed- and rotary-wing aircraft, spacecraft and rocket propulsion systems, and wind turbines, research examines:

- transonic axial-flow turbines with ultra-high blade loading operating at low Reynolds numbers;
- secondary loss control in axial turbines through endwall contouring;
- mixing performance of gas-turbine lobed mixers;
- instability and laminar-to-turbulent transition in separated and free shear layers;
- aerodynamics and aero-acoustics of rotorcraft blade/vortex interactions;
- design of ejector-engine nozzles; and
- aerodynamics of unmanned aerial vehicles operating at low altitude and in wind gusts.
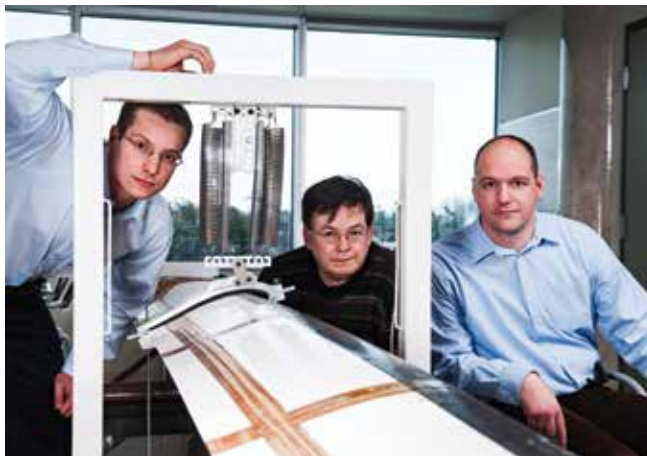
Graduate student Kostyantyn Khomutov is leading the start-up company Smart Rotor Systems Inc. to market the active pitch link, a pen-sized device that reduces vibration in helicopter blades by redistributing energy, with co-founders and professors Fred Nitzsche and Daniel Feszty.

AEROSPACE STRUCTURES

Research concentrates on optimizing aircraft design and evaluating new materials, processes and technology for aircraft structural applications. Several servo-hydraulic materials and structure test systems are available to researchers with current projects related to:

- fibre metal laminates for aircraft structures that provide improved damage tolerance, integrity and fatigue properties;
- smart structures to reduce rotorcraft noise and vibration;
- dynamics and aerodynamics of shipboard helicopter operation; and
- understanding fatigue nucleation and short fatigue crack growth behaviour of aerospace aluminium alloys.

Subjecting bone to loads expected in daily activities, such as walking and stair climbing, helps biomedical researchers understand fixation and movement in hip replacements.

BIOMEDICAL ENGINEERING

The application of mechanical engineering to the biomedical field is a rapidly growing area of research. Faculty have strong collaborations with biomedical engineering research centres, the pharmaceutical industry, and manufacturers of medical devices. Current research programs involve:

- evaluation of polymers for implantable medical devices;
- design of prosthetic limbs and wrist implants;
- dynamics and control of actuators for variable-stiffness limbs;
- fracture fixation and bone regeneration using tissue engineering;
- two-phase flows associated with aerosol generation from commercial pharmaceutical inhaler devices and deposition losses in oral and nasal airways;
- tumour chemotherapy enhancement using a micro-bubble infusion pump;
- mathematical modeling of the cardiovascular system;
- design optimization of the Intra Aortic Balloon Pump;
- biomechanics of musculoskeletal injury in skilled musicians; and
- intelligent vision systems for robotic-assisted surgery.

SUSTAINABLE ENERGY CONVERSION

Advanced research involves evaluation and modeling of two-phase flows with applications in automotive air conditioning systems, fuel cells, solidification processes, heat pipes and oil flares. Applications deal with satellite thermal control, gas turbine cooling, and materials processing and cooling of electronic microprocessors, along with research in:

- zero-emission, gas-turbine-based plants for power generation;

- bio-fuel combustion in gas turbines;

- mathematical modeling and manufacturing of two-phase capillary pumped heat transfer devices such as conventional heat pipes and loop heat pipes;

- efficient and environmentally friendly automobile air conditioning systems;

- measurement and modeling of soot formation in multi-component fuels;

- pollutant emissions and control of oil-field flares;

- stratified combustion;

- micro-cogeneration based upon fuel cells and Stirling cycles;

- building performance simulation;

- optimization of solar energy utilization; and

- alternative cooling approaches.

MATERIALS AND MANUFACTURING PROCESSES

We focus on optimizing the processing, microstructure and properties of advanced materials, and are developing extensive experimental programs and computer simulation methods. Areas of focus include:

- titanium aluminide intermetallics for low-pressure and -power turbine blades;

- investigation of processing, composition and phase stability of single crystal superalloys for high-pressure turbine blade applications;

- mathematical and computational modeling to design ceramic thermal barrier coatings with high reflectance to radiation in advanced gas turbine engines;

- development of special elements and techniques for adaptive and automatic finite element analysis, for thermal and stress analysis of welds and related manufacturing processes;

- integration of a graphical user interface for the pre-processing of hexahedral elements derived from free-meshed tetrahedral elements;

- modeling of dendrite growth, development of micro-macro models of solidification processes, and phase field micromechanics models of the martensitic transformation;

- development of innovative superalloys and their composites for high-temperature wear/corrosion applications;

- development of new coatings and coating processes for thermal erosion and resistance; and

- manufacture and properties of carbon nanotube-polymer matrix composites.

SOLID AND FRACTURE MECHANICS

We develop advanced methods for fatigue and fracture assessment of engineering structures in the pressure vessel, aerospace, automotive and offshore industries. Research enables realistic correlations of fatigue and fracture properties from laboratory test specimens to full-scale engineering structures, and:

- finite element modeling of materials damage to develop a physics-based holistic life prediction methodology for aerospace components and structures;

- efficient boundary element methods for stress analysis;

- exact volume-to-surface integral transformation in the development of boundary integral equations for anisotropic bodies with body forces and/or thermal effects;

- fracture mechanics of advanced composite materials;

- stress analysis of micro-electronic packaging;

- multi-scale modeling of plasticity and fracture in metals; and

- development of the Quasicontinuum Method for mixed continuum and atomistic simulation of the mechanical response and fracture mechanics of polycrystalline materials.

ROBOTICS, CONTROL, GUIDANCE AND NAVIGATION

This area of research is dedicated to advanced application of robots and control/navigation of autonomous vehicles and satellites. To explore these topics, we have industrial robots for testing control and calibration strategies. Some of our projects include:

- robot mechanical systems and kinematic calibration;

- mechanism synthesis and applied dynamics

- development of innovative simulator motion platforms with unlimited rotational degrees of freedom;

- sensor fusion techniques and control of autonomous formation flying;

- design and development of active systems for control of rotorcraft blade dynamics;

- autonomous vehicles engineering;

- systems control and estimation theory;

- mining robotics and automation; and

- coordinated control of multivehicle systems.

SPACE TECHNOLOGY

Our work on satellite, rocket and other spacecraft engineering is dedicated to low-cost space launch systems, hypersonic and high-speed flows, inertial technology and air-breathing propulsion concepts and includes:

- rocket-based combined-cycle engines for more efficient use of atmospheric oxygen during launch;

- development and testing of gyro wheel-based satellite control systems;

- analytical and experimental techniques in loss of rotation in tethered spacecraft;

- application of loop heat pipes for spacecraft thermal control; and

- space robotics, satellite servicing and planetary rovers.

Partners and Collaborators

Department research benefits from strong relationships with external research centres locally and globally. Research collaborations and funding arrangements exist with several institutes of the National Research Council of Canada, Environment Canada, Natural Resources Canada, National Defence, the Ottawa Hospital and the Canadian Space Agency. Major industry partners include Pratt & Whitney Canada Inc., United Technologies, Deloro-Stellite, Indal Technologies, Liburdi Engineering, Magellan Aerospace, Augusta SpA., Atomic Energy of Canada Ltd., Rolls-Royce Canada and the Petroleum Technology Alliance of Canada, among many others. Faculty have been successful at supporting research through grants from NSERC, the Ontario Centres for Excellence, Canada Foundation for Innovation, and the Ontario Research Fund.

The scope of graduate student research is expanded through exchange agreements with leading universities including Delft University of Technology, the University of Glasgow and the University of Sao Paulo.

Graduate Programs

graduate.carleton.ca/programs

The MASc and MEng in aerospace, materials, or mechanical engineering and PhD in aerospace and mechanical engineering are offered through the Ottawa-Carleton Institute for Mechanical and Aerospace Engineering, a joint institute between Carleton and the Department of Mechanical Engineering at the University of Ottawa. Students can also study for the MASc in biomedical engineering through the department's involvement in the Ottawa-Carleton Institute for Biomedical Engineering, a joint institute of four academic units at Carleton and three at the University of Ottawa.

A recently established master's program in Sustainable Energy Engineering and Policy, co-offered by three engineering departments and by the School of Public Policy and Administration, enables students to study the policy and engineering aspects of energy generation, conversion, distribution and utilization in an interdisciplinary setting.

The space exploration research group uses a Husky rover platform to develop control and navigation systems for mobile rovers.

Fred F. Afagh, PEng

Associate Dean (Research and Graduate Studies); Professor

[Read more]

RESEARCH

Structural modeling of thin-walled, open and closed cross-section beams; dynamic modeling, control and stability; smart structures technology; stability analysis.

APPLICATION

Development of smart structures for aerospace and energy applications. Helicopter rotors and horizontal axis wind turbine blades. Elastic and dynamic stability of various structural systems and elements. Postural stability analysis.

ACTIVITIES

- Editorial Advisory Board, *Asian Journal of Engineering and Applied Technology*

Mojtaba Ahmadi, PEng

Associate Professor

[Read more]

RESEARCH

General areas of robotics and controls; biomechatronics and bio-inspired robotics; robotic rehabilitation and virtual gait retraining; assistive devices and exoskeletons for walking; linear, nonlinear, and learning controllers; general mechatronic design process and simulation; robotic arm design and control.

APPLICATION

New rehabilitation technologies for post-stroke patients; assistive devices for people with walking disability and the elderly; development and control of intelligent legged robots; biomedical robots; design and analysis of robotic systems for aerospace applications.

ACTIVITIES

- Technical Program Committee, IEEE Canada Conference on Electrical and Computer Engineering (2013)
- Technical Program Committee, International Conference on Mechatronics and Mechanical Engineering (ICMEM), 2012
- Associate Editor, *Journal of Mechatronics and Mechanical Engineering*, ASET (from 2012)

Andrei Artemev, PEng

Professor

[Read more]

RESEARCH

Development of computer simulation methods for structure and properties of solid materials and structure evolution in phase transformations; phase field models of domain structures in thin ferroelectric films and nano-composites; micro-macro models of phase transformations and phase-field micromechanics models of the martensitic transformation; computer modeling and damage analysis of functional composite materials.

Ian Beausoleil-Morrison, PEng

Canada Research Chair in Innovative Energy Systems for Residential Buildings (Tier II);
Associate Professor
www.sbes.ca

RESEARCH

Innovative energy systems for residential buildings; solar housing; micro-cogeneration; building performance simulation; mitigating house-grid interaction.

APPLICATION

Design and development of a solar housing research facility on the Carleton campus. The Carleton Research and Innovation in Sustainable Energy (C-RISE) house will provide a platform for the long-term study of innovative architectural and engineering concepts for housing.

ACTIVITIES

- President, International Building Performance Simulation Association
- Co-editor, *International Journal of Building Performance Simulation*
- Member, College of Peer Review for the Engineering and Physical Sciences Research Council of the United Kingdom

Robert Bell, PEng

Professor

Read more

RESEARCH

Fatigue and fracture mechanics; development of life prediction software, multiple crack initiation, crack interaction and coalescence, weight function techniques, experimental studies; damage-tolerance performance of laser-welded aluminum joints and laser-welded stringer/skin panels; stress analysis and fatigue endurance of elastomer materials using the Finite Element Methods; fatigue performance of friction-stirred welded joints; residual stress measurements using compliance method.

ACTIVITIES

- International Conference on Fracture, ICF13, Bejjing, (2013)
- Member, International Scientific Committee
- ICF13, Session 11 Organizer, "Criteria for Fracture and Failure"

Cynthia Cruickshank

Assistant Professor
solar.carleton.ca

RESEARCH

System- and component-level modeling of solar thermal energy systems and sensible heat storages, supported by experimental analysis; optimization and integration of new solar thermal technologies with conventional heating and cooling systems; experimental and numerical evaluation of flowing electrolyte direct methanol fuel cells.

APPLICATION

The design and optimization of small-scale thermal energy storages for potable water applications. The design and integration of solar combined systems for space and water heating including their integration with conventional building systems. Investigations related to advanced buildings, including energy efficient and sustainable energy concepts for commercial and residential applications.

ACTIVITIES

- Member, Technical Research Committee, Canadian Home Builders Association
- Carleton University Lead Faculty Advisor, Team Ontario, Solar Decathlon

Alex Ellery
Canada Research Chair in Space Robotics and Space Technology (Tier II);
Associate Professor

RESEARCH
Muscle-like behaviours for robotic manipulators; forward model augmentation to feedback control of manipulators; micro-penetrator development; micro-rover development; optic flow and potential field-based navigation.

APPLICATION
Space-based manipulators; planetary rovers; lunar base infrastructure development.

Jason Etele, PEng
Associate Chair (Graduate Studies); Associate Professor

RESEARCH
Design of next-generation launch vehicles using the "exchange inlet", an air breathing Rocket Based Combined Cycle (RBCC) concept; experimental and numerical investigation of building generated turbulence and its effect on the flight of small unmanned aerial vehicles; DBD actuator simulation and design.

ACTIVITIES
- JSPS Long Term Fellowship Visiting Researcher, Japanese Aerospace eXploration Agency (JAXA), Kakuda Space Center

Daniel Feszty, PEng
Associate Professor

RESEARCH
Vibration and noise control; helicopter aerodynamics; wind turbine aerodynamics with focus on wake interference effects and wind farm layout optimization; energy harvesting via unsteady flows; flow control and stiffness control; experimental rotor design, manufacturing and testing; computational aeroelasticity.

APPLICATION
Novel aerodynamic concepts to improve the noise signature, passenger comfort, efficiency and performance of helicopters and to increase the power output of wind farms. Vibration control for robotic camera platforms.

ACTIVITIES
- Director, Aerospace Research Unit, Rotorcraft Research Group
- Co-founder and Acting Director, Aerospace Research Unit, Carleton University
- Co-founder and faculty advisor, student chapter of the American Helicopter Society (2013)
- Carleton University's delegate to CRIAQ

Hanspeter Frei, PEng
Associate Professor

Read more

RESEARCH

Prediction of hip fractures using finite element method; prevention of osteoporotic hip fractures using tissue engineering approaches; design of novel implants for the repair of osteoporotic fractures.

APPLICATION

Osteoporosis-related bone fractures lead to premature disability and leave the patient with a reduced quality of life. Despite considerable research efforts in the treatment of osteoporosis, the number of hip fractures are increasing and novel multidisciplinary approaches to predict, prevent and repair osteoporotic bone fractures are required.

John Gaydos, PEng
Associate Professor

Read more

RESEARCH

Capillarity and surface fluid mechanics applied to measurement techniques for liquid-fluid surface tension and interfacial energy; contact angle and line tension on patterned surfaces; application of semiconductor fabrication processes to microfluidic device research and development.

APPLICATION

Surface phenomena (e.g. soap bubbles) are easy to generate but difficult to explain because of the molecular forces at the interface. Modeling of these surface effects is important in nano-technology and the miniaturization of many devices.

John Goldak
Distinguished Research Professor

Read more

RESEARCH

Designer-driven non-linear transient FEM analysis of manufacturing processes such as welding, heat treating and casting to optimize the design and production of industrial structures; development of software environments that enable designers to accurately simulate and optimize the manufacturing processes and in-service behaviour of complex structures.

APPLICATION

Simulating welding of welded structures to manage distortion that impacts manufacturing costs and residual stress that impacts fatigue life. Heat treatment of gears to predict distortion, residual stress and hardness and then optimize heating process. Fabrication and in-service behaviour of piping systems.

ACTIVITIES

- Member of Advisory Committee of American Welding Society on Standards for Verification and Validation of Computational Weld Mechanics
- Member, International Seminar on Welding Science and Engineering, WSE (2011)
- Joining and Welding Research Institute, Osaka University, Osaka, Japan

Junjie Gu, PEng
Associate Professor

RESEARCH

Transport phenomena in micro-scale processes; two-phase flow and heat transfer; heat pumps and refrigeration; automobile air conditioning systems; sorptive refrigeration; solar air conditioning; waste-heat refrigeration; waste-heat power generation; renewable energy; energy systems; coal gasification.

ACTIVITIES

- Founder, Carleton Student Branch, ASHRAE

M. John D. Hayes, PEng
Professor

RESEARCH

Robotic mechanical systems; machine vision; kinematic calibration; mechanism synthesis; applied dynamics; theoretical kinematics; computational geometry; simulation; simulator motion platform design; visual servoing; medical devices.

APPLICATION

Industrial robotics, kinematic and dynamic control of simulator motion platforms, specifically the Atlas Motion Platform.

ACTIVITIES

- Editorial Board, *Transactions of the Canadian Society for Mechanical Engineering*
- President, Canadian Committee for the Theory of Machines and Mechanisms
- Chair, CCToMM, Symposium on Mechanisms, Machines, and Mechatronics, 2013

Xiao Huang, PEng
Professor

RESEARCH

Coating design, manufacturing and testing; wide gap braze repair of gas turbine components; ceramic matrix composites; biomass gasification and clean energy research.

APPLICATION

Coatings and alloy design and testing for gas turbine and steam turbine industry; materials and processing technology for energy sector; and clean energy research for transportation sector.

ACTIVITIES

- Vice Chair, Manufacturing, Materials and Metallurgy Committee, International Gas Turbine Institute, Turbo Expo (2009-10)
- Chair, Manufacturing, Materials and Metallurgy Committee, International Gas Turbine Institute, Turbo Expo (2011-12)
- Topic Chair, International Conference on Fracture (2013)

Matthew Johnson, PEng

Canada Research Chair in Energy and Combustion Generated Pollutant Emissions (Tier II); Associate Professor

Read more

RESEARCH

Technology to quantify soot/black carbon emissions in atmospheric plumes of gas flares and other sources; novel approaches for detection and quantification of fugitive emissions in the upstream energy industry; pollutant emissions from turbulent flames and gas flares, especially emissions associated with hydrofracturing; techno-economic analysis of opportunities from mitigation of greenhouse gas emissions in the upstream energy industry; experimental fluid mechanics; application of laser diagnostics.

APPLICATION

Reduction of pollution, especially emissions associated with upstream energy production in Canada.

Tarik Kaya, PEng

Professor

Read more

RESEARCH

Two-phase heat transfer; interface instability; heat pipes for electronics cooling; loop heat pipes; spacecraft thermal control; mathematical modeling and manufacturing of two-phase capillary pumped heat transfer devices.

APPLICATION

Spacecraft thermal control; electronics cooling.

ACTIVITIES

- Member, Editorial Board, *Frontiers in Heat Pipes*
- Associate Editor, *International Journal Energy &Technology*
- Member, AIAA International Organizing Committee on ICES

Jeremy Laliberté, PEng

Assistant Professor

Read more

RESEARCH

Air vehicle conceptual design; uninhabited aircraft systems development; design of lightweight metallic and composite aerospace structures; out-of-autoclave manufacturing of polymer composites; direct digital manufacturing; low velocity impact damage testing and modeling; durability and degradation of polymer composite materials.

APPLICATION

Novel aerospace vehicle design, uninhabited aircraft systems, and lightweight materials and structures.

ACTIVITIES

- Associate editor, *Journal of Unmanned Vehicle Systems*
- Session developer, CASI AERO conference (2013)
- Member and Academic Coordinator, Unmannned Systems Canada

Rob Langlois, PEng
Professor

RESEARCH

Applied multibody dynamics; mathematical modeling and computer simulation; vehicle dynamics.

APPLICATION

Shipboard helicopter operation; shipboard mechanical systems, postural stability analysis; vehicle and system simulation.

Jie Liu, PEng
Assistant Professor

RESEARCH

Lithium ion battery systems; machinery health condition monitoring; failure prognostics and health management; vibration and system control; intelligent mechatronic systems; smart sensing; machine learning; instrumentation and measurement.

APPLICATION

Power storage for applications in automotive, military, and communication; gas turbine engine health condition monitoring and failure prognostics; aircraft auxiliary power unit starter remaining useful life prediction; magnetic tunnel junction sensor for ultra-low magnetic field sensing; intelligent vacuums.

ACTIVITIES

- Steering Committee Member, Annual IEEE Prognostics and Health Management Conference (2013)
- Conference Panel Chair, IEEE PHM Software, Logic, and Reasoning (2012, 2013)
- Chair, Sensor Section, IEEE Reliability Society Technical Networks (2012, 2013)

Rong Liu, PEng
Professor

RESEARCH

Erosion/corrosion resistance/mechanisms of superalloys; slurry coating process optimization; analytical investigation of coating cracking and spallation; high-temperature tribology; heat treatment of superalloys and stainless steels; metal-on-metal bearings of orthopedic implants.

APPLICATION

These new designed and developed high-performance superalloys and their coatings are potential materials for high-temperature and severe wear/corrosion operation environments such as mechanical, oil, chemical, automotive and aerospace industries.

ACTIVITIES

- Lead Guest Editor, "High- and Superhigh-temperature Tribological Behavior of Tribological Materials and Coatings", *Advances in Tribology*
- Member, Scientific Committee, International Conference on Composites Engineering
- Session Chair, International Conference on Aerospace, Mechanical, Automotive and Materials Engineering (ICAMAME)
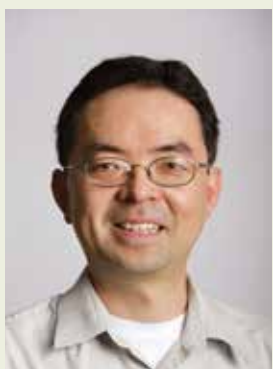
Edgar A. Matida, PEng
Associate Professor

Read more

RESEARCH

Aerosol science and technology (characterization and deposition); nozzle sprays; dispersed two-phase random-walk models; dispersed two-phase impinging jets; large eddy simulation (LES); laser-doppler velocimetry (LDV); particle image velocimetry (PIV).

APPLICATION

Pharmaceutical aerosols (pressurized metered dose inhalers) and add-on spacer devices; nasal drug delivery; diesel fuel characterization; airfoil-vortex interaction related to rotorcraft; fuel cell modeling.

ACTIVITIES

- Member, Editorial Board, *Journal of Aerosol Medicine and Pulmonary Drug Delivery*

Glenn McRae, PEng
Professor

Read more

RESEARCH

Studies of hydrogen solubility and delayed hydride cracking in zirconium alloys used in the nuclear industry, at Chalk River Laboratory and Argonne National Laboratory; solid state X-ray dosimetry for quality assurance of procedures to sterilize donated blood; design of targets for medical isotope production with accelerators; coupling neutron-activation analysis and single photon emission computed tomography to make a non-invasive 'nSPECT' bone-cancer imager, and a calibration 'flood' source; corrosion of high performance alloys, and rebar in concrete; development of electrochemical techniques to measure the integrity of protective coatings on beverage cans and helicopters; sustainable energy engineering for residential homes in the Arctic.

Craig G. Merrett
Assistant Professor

Read more

RESEARCH

Aero-servo-viscoelasticity; unsteady aerodynamics; stability analysis of viscoelastic structures; service life of viscoelastic structures; and multivariable optimization.

APPLICATION

Flight vehicle design and performance; renewable energy devices; composite materials; biological simulacra; components at elevated temperatures.

Ronald E. Miller, PEng

Professor

RESEARCH

Nano-mechanics; multiscale and molecular dynamics simulations of metallic and hydrocarbon systems; high-performance computing applications of multi-scale modeling in materials science; development of interatomic potentials for materials science.

APPLICATION

Delayed hydride cracking in nuclear reactors; oil breakdown mechanisms; effects of radiation on materials in nuclear reactors.

ACTIVITIES

- Invited Professor, Laboratory for Multiscale Mechanics Modeling, *Faculte des sciences et techniques de l'ingenieur, Ecole Polytechnique Federale de Lausanne*, Lausanne, Switzerland (2013-14)
- Symposium Co-Organizer, "From Atomistics to Reality: Spanning Scales in Simulations and Experiments", Society of Engineering Science, 50th Annual Technical Meeting (2013)

Fred Nitzsche, PEng

Professor
rotorcraft.mae.carleton.ca

RESEARCH

Aeroelasticity of fixed and rotary wings and "smart" structures technology.

APPLICATION

Reduction of noise and vibration in helicopters and wind turbines (vertical and horizontal axes).

ACTIVITIES

- Leader, Rotorcraft Research Group, Carleton University

- Visiting researcher/lecturer, University of Rome "La Sapienza" and University of Rome III, Italy; German Aerospace Centre (DLR) and Technical University of Braunschweig, Germany; and University of São Paulo, Brazil
- Member, American Institute of Aeronautics and Astronautics, Structural Dynamics Technical Committee and International Organizing Committee of International Conference on Adaptive Structures Technologies

Oren E. Petel

Assistant Professor

RESEARCH

Shock wave physics of condensed matter; high-strain rate deformation of multiphase materials; injury biomechanics; critical phenomena in energetic materials.

APPLICATION

The prevention of personal injury through the integration of novel materials in personal protective equipment for blast wave, ballistic impact, and general blunt impact protection. The development of novel diagnostics for instigations into concussion and traumatic brain injury.

ACTIVITIES

- Member of the American Physical Society, shock compression of condensed matter topical group

Joana Rocha
Assistant Professor

RESEARCH

Acoustics; aeroacoustics; aircraft noise; laboratory reproduction of flow-excited panel's response; analytical and numerical modeling for noise and vibration prediction; wind-tunnel testing and simulation of aircraft airframe noise; turbulence modeling; wind turbine noise; human voice and speech.

APPLICATION

Community noise reduction, development of quieter aircraft concepts, and structural design for reduced noise and vibration. Laboratory simulation of flight conditions, advanced wing trailing edge concepts, innovative airframe and engine liners design, cabin design optimization, and human vocal folds surgery.

Donald Russell, PEng (Nova Scotia)
Associate Dean (Academic Planning and Policy); Professor

RESEARCH

Dynamics and modeling of mechanical systems; biomechanics; interaction between mechanical and biological systems; prosthetic limbs; biomechanics of piano playing and related injuries; patient simulators.

APPLICATION

Improved design of prosthetic limbs; evaluating the relationship between piano techniques and the occurrence of piano playing related injuries.

ACTIVITIES

- Past-President, Canadian Medical and Biological Engineering Society
- Adjunct Professor, School of Music, University of Ottawa

Henry M. J. Saari, PEng
Associate Chair (Undergraduate Studies); Associate Professor

RESEARCH

Processing (powder metallurgy, casting, brazing and heat treatment) and properties of gas turbine materials (titanium aluminides, superalloys); corrosion of materials in supercritical carbon dioxide; supercritical carbon dioxide Brayton cycle development.

APPLICATION

New, lightweight, high-temperature materials to improve efficiency and power output of gas turbine engines; advanced gas turbine technology for high-efficiency power generation.

ACTIVITIES

- Executive Member, ASM International, Ottawa Valley Chapter

Jurek Sasiadek, PEng
Professor

Read more

RESEARCH

Guidance, navigation and control; robotics; sensor and data fusion; mechatronics; unmanned aerial vehicles; mobile robots; intelligent and adaptive control systems; autonomous systems; non-linear control; cooperative robot control; vision systems; global positioning systems; inertial navigation systems; control theory and application.

APPLICATION

Aerospace technologies; UAV, mobile robots for security; autonomous flying planes and helicopters, spacecraft formation flying; power plant stations; energy systems; heart and cardiovascular health monitoring using imaging and CT methods.

ACTIVITIES

- Director, American Council of Automatic Control
- Member, Council, International Federation of Automatic Control
- Technical Committee Member, AIAA Guidance, Navigation and Control

Steen A. Sjolander, PEng
Pratt and Whitney Canada Research Fellow; Chancellor's Professor

Read more

RESEARCH

Axial-flow compressors and turbines; experimental techniques for low-speed and transonic aerodynamics of turbomachinery; flow control for turbomachinery; gas turbine engines; low emissions; greenhouse gas reduction; supercritical carbon dioxide power cycles.

APPLICATION

Aircraft and industrial gas turbine engines; power generation units for low-emission and lower temperature, alternative heat sources.

ACTIVITIES

- Member, Turbomachinery Committee, American Society of Mechanical Engineers
- Member, College of Reviewers, Canada Research Chairs Program

Andrew D. Speirs
Assistant Professor

Read more

RESEARCH

Pathomechanisms of osteoarthritis; femoroacetabular impingement; quantitative analysis of medical imaging.

APPLICATION

Combining in vitro testing, medical image analysis and finite element analysis to better understand the potential mechanical causes of osteoarthritic (OA) degeneration of joints. Femoroacetabular impingement is closely linked with OA in the hip and can be used to study early events in the degenerative cascade.

ACTIVITIES

- Visiting Researcher at University of Bern, Switzerland (2011)

Choon-Lai Tan
Professor

RESEARCH

Computational mechanics/stress analysis; boundary element methods; fracture mechanics; anisotropic thermoelasticity; mechanics of composites.

ACTIVITIES

- Member, Editorial Board, *Computer Modeling in Engineering and Sciences, Electronic Journal of Boundary Elements; Advances in Fracture Mechanics*, book series, WIT Press, U.K.

- Conference sessional chair, International Conference on Computational & Experimental Sciences; Boundary Element Techniques conferences
- Member, International Scientific Committee, International Conference on Computational & Experimental Sciences; Boundary Element Techniques conference series; Asia-Pacific International Conferences on Computational Methods in Engineering

Steve Ulrich, PEng
Assistant Professor

RESEARCH

New adaptive control theories; nonlinear estimation techniques; real-time path-planning and guidance laws; computer vision; dynamics modeling; robotics.

APPLICATION

Development of the Spacecraft Robotics and Control Laboratory, to investigate autonomous spacecraft guidance, navigation, and control systems, formation flying, vision-based navigation for small satellites, and space robotic technologies for spacecraft proximity operations.

ACTIVITIES

- Member of the SPHERES Working Group at NASA Ames Research Center, California
- Postdoctoral Associate at the Massachusetts Institute of Technology's Space Systems Laboratory
- Session Chair at AIAA, IEEE, and IFAC conferences

Xin Wang, PEng
Professor

RESEARCH

Solid mechanics; linear and non-linear fracture mechanics; finite element method; fatigue and fracture analyses of engineering materials and structures; structural integrity assessment methods; material characterization and numerical simulation of metal forming process.

APPLICATION

Fatigue and fracture assessment of engineering components in pressure vessel and offshore and aerospace industries research enables testing and better prediction of fatigue and facture properties; development of advanced manufacturing process for metal forming industries.

ACTIVITIES

- Member, Scientific Committee and Session Organizer/Chair, ASME International Conference on Offshore Mechanics and Arctic Engineering (2010-11, 2011-12, 2012-13)
- Member, Editorial Board, *Advances and Applications in Mechanical Engineering* and *Technology* and *Journal of Aeronautics & Aerospace Engineering*
- Member, Technical Committee, ASTM E08 on Fatigue and Fracture Mechanics

Jo Y. Wong, CEng, PEng, FIMechE, FASME, FCSME

Distinguished Research Professor

RESEARCH

Ground transportation technology; off-road vehicle engineering; planetary rover mobility; road vehicle dynamics; applications of advanced technologies to vehicle engineering; air cushion technology; magnetic levitation systems.

ACTIVITIES

- Member, Editorial Board, *Vehicle System Dynamics, International Journal of Heavy Vehicle Systems, and Journal of Terramechanics*
- Past President, International Society for Terrain-Vehicle Systems

Metin I. Yaras, PEng

Chair; Professor

RESEARCH

Numerical and experimental study of fluid flow and heat transfer phenomena with a focus on flow instability, transition and turbulence.

APPLICATION

Study of instability and transition of wall-bounded, separated, and free shear layers through wind-tunnel tests and direct numerical simulations. Transition control in separated shear layers. Direct numerical simulation and experimental study of convection heat transfer in supercritical fluids as related to the cooling of fuel rods in Generation-IV nuclear reactors. Aerodynamics of lobed mixers with three-dimensional inflow velocity fields. Aerodynamics of low-Reynolds number airfoils for gas-turbine, UAV-propeller and wind-turbine applications. Development of a novel hydrokinetic turbine for tidal-current and river applications with improved power-to-size ratio. Computational study of blood flow in the aorta.

DEPARTMENT OF
Systems and Computer Engineering

CARLETON

The Department of Systems and Computer Engineering is one of the largest and most research-intensive departments of electrical and computer engineering in Canada and is recognized as one of the world leaders in software engineering and computer systems engineering.

Fourth-year projects for students include the development of a "robotic guide dog." Student teams develop and refine a system for navigation, communication and response.

The department has research strengths in communications, software design, computer systems, biomedical engineering, and technology management. Our communications research group is internationally recognized and supported by a strong team of faculty members. We have expertise in broadband and wireless communications and network communications. Researchers are collaborating with leading industrial partners to develop the next generation of broadband wireless communication networks. We have developed a strong biomedical research group, including two Canada Research Chairs, which has developed better methods for diagnosing diseases, improved the computer-assisted analysis of medical data and researched innovative systems, such as surgical simulators for training doctors.

Our software engineering research team is ranked as one of the best in the world and is internationally recognized. Team members have developed new methods of software validation and verification and have made advances in computer network intrusion detection.

Our team of computer systems researchers has been thriving for more than three decades; the computer systems program is ranked as one of the best in the world. Researchers are developing new algorithms for

cloud computing and security, and methods of artificial intelligence and multi-agent learning algorithms with applications in robotics. The department also has a prominent research group in simulation and visualization.

Core Themes

COMPUTER SYSTEMS ENGINEERING

Reliable computer systems underlie many modern systems. This requires careful engineering of software as well as trustworthy hardware-software co-design for systems that involve computers as an embedded element. Research is underway to devise effective middleware techniques for providing interoperability and performing resource management in large distributed systems, with applications to cloud computing. There is a substantial effort to model and improve the performance and reliability of software systems ranging from embedded communications software to enterprise service systems.

SOFTWARE ENGINEERING

Research focuses on technology evaluation (empirical software engineering) as well as the development of improved methodologies. Our overall objective is to offer effective and efficient methodologies to develop dependable software systems in aerospace, health care, telecom and security fields. Research pertains to many aspects of software engineering including, but not limited to:

- requirement engineering;
- model-driven engineering (mainly UML-based software development);
- software architectures;
- product lines;
- aspect-oriented programming;
- verification, validation and testing; and
- software maintenance.

COMPUTER COMMUNICATIONS, DISTRIBUTED SYSTEMS AND MULTIMEDIA

Research focused on advanced computer networks and contemporary computer applications includes:

- traffic modeling;
- algorithmic performance analysis;
- MPEG video;
- multicasting;
- IP;
- network security;
- information assurance;
- network architecture and applications;
- multimedia;
- animation;
- computer vision;
- virtual reality environments; and
- real-time, parallel and distributed systems.

DIGITAL AND WIRELESS COMMUNICATIONS

Reliable, efficient communication of voice and data (including images and video) is a cornerstone of the modern economy. Research in this area covers all aspects of communication, including:

- mobile wireless systems;
- optical networks;
- network traffic modeling and protocols;
- cellular, ad hoc and sensor networks;
- cross-layer optimization;
- compression algorithms;
- Voice-over-Internet-Protocol; and
- quality of service.

SIGNAL, SPEECH AND IMAGE PROCESSING

Focused on the acquisition and processing of data, including acoustic, voice, image, video and biomedical signals, research examines compression of data and reliable transmission over noisy wireless channels as the volume of data increases. Applications include:

- noise reduction;
- speech quality enhancement;
- Voice-over-Internet-Protocol; and
- improved video conferencing.

SYSTEM AND MACHINE INTELLIGENCE

Computer-based systems can undertake more advanced functions as their 'intelligence' increases. Research addresses issues on the spectrum of machine intelligence, from classical optimization and control to new methods such as genetic algorithms and swarm intelligence. Applications include improved:

- design of systems;
- control of robots;
- control of prostheses; and
- diagnosis of disease.
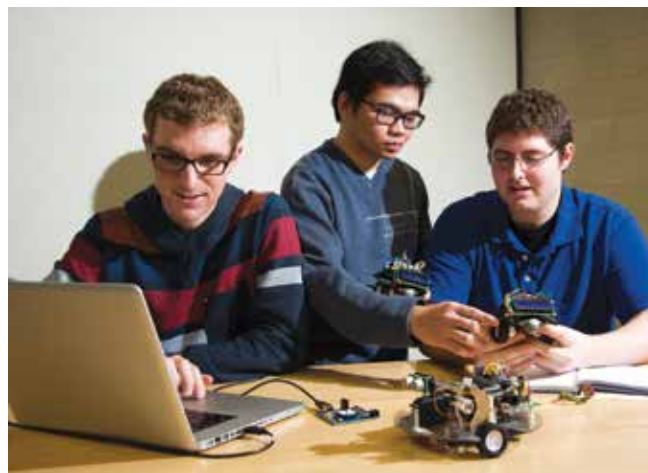
BIOMEDICAL ENGINEERING

Our research reflects the diversity and interdisciplinarity of biomedical engineering. The analysis of biomedical signals is a focus of this department, with particular emphasis on:

- ultrasound;
- NMR/MRI;
- electrical impedance tomography;
- infrared imaging;
- electrocardiography;
- electromyography;
- heart sounds;
- 'electronic nose' sensor data; and
- multisensory stethoscopes.

Alongside our work in the analysis of biomedical signals, we develop biomedical instruments and devices, such as

improved user interfaces for assistive devices, which rely on our strengths in signal processing and artificial intelligence. There is significant research activity in biomedical informatics, including both bioinformatics and clinical informatics.

TECHNOLOGY INNOVATION MANAGEMENT

The development and commercialization of new technologies is a process as complex as the technologies themselves. Research focuses on commercialization and business development beyond the laboratory, including methods to grow technology businesses, particularly during the early stages of the technology lifecycle. Applications include:

- capturing value from technology in open environments;
- product development management;
- venture capital and technology company creation; and
- management in the development of telecommunications technology intensive products and services.

Research Group

BROADBAND COMMUNICATIONS AND WIRELESS SYSTEMS CENTRE

The centre's interdisciplinary constituency includes Department of Electronics researchers engaged in wireless-related projects, and is one of the largest Canadian university research groups in wireless communications. Research and development in industry and government contribute to research at the centre.

Research topics cover:

- propagation and channel modeling;
- modulation;
- coding and synchronization;
- signal processing;
- radio resource management;
- multi-hop and cooperative communications;
- broadband wireless systems;
- ad hoc and sensor networks;
- wireless protocols for access multimedia and the Internet;
- mobile computing; and
- mobility management.

Research Facilities

TEXAS INSTRUMENTS EMBEDDED PROCESSING LABORATORY

The lab equips the next generation of engineers with the skills to develop innovative solutions across a wide array of electronics in some of the most exciting markets including medical, sustainable energy and smart grid, automotive and home automation. In addition to using TI embedded processors to power these systems, students also have access to TI's broad portfolio of analog technologies for a complete system solution.

ALCATEL-LUCENT ADVANCED NETWORKS LABORATORY

Carleton is the only Canadian university selected for Alcatel-Lucent's Research Partner Program, which fosters innovation through strategic research partnerships. The laboratory is equipped with three ATM switches, bridges and interface cards. Research focuses on computer networks to improve network management, performance, and quality of service through rapid analysis and quality control.

MITEL NETWORKS AND ANALOG DEVICES INCORPORATION VOIP LABORATORY

Based on the Mitel Integrated Communications Platform (ICP3200), the laboratory is equipped with 20 development stations, each with a PC and three phones (analog, digital, and IP). Other equipment includes:

- a speech quality analyzer;
- speech recognition system;
- video cameras; and
- quality-of-service testing equipment.

Research concentrates on Internet telephony, next-generation telephone equipment and services, and systems technology. Advanced technology in speech quality enhancement, high-fidelity stereophonic sound for telephones, and voice and speaker recognition is also pursued.

REAL-TIME AND DISTRIBUTED SYSTEMS LABORATORY

Performance and resource management aspects of parallel and distributed systems are explored, including matching the software architecture to the system requirements and evaluating implementation architectures (e.g., for scalability). New methodologies for hardware-software co-design are under development, such as the formalization of Use Case Maps notation and ways of designing event-driven software through software computer-aided design. Software performance engineering is also studied, including methods for predicting the performance of concurrent systems.

SOFTWARE QUALITY ENGINEERING LABORATORY

The laboratory focuses on applied software engineering research and is dedicated to developing new methodologies and prototype tools to produce higher quality software. Activities concentrate on the verification and validation of software systems with an emphasis on object-oriented systems and high-dependability systems. Model-driven development and object-oriented analysis and design with the Unified Modeling Language (UML), software quality assurance and control based on quantitative methods, and experimental software engineering are studied. The laboratory researches automated testing of object-oriented, distributed, and real-time systems and automated support for impact analysis of object-oriented designs and change management.

BIOMEDICAL ENGINEERING LABORATORY

Laboratory equipment includes:

- three thermographic cameras;
- a sixteen-channel biological signal acquisition system for collecting myoelectric signals, ECGs, and EEGs;
- AlphaMOS Prometheus and Cyranose electronic noses;
- electrical impedance tomography and respiratory inductance plethysmography systems;
- a benchtop NMR spectrometer; and
- ultrasonic medical imaging/measurement systems.

Advanced technologies being developed for diagnostics and treatment include:

- signal processing and compression of medical data in noisy environments;
- artificial intelligence systems for estimating clinical outcomes in neonatal intensive care and other medical situations;
- intelligent sensor systems for remote monitoring;
- myoelectric control of upper arm prostheses, prediction of gene regulation and protein structure and function through bioinformatics;
- diagnostic aid tool for rheumatoid arthritis;
- imaging of regional lung function using electrical impedance tomography; and
- ultrasonic medical imaging and diagnosis as well as applications in telesurgery and telemedicine.

Collaborators include the Children's Hospital of Eastern Ontario, University of Ottawa Heart Institute, Ottawa Hospital Rehabilitation Centre, Health Canada, and the SCO Health Service.

ADVANCED REAL-TIME SIMULATION LABORATORY

With a high-performance computing platform to support an advanced real-time simulation engine (including hardware in-the-loop and graphics workstations for human interaction), the laboratory is devoted to research into real-time modeling and simulation, and the creation and execution of very large and complex models with strong timing requirements. Research includes mechanisms for automatic generation of executable models derived from specifications of the systems and formal methods for modeling and simulation. Focus is on practical projects using advanced development tools and 3D visualization, such as model-based development of embedded and real-time applications, parallel and distributed simulation techniques, and interoperability of executing models.

We collaborate with McGill University, Concordia University, ACIMS (University of Arizona, USA), *Polytech de Marseille, Université de Nice/INRIA Sophia-Antipolis, Université Blaise Pascal* (France). The laboratory is a member of the Carleton University Centre for Visualization and Simulation.

HUAWEI-TELUS INNOVATION CENTRE FOR ENTERPRISE CLOUD SERVICES

A venue for cutting-edge research in cloud computing, students, faculty and industry partners research problems associated with enterprise clouds, including management of
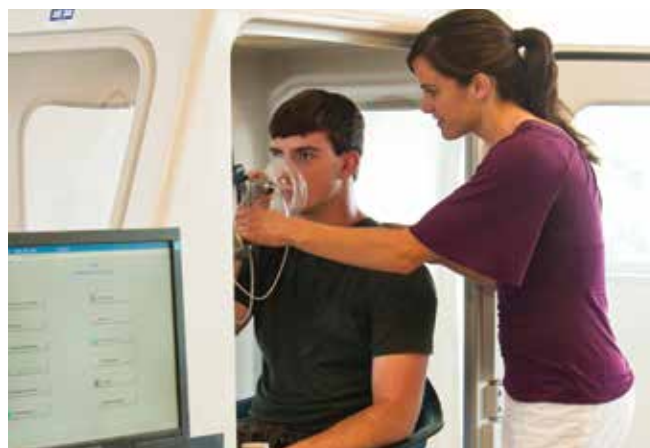
Biomedical students are developing new algorithms to assess asthma and obstructed breathing and comparing them to existing methods. Here, a spirometer measures the volume of air breathed in and out, while the sealed plethysmograph chamber detects changes in pressure to monitor lung volume and effort.

computing, on-demand storage and network resources, data-centre networking, scalability, business continuity and security.

Partners and Collaborators

Carleton University's location in the nation's capital provides easy access to major government research laboratories such as the National Research Council, the Communications Research Centre, Defence Research and Development Canada, and National Defence Canada.

Funding and Sponsorship

Our research is supported by a wide array of industry leaders including: Alcatel, Bell, BlackBerry, Ericsson, Huawei, IBM, IDT Canada, Intel, Mitel, Samsung, TELUS and many others. Several industrial partners have donated fully equipped laboratories for use in research and graduate training, including Alcatel-Lucent, BlackBerry, Huawei, IBM, Mitel, TELUS and Texas Instruments.

Graduate Programs

graduate.carleton.ca/programs

The MASc, MEng, and PhD in electrical engineering are offered through the Ottawa-Carleton Institute for Electrical and Computer Engineering, a joint initiative with the Department of Electronics at Carleton University and the School of Information Technology and Engineering at the University of Ottawa. This arrangement offers our students access to a wide range of graduate courses in electrical and computer engineering.

The MASc and MEng in technology innovation management provide advanced education at the interface of telecommunications technology and technology management.

The MASc in biomedical engineering is an interdisciplinary degree program offered through the Ottawa-Carleton Institute for Biomedical Engineering, which combines the resources of several departments at Carleton University and the University of Ottawa, and draws upon the expertise of medical research units.

Andy Adler, PEng

Canada Research Chair in Biomedical Engineering (Tier II); Professor

RESEARCH

Development of novel biomedical measurement devices and medical image and signal processing algorithms; biometrics imaging and security systems and associated algorithms, measurement devices, and privacy and security aspects.

APPLICATION

Electrical impedance tomography for monitoring of lung and heart functions; image reconstruction algorithms for ill-conditioned systems with correlated data; statistical models to compare human-versus-machine face recognition; demonstrated vulnerabilities in biometric encryption; algorithms to measures of biometric information content and sample quality; measuring parameters for conducted energy weapons safety.

ACTIVITIES

- Maintainer of open source toolkit for Impedance Imaging (www.eidors.org)
- Conference Chair, 2014 International Conference on Biomedical Applications of Electrical Impedance Tomography
- Member, Canadian Advisory Committee, ISO JTC1/SC37 Biometrics

Victor Aitken, PEng

Associate Professor

RESEARCH

Control systems; state estimation; data and information fusion; redundancy; sliding mode systems; non-linear systems; vision, mapping and localization; sensing, control and state estimation methods for navigation and guidance of unmanned vehicle systems; vision, state estimation and information fusion for robotics and biomedical applications.

APPLICATION

The research has been applied in large scale robotic landmine detection systems for the Canadian military, automation of underground mining machines for Canadian industry, and in detection and analysis of eye motion for automation of retinal surgery.

ACTIVITIES

- Member, IEEE International Conference on Automation and Logistics
- Member, IEEE International Workshop on Robotic & Sensor Environments

Samuel A. Ajila, PEng

Associate Professor

RESEARCH

Software engineering: re-engineering and maintenance; evolution and change management; aspects-oriented design and programming; data and knowledge-based management; cloud computing with emphasis on Virtual Machine (VM) migration; Service Level Agreements (SLAs); routing protocols.

APPLICATION

Research has been applied to software-intensive systems (real time and distributed systems), industrial processes, and data-intensive systems.

Tony Bailetti

Associate Professor

timprogram.ca

RESEARCH

Technology commercialization; distributed product development; growing companies in open environments; open source software; technology company creation; design and implementation of methods to grow technology businesses, particularly during the early stages of the technology life cycle; capture value from technology in open environments; design and development of complex products.

ACTIVITIES

- Director, Technology Innovation Management program
- Vice-President, Research, Executive Council, Engineering and Technology Management Education and Research Council

Amir Banihashemi, PEng

Professor

Read more

RESEARCH

Digital and wireless communications; information theory and coding; theory and implementation of iterative coding schemes; network coding, compressed sensing, joint source-channel coding; multimedia transmission over Internet and wireless links; cooperative coding and communication; distributed source/channel coding; space-time coding and processing; analog decoding.

APPLICATION

Digital and wireless communications, communication networks, and signal processing.

ACTIVITIES

- Director, Broadband Communications and Wireless Systems Centre
- IEEE Senior Member
- Member, Technical Program Committee, ICC 2012 and ICC 2013

Adrian Chan, PEng

Associate Professor

Read more

RESEARCH

Biomedical engineering; biological signals (ECG, EMG, EEG); signal processing; pattern recognition; assistive devices; electronic noses.

APPLICATION

Multi-modal, non-invasive sensor systems for remote and/or portable monitoring (e.g., ambulatory ECG monitoring for myocardial ischemia detection); non-linear biological signal processing for prosthetic control and fatigue monitoring; detection and identification of bacteria using electronic noses.

ACTIVITIES

- Director, Ottawa-Carleton Institute of Biomedical Engineering (2012-present)
- Vice-President, Canadian Medical and Biological Engineering Society (2010-present)
- Chairperson, Advisory Board, READ (Research, Education, Accessibility and Design) Initiative (2012-present)

John Chinneck, PEng
Professor

RESEARCH

Optimization (i.e., determining an optimal choice when restricted by constraints); mathematical programming; operations research; modeling; mixed-integer programming; linear and non-linear programming, especially global optimization; heuristics; infeasibility analysis; algorithms to analyze and debug optimization models and to speed optimization solutions.

APPLICATION

Recent applications have been in improved task allocation in cloud computing, channel assignment in wireless mesh networks, 3G communications network planning, and data classifiers.

ACTIVITIES

- Editor in Chief, INFORMS *Journal on Computing* (2007-12)
- Program Committee, CP-AI-OR 2013, Yorktown Heights, New York
- Program Committee, ICORES 2013, Vilamoura, Barcelona

Richard Dansereau, PEng (Manitoba)
Associate Professor

RESEARCH

Digital signal processing; biomedical signal processing; multimodal and/or multi-channel signal separation and enhancement; joint audio-visual processing, scalable wavelet image/video compression; robust error-resilient video transmission; video quality metrics; quality of service (QoS); wavelets; fractal measures; chaotic dynamic systems.

APPLICATION

EMG signal decomposition to extract motor unit action potential firings, single channel speech separation, musical instrument separation from mixed recordings, speech enhancement using visual cues, fetal ECG signal separation from maternal ECG signal using phonocardiagram side information, and speaker tracking and speech enhancement.

Mohamed El-Tanany, PEng
Professor

RESEARCH

Wireless and wired communication systems; software defined radio receivers; synchronization of communications receivers for wireless radio channels; transmission techniques for wireless sensor networks under difficult propagation and interference conditions. Particular emphasis on experimental work and use of realizable DSP algorithms.

APPLICATION

Wireless sensor area networks in smart home environments, digital signal processing for the modeling and compensation for non-linearity and phase noise in LTE physical layer. Robust transmission techniques for wireless sensor networks in environments where the propagation conditions are particularly difficult.

Babak Esfandiari
Associate Professor

RESEARCH

Agent-based systems; network computing; object-oriented design and languages.

APPLICATION

Network supervision, autonomous robotics and the World Wide Web.

ACTIVITIES

- Editorial Board, *Computational Intelligence*
- Program Committees, AAAI 2013 Video Competition, ACM Workshop on Incentive and Trust in E-Commerce (WIT-EC'12 and 13), and 2013 Fourth Canadian Semantic Web Symposium

Greg Franks, PEng
Associate Professor

RESEARCH

Software performance engineering; analytic performance modeling using "layered queues"; discrete event simulation of distributed computer systems; reverse engineering of distributed software systems through trace analysis; model building, solution and analysis process; software engineering; operating systems; operating system schedulers.

APPLICATION

Performance models are used to set performance budgets for components, to find feasible designs and to locate bottlenecks, and to plan the resources for installed systems, thus reducing risk and leading to substantial cost savings for performance-sensitive projects. Building models automatically from traces of systems substantially reduces the need for expert practitioners, thereby expanding the use of modeling tools.

ACTIVITIES

- Publicity Co-Chair, ICPE (2012)

Monique Frize, PEng, IEEE Fellow
Distinguished Research Professor

RESEARCH

Biomedical engineering; thermal medical image collection and analysis; ethics for engineers; women in science and engineering; artificial intelligence tools applied to decision-making in the clinical environment; medical equipment management in developed and developing countries.

APPLICATION

Clinical decision-making tools for physicians and parents, e.g., estimating pre-term births and delivery mode, outcomes for neonatal intensive care infants. Thermal imaging to assess pain, potential musculoskeletal injuries in piano players, level of inflammation in rheumatoid arthritis patients. Development of medical technology management model in industrialized and developing countries.

ACTIVITIES

- Council member, International Union for Physical and Engineering Sciences in Medicine
- Editorial Boards, *Biomedical Engineering Online, Medical Engineering & Physics*
- President, INWES Education and Research Institute

Rafik A. Goubran, PEng, IEEE Fellow, CAE Fellow

Dean; Professor

RESEARCH

Digital signal processing and its applications in biomedical engineering, sensors, smart homes, and speech processing; echo and noise cancellation, pattern recognition, and classification.

APPLICATION

Patient monitoring using non-intrusive sensors (pressure-sensitive mats); environmental sensors (RFID and electronic noses); smart-phone based sensors (accelerometers); wearable sensors (ECG, skin conductance, breathing); heart and lung sound analysis; thermal imaging; smart hearing aids; speech quality enhancement; broadband and stereophonic VoIP; and smart multimedia VoIP terminals.

ACTIVITIES

- Co-Leader and Research Scientist, TAFETA, Elisabeth Bruyere Research Institute (2005-present)
- Member, Technical Program Committee, IEEE-MeMeA and IEEE-I2MTC (2009-present)
- Chair, Council of Ontario Deans of Engineering (2009-11)
- Executive Committee, Global Engineering Deans Council (2013-16)

James Green, PEng

Associate Professor

RESEARCH

Biomedical informatics; machine learning; pattern classification; proteomics; assistive devices; real-time patient monitoring; high performance computing on the multicore processors.

APPLICATION

Characterization of protein structure, interaction and function from sequence. Prediction of post-translational modification of proteins. Hardware acceleration of bioinformatics algorithms. Computational identification of thyroid response elements. Development of novel assistive devices for persons with disabilities and the elderly.

ACTIVITIES

- Academic Co-Chair, 2013 Joint Conference of the Canadian Medical and Biological Engineering Society and *L'Association des Physiciens et Ingénieurs Biomédicaux du Québec*
- Associate editor, CCECE 2012 Biomedical Engineering and Health Informatics track
- Secretary, IEEE EMBS Ottawa Chapter (2007-present)

Roshdy Hafez, PEng

Chair; Professor

RESEARCH

Wireless theory; local access technologies: OFDM, CDMA; 3G/4G broadband wireless access; LANs and ad hoc networking; RF design and integrated fibre/wireless local loops with applications in sensors networking and ad hoc coverage extensions; wireless security, monitoring and control; broadband access in rural areas.

Changcheng Huang, PEng
Professor

Read more

RESEARCH

Traffic modeling and fast simulation techniques; network congestion control and Quality of Service (QoS) mechanisms; network failure detection and protection mechanisms; Internet architecture and protocols; QoS issues in wireless and sensor networks.

APPLICATION

Virtual private networks peer-to-peer multimedia services; voice over IP services; environmental monitoring; traffic engineering for carrier networks.

ACTIVITIES

- Member, Technical Program Committee, International Conferences and Workshops

Thomas Kunz
Associate Chair (Graduate Studies); Professor

Read more

RESEARCH

Ad hoc networks and sensor networks: network protocol issues, middleware, and innovative applications, e.g. Quality of Service support; maximizing the network capacity through appropriate MAC and routing protocols; performance and fairness of TCP; clock synchronization and localization protocols; smart grid/smart homes.

ACTIVITIES

- Guest Editor, Open Mobile Platforms, *Open Source Business Resource* (2010)
- Co-Chair, Technical Program Committee, Wireless Models, Simulations and Experiments Track – IFIP Wireless Days (2011)
- Co-Chair, Workshop on Multihop Wireless Network Testbeds and Experiments, Istanbul, Turkey (2011)

Yvan Labiche, PEng
Associate Professor
squall.sce.carleton.ca

RESEARCH

Software verification and validation; model-based testing; software testing (unit/integration/system, functional/structural, procedural, OO, real-time); software engineering; model-driven development; UML; search-based software engineering; empirical software engineering; technology evaluation.

APPLICATION

Telecommunication software; security (network intrusion detection, transportation); aerospace health (medical imaging systems).

ACTIVITIES

- Associate Editor, *Journal of Software Testing, Verification and Validation*
- Steering Committee, IEEE International Conference on Software Testing, Verification and Validation
- Program Co-Chair, IEEE International Conference on Software Testing, Verification and Validation (2012)

Ioannis (John) Lambadaris, PEng
Professor

Read more

RESEARCH

Applied stochastic processes; stochastic optimization; queuing theory; communication systems hardware; analysis and modeling of traffic in modern computer and communication networks; voice over IP (VoIP); architectures and performance evaluation; optimal control of optical networks; resource allocation and routing; congestion control for Internet; active queue management and scheduling algorithms; security applications; wireless sensor networks for remote control, surveillance and security; mixed analog-digital design; RF board design; RF transceiver architectures-signal integrity.

ACTIVITIES

- Member, IPC for the International Conference on Next Generation Networks & Services 09 (2012)
- General Chair, Communications Networks and Services Research conference 2011
- Technical Program Committee Representative, IEEE Globecom 2011 (Wireless Networking Symposium)

Peter Xiaoping Liu, PEng
Canada Research Chair in Haptics Technologies (Tier II); Professor

Read more

RESEARCH

Network-based teleoperation and telerobotics; context-aware networks; haptics; robots and intelligent systems.

APPLICATION

Telesurgery, minimally invasive surgery; and surgery training systems.

ACTIVITIES

- Leading Guest Editor, Wireless Mechatronics, *IEEE/ASME Transactions on Mechatronics* (2011)
- Leading Guest Editor, HAVE, *IEEE Transactions on Instrumentation and Measurement* (2011)
- Associate Editor, *IEEE Transactions Automation Science and Engineering*

Chung-Horng Lung, PEng
Associate Professor

Read more

RESEARCH

Software engineering, performance engineering, architecture and re-engineering; domain engineering; autonomic computing; computer networks; software-defined networking, traffic engineering; security, network measurement, quality of service; wireless ad-hoc networks; sensor networks; methods to facilitate teleoperations from the network perspective; distributed systems: cloud computing, web services, load balancing, and XML routing and filtering.

APPLICATION

Increasing system/software performance and improving software quality; improving network performance and enhancing network robustness.

ACTIVITIES

- Technical committee member, conferences including: IEEE ICC 2011-13, IEEE GLOBECOM 2011-13, IEEE IWCMC 2013, ICNC'14, IEEE COMPSAC 2011, ACM SAC 2013

Shikharesh Majumdar, PEng

Professor

Read more

RESEARCH

Resource management on clouds and grids, and on wireless sensor networks; mobile Web services; XML filtering and forwarding; middleware; operating systems; telecommunication systems; smart facilities management; distributed systems; performance modeling and optimization.

APPLICATION

Cloud for sensor-based bridge infrastructure management; utility computing, cloud computing, scientific computing, high performance systems, telecommunication systems, medical information systems, enterprise extranets.

ACTIVITIES

- Director, Carleton University Research Centre on Real Time and Distributed Systems
- Area Editor, *Simulation Modeling Practice and Theory*
- General Chair, IEEE/ACM International Conference on Cluster, Cloud and Grid Computing (2012)
- Member, Steering Committee and Program Committee of several international conferences

Andrew Marble, PEng

Assistant Professor

Read more

RESEARCH

Integrated systems combining hardware, pulse sequences, and signal processing techniques for low field NMR and MRI; development of new optimization techniques to allow magnetic fields to be created from more compact instruments.

APPLICATION

Using above research and new signal processing and control techniques, design and develop a family of small, low cost MRI equipment with applications in non-destructive testing for both healthcare and material science.

Ian Marsland, PEng

Associate Professor

Read more

RESEARCH

Digital communication; wireless communication; equalization; MIMO systems; iterative detection and decoding; error control coding; advanced receiver architectures for efficient wireless communication systems.

APPLICATION

Wireless systems that are capable of serving more people with increased reliability and transmission speeds.

ACTIVITIES

- Technical Program Committee, IEEE Vehicular Technologies Conference (2013)
- Member, PEO Emerging Disciplines Task Force

Yuu Ono, PEng

Associate Professor

RESEARCH

Sensors, technique and system for biomedical monitoring/diagnosis/characterization; ultrasound measurement and imaging.

APPLICATION

Physiological monitoring; medical imaging and diagnosis; biological tissue characterization; real-time monitoring, control and optimization of material processes; materials characterization; and non-destructive evaluation of products and structures.

ACTIVITIES

- Session Chair, IEEE MeMeA Symposium, Gatineau, QC, 2013
- Technical Program Committee, Annual CMBES Conference, Ottawa, ON, 2013
- Member, organizing committee, Ultrasonic Electronics Symposium, Kyoto, Japan, 2013
- Vice-Chair, IEEE EMBS Ottawa chapter, 2007-present

Trevor W. Pearce, PEng

Associate Professor

RESEARCH

Real-time systems; real-time operating systems; embedded systems; real-time simulation; computer engineering education.

APPLICATION

Increasing the use of modeling and simulation in the engineering of real-time systems; improving the application of hard real-time system performance prediction by accounting for run-time overheads more accurately.

ACTIVITIES

- Member, Drafting Committee, IEEE Standard Modeling and Simulation, and High Level Architecture

Dorina C. Petriu, PEng, CAE Fellow, EIC Fellow

Professor

RESEARCH

Software performance engineering; model-driven software development; real-time and distributed software; model transformations; integrating performance analysis in the software development process.

ACTIVITIES

- Member, NSERC Evaluation Group for Discovery grants in Computer Science (2010-14)
- Guest editor (two special issues) and member, Editorial Board, *Software and Systems Modeling* (SoSyM):
- Steering Committee for two conferences and Program Committee for 10 conferences and workshops in 2012 and 2013

Howard Schwartz, PEng
Professor

RESEARCH

Reinforcement learning, multi-robot learning, adaptive control, robot control, system identification and estimation; computer learning, with focus on robotic applications; fuzzy control, system identification and estimation are developed to automatically adjust and adapt robot behaviour; genetic algorithms and game theory.

APPLICATION

Working with industry to enhance robot situational awareness for bomb disposal. Use of robots for perimeter security. Working with industrial partners to develop learning models for cellular network synchronization. Robots learn how to work together and how to compete for applications in security, mapping and search and rescue.

ACTIVITIES

- Associate Editor, *IEEE Transactions on Cybernetics*
- Member, Technical Program Committee, International Conference on Control and Applications (2011)
- Chair, Session on Machine Learning, American Control Conference (2011)

Jérôme Talim, PEng
Associate Chair (Undergraduate Studies); Assistant Professor

RESEARCH

Internet of Things modeling; resource allocation, pricing and reservation in a cloud computing environment.

APPLICATION

Development of Web desktop and rich Internet applications and mobile applications. General framework for collaborative working environment.

Gabriel A. Wainer
Professor

RESEARCH

Modeling and simulation methodologies; real-time and embedded systems; parallel and distributed simulation; Web-service oriented simulation.

APPLICATION

Forest fire spreading; biomedical applications; embedded real-time software development; computer networks performance; defense and emergency response; crowd and evacuation simulation; simulation in architecture.

ACTIVITIES

- Vice-President, Conferences Society for Modeling and Simulation International, San Diego, CA USA (2012-Present)
- Special Issues Editor, *SIMULATION* (2008–present)
- Member, Editorial Board, *IEEE Computing in Science and Engineering* (2012-Present)

Michael Weiss

Associate Professor

timprogram.ca

RESEARCH

Open source; business ecosystems; mashups; patterns; and social network analysis.

Murray Woodside, PEng

Distinguished Research Professor

Read more

RESEARCH

Improving the performance of complex distributed computer software by the use of performance models; deriving models from annotated software designs in UML; deriving models from traces and other measurements; model-solving algorithms; strategies and tools for performance improvement; usability of modeling; accuracy of solutions; architectural patterns for high-performance systems. Autonomic control based on models, and estimation of model parameters and structure by tracking filters.

APPLICATION

Many applications from web services and enterprise computing through communications switching systems and voice-over-IP to embedded systems; autonomic systems; component-based software; product lines; modeling of mechanisms that enhance reliability and security.

Halim Yanikomeroglu, PEng

Professor

Read more

RESEARCH

Physical, medium access, and networking layers, and the cross-layer aspects of wireless communications systems and networks; radio access network (RAN) architectures; relay/multihop/mesh networks; cooperative communications; radio resource management; cognitive radio, spectrum, opportunistic spectrum access.

APPLICATION

Personal, mobile, cellular, and wireless communication systems and networks (including LTE-advanced, 4G, and beyond-4G).

ACTIVITIES

- Editor, *IEEE Transactions on Communications*
- Technical Program Co-Chair, IEEE Wireless Communications and Networking Conference 2014
- Steering Committee Member, IEEE Wireless Communications and Networking Conference

AZRIELI SCHOOL OF
Architecture and Urbanism

CARLETON

Architecture is a built reflection of our culture and an active participant in changing culture. Architects have a deep concern for society, culture and the urban environment, and a passion for turning imagined ideas into reality.

The discipline of architecture involves a critical examination of the material structure of buildings, the art of documentation and representation, the design of details, buildings and urban scale interventions, the theoretical context of built and un-built work, the conservation and sustainability of the built environment, and establishing a critical framework to evaluate these ideas. Through careful consideration of a series of complex orders, architecture must also improve the physical and mental well-being of its occupants and visitors.

Students design and build full-scale pavilions along the river bank on the Carleton campus in the annual "Dinner is Served Design/Build Event." The teams serve dinner to invited guests who judge each project on landscape sensitivity, structure, lighting, sitting/setting, wood construction, interaction, cuisine, etc.

Our school is recognized nationally and internationally as having unique research trajectories in the fields of structural imagination, hand drawing and digital media, simulation and digital fabrication, materiality, conservation, sustainable construction technologies, modern architecture and modernity, urban design, suburban re-design, critical practice and critical theory, lighting and set design, and architectural histories.

Research Groups and Facilities

CARLETON IMMERSIVE MEDIA STUDIO (CIMS)

CIMS is an interdisciplinary research unit that intertwines content-based and applied-research agendas to investigate applications for emerging digital and network technologies in the creation and dissemination of cultural content related to architecture. CIMS develops tools, processes and techniques that transform data into tangible and meaningful artifacts that have an impact on the way we see and work

in the world. Research in CIMS explores and develops innovative symbiotic relationships between the digital and fabricated 2D and 3D modes of representation.

Located in the Visualization and Simulation Building (VSIM), the facility is equipped with access to LightPath and CANet4 connectivity. CIMS' state-of-the-art fabrication and communications technologies, including the Hybrid Training and Research Laboratory, are designed for remote collaborative research projects. Past and current projects address:

- heritage conservation;
- remote collaborative design;
- medical imaging; and
- visualization of simulation models.

CARLETON DE-FORMATION CLUSTER

Interdisciplinary research grounded in a sequence of structural de-forming operations such as composition/decomposition, weighing, ordering, deletion/supplementation, numerical analysis, and distortion. Architects design structures that organize, maintain, sustain and support the places that they forecast. Working methodologies involve historical studies and exploratory built parametric models and digital analysis leading to data for structural and architectural development.

Steph Bolduc's master's thesis in architecture featured a recreation centre as part of the proposal for future development of the Kitigan Zibi Anishinabeg First Nation.

CARLETON SOLIDS AND LIGHT TECTONICS LABORATORY FOR STUDIES IN MATERIALITY (CSALT)

Research in the CSALT laboratory focuses on the understanding, application and invention of the material culture of architecture, construction and design. Our objective is to research traditional material cultures, particularly those properties that have been displaced or forgotten. This historical framework acts as a springboard to inform new material understandings and "hybrid" constructions that contribute to the betterment of new and sustainable architecture and culture.

CSALT is located in the Architecture Building and hosts a materials library, testing facilities, and CNC milling. The lab has access to wood, metal, and "wet" workshops.

Graduate Programs

graduate.carleton.ca/programs

The Azrieli School of Architecture and Urbanism offers four graduate programs. The Master of Architecture is a studio-based, accredited professional program that focuses on innovation and creativity within theoretical and practical parameters. The Graduate Diploma in Architectural Conservation further develops knowledge and skills in the theory and practice of architectural conservation. The Master of Architectural Studies is a research-intensive post-professional program, and the PhD in Architecture is in the field of the culture of practice.

Read more about faculty members' research at carleton.ca/architecture/faculty-and-staff

K. S. Andonian, MRAIC
Professor

Read more

RESEARCH

Knowledge and info-technologies in architecture; early and medieval Christian church architecture; architecture and philosophy; systems design and social, economic, cultural and environmental sustainability; colour, texture and materiality of the other; genetics of urbanism; globalization, gentrification, urbanization.

ACTIVITIES

- Member, Conference Organizing Committee, InterSymp (2006-11)
- Organized and chaired 1st and 2nd International W/S on Broadening the Scope of Architectural Creativity, Finland and Turkey (2008-10)
- Organized and chaired 1st-4th International Symposia on Architecture of 21st Century – In Search of New Paradigms, Germany (2008-11)

Manuel Antonio Báez, MRAIC
Associate Director (Undegraduate Studies); Associate Professor

Read more

RESEARCH

Investigation of fundamental integrative principles of form, structure and generative processes in nature, architecture and engineering; development of research-related design concepts, construction systems, processes and educational methods; interdisciplinary research inspired by: the nature of materials and integrative processes, morphology, developmental biology, complexity theory, emergence and natural systems theory.

APPLICATION

Architectural design and construction.

ACTIVITIES

- Director, Carleton De-Formation Cluster, Azrieli School of Architecture and Urbanism
- Invited research presenter, Art and Technology, Creative Mornings™ Ottawa (2012)
- Invited research presenter, *Ideas Driving Innovation*, TEDx Carleton U (2010)

Sheryl Boyle
Interim Director; Associate Professor

Read more

RESEARCH

Non-visual senses in Italian Renaissance culture, sensory studies, materiality, adaptive reuse.

ACTIVITIES

- Director, CSALT
- Writings on material culture and sensory studies

- Member, C-RISE solar thermal research team, Carleton University
- Member, Centre for Sensory Studies, Concordia University

Yvan-pier Cazabon, MRAIC
Associate Professor

Read more

RESEARCH

History/theory of architectural technology; critical review of building practice and material application in diverse climates: comparative studies with emphasis on Canadian materials, construction techniques and design; international development and analysis with focus on historical conservation and preservation; theatre and performance: set-design and construction, lighting design, artistic direction.

ACTIVITIES

- Production of Shakespeare's *As You Like It,* a collaboration between the School of Architecture and Urbanism and the Department of English Language and Literature (2013)
- Directed Studies Abroad program to Trinidad & Tobago (2011 and 2012). In collaboration with Citizens for Conservation (Port of Spain), with a mandate to analyze, measure and document historically significant Trinidadian architecture.

Roger Connah
Associate Professor

Read more

RESEARCH

Deschooling Architecture: (il)literacy and hybrid critical writing; critical fictions and expanded architecture (critical pedagogies); the use and abuse of contemporary philosophy in architecture; calligraphisms: information and cognitive mappings (graphics, film and communication); trans-architectures; architecture, agency and activism. Interdisciplinary practices for architecture.

ACTIVITIES

- Organiser and moderator, Frascari Symposium: Towards a Critical Phenomenology, Carleton University (2013)
- Curator, *Steel Lives-Still Life*, by Norayr Kasper, Venice Biennale

Kelly Crossman
Associate Professor

Read more

RESEARCH

Interaction of architecture and contemporary thought with special reference to documentary records and texts in the context of critical, media and digital theory; nationalist ideologies and architectural conceptualization during the 19th and 20th centuries historiographical and formal themes in the history of Canadian architecture diffusion of modernist architectural ideology and modes of practice including the particular influence of Team X, CIAM and GSD Harvard.

ACTIVITIES

- Publisher and Editor, *Architecture and Ideas*, a Journal of the History, Theory, Criticism and Practice of Architecture

Janine Debanné
Associate Professor

RESEARCH

History and theory of architecture; Modernist residences of the National Capital Region (1950-70); postwar dwelling; reception and appropriation of built architecture including documentation from the point of view of dwellers and architects; poetics of architectural dimensions; architectural drawing and sketching as tools for ideation and communication.

APPLICATION

Public understanding of architecture, interpretation and explanation of the cultural significance of built ensembles and artifacts in Canada with a focus on Ottawa. Formulation of housing design strategies in urban areas, design teaching, urban analysis and planning, and design of public spaces.

Mariana Esponda
Assistant Professor

RESEARCH

Interaction between traditional techniques and new materials, with a special focus on assessment of traditional building technologies and to allow a new life through contemporary and sustainable use; development of reinforced concrete during the modern era to identify building technology, language-innovation, signs of deterioration and repair; adaptive reuse of historical buildings.

APPLICATION

Improved quality of heritage buildings and re-adaption of historical constructions with new uses and sustainable historical construction, while respecting the structure and traditional materials.

ACTIVITIES

- Guest editorship, *International Journal of Architectural Heritage*
- Member, Scientific Committee of the Latin American Congress of Historical Construction
- Member, ICOMOS Canada Scientific Committee

Stephen Fai, MRAIC
Associate Professor

RESEARCH

Representation of architecture; religion in architecture; microhistories.

APPLICATION

Hybrid representations; ethno-cultural materials and methods of construction; visualization (architecture, science, engineering).

ACTIVITIES

- Director, CIMS

Lucie Fontein
Associate Professor

RESEARCH

Hospitable design with an emphasis on daylighting; practical wisdom (phronesis) and the work of Carmen Corneil; C-Rise Foundation for Innovation grant to study seasonal energy storage; professional practice.

ACTIVITIES

- Visiting professor, University of Cincinnati

Benjamin Gianni
Associate Professor

RESEARCH

Housing history, typology and policy; urban and suburban morphology; historical development of suburbs; planned communities; urban design; post-WWII urbanism; smart growth and sustainable urbanism; renewal and redevelopment of public housing stock; judicial education; e-learning.

ACTIVITIES

- Vice-Chair and Chair, Building Committee, Board of Directors, Ottawa Art Gallery
- Co-organizer, *Suburban Planning Workshop*, sponsored by Carleton University, the City of Ottawa and the Embassy of France, Ottawa, ON (2012)
- Co-organizer, *Design for the Future: Sustainable Urban Design in Canada and the Netherlands*, conference sponsored by Carleton University and the Embassy of the Kingdom of the Netherlands, Ottawa, ON (2011)

Federica Goffi
Associate Director (Graduate Studies); Associate Professor

RESEARCH

History of visual representation. Study of sustainability and historical preservation. Aural architecture. Hybrid technologies and history of construction. History and theory of the notion of conservation. Micro-historical studies focused on time in its threefold nature of 'time', 'weather', 'tempo'.

APPLICATION

Hybrid Drawings. Conference Papers and Book chapters. Archival research.

ACTIVITIES

- Coordinator of Forum Lecture Series
- Member of AHRA (Architectural Humanities Research Association)

Paul Kariouk
Associate Professor

Read more

RESEARCH

Twentieth-century architectural history and theory; history and theory of landscape architecture; relationships between collective identity, memorialization and urban space.

ACTIVITIES

- Board of Advisors to the Dean for the School of Architecture, University of Virginia

Stanley Loten
Distinguished Research Professor

RESEARCH

Mesoamerican archaeology; architecture and the sites of Tikal, Guatemala; architecture of Altun Ha, Beliza and Lamanai, Belize; Andean archaeology; architecture at the pre-Inca site of Marcahuamachuco, Peru.

APPLICATION

Controlling architectural stratigraphy in ancient architectural structures of Central America and the Andean region.

Shelagh McCartney
Assistant Professor

Read more

RESEARCH

Urbanization and housing; vulnerable housing and urbanization processes; urban growth dynamics; urban design; urban morphology; aboriginal housing and land policy; private public development; real estate finance and development; strategic planning; research methods; negotiation and conflict.

ACTIVITIES

- Coordinator, Urbanism Program

Inderbir Singh Riar

Lecturer

Read more

RESEARCH

History and historiography of modern architecture; theories of post-war urbanism, including Team 10; technology and the avant-garde; megastructures and Canadian modernism; utopia and utopianism; world's fairs and ephemeral events.

Johan Voordouw, ARB (UK)

Assistant Professor

Read more

RESEARCH

Digital architecture; emerging modes of digital fabrication; relationship of technology to building tectonics and space production.

APPLICATION

Application of the work includes improved design workflow and linking the architectural design process with fabrication. These issues have implications both in an emerging pedagogical approach to architecture and the evolving nature of professional practice.

ACTIVITIES

- Ottawa Regional Society of Architects Committee
- ACSA Committee

SCHOOL OF
Industrial Design

CARLETON

The School of Industrial Design has a well-recognized, technically oriented design curriculum with strengths in materials and manufacturing processes, CAD applications, ergonomic functionality and environmentally sustainable design.

In collaboration with the Canadian Paralympic Foundation, students design prototype sport equipment.

The school conducts ongoing applied research in the areas of materials, manufacturing processes, prototyping methods, advanced visualization, extreme environments, sustainable design, human-oriented design, interactive product design, design research methods and strategic design planning. The school has an extensive track record with industry-sponsored research and collaborates in research initiatives in health care, rapid prototyping, and the application of interactive technologies.

Research Facilities

Ranked among the best in North America, our facilities include modeling and testing laboratories (wood, plastic, metal), two rapid prototyping machines, a mass-production/mould simulation laboratory and a paint booth. We provide a safe, professional and dynamic environment where students can learn the technical skills to physically build their projects.

Graduate Programs

graduate.carleton.ca/programs

The Master of Design advances knowledge through forward-looking design principles and interdisciplinary design practices that contribute to the strategic value of design. The research-focused program probes theoretical and research issues in strategic design planning, knowledge creation and dissemination, and interdisciplinary design development.

Read more about faculty members' research at id.carleton.ca/about-sid/people/faculty/

WonJoon Chung
Assistant Professor

Read more

RESEARCH

Design research; design synthesis; design-driven innovation; methods for idea exploration; jazz improvisation for interdisciplinary collaboration; principles of design sketches for idea visualization and generation; collaborative prototyping.

APPLICATION

Idea exploration methods for design-driven innovation for studio projects. Design idea exploration methods for design-driven innovation to foster creative and critical thinking processes. Curriculum development to foster design sketches for non-designers (i.e., business students).

ACTIVITIES

- Conference session chair, IDSA Education Symposium, IDSA International Conference (2012); and "Emotion-driven Design and Innovation", 2nd International Conference on Affective and Pleasurable Design, held in conjunction with the 5th International Conference on Applied Human Factors and Ergonomics (2014)
- Scientific Board member, 2nd International Conference on Affective and Pleasurable Design
- Visiting professor, Department of Human Environment & Design, Yonsei University, Seoul, Korea (September 1, 2013-June 30, 2014)

Lois Frankel
Associate Professor

Read more

RESEARCH

Interaction design with a focus on health, well-being and aging; user-centred design; ethnographic design research; sensory aspects of form and colour.

APPLICATION

Interactive product design; ethnographic design studies; jewellery design; wearable computing devices.

Thomas Garvey
Director; Associate Professor

Read more

RESEARCH

Product development for extreme and minimal environments; Japanese approaches and adaptations to minimal space living; population density and factors in the effective use of minimal space; emergency and medical response equipment; healthcare products and patient environments.

ACTIVITIES

- Industrial and Universal Design Taskforce, Global University Programs in Healthcare Architecture

Bjarki Hallgrimsson
Associate Professor

Read more

RESEARCH

Industrial design practice and product development; rehabilitation and ambulatory assistive devices, medical products manufacturing, prototyping; computer-aided design applications.

APPLICATION

Product design and development of new products; rollators and ambulatory assistive devices; plastic part design and manufacturing; expert witness patent litigation.

ACTIVITIES

- Rehabilitation Engineering and Assistive Device Technology Association

Lorenzo Imbesi
Graduate Program Coordinator; Associate Professor

Read more

RESEARCH

Design culture; theories of design; design thinking; inter/trans/post-disciplinary; critical design; design and society; interaction design; new technologies; artifacts, ethics and design; behaviours; design ethnography; experience design; service design; social innovation; design empowerment; prosumer; cultural jamming.

ACTIVITIES

- Editor, *Design Principles and Practices*: an International Journal
- Yearly English Journal Executive Committee, European Academy of Design
- Chair, 5th Design Principles and Practices International Conference, Rome, Italy (2011); 7th Design Principles and Practices International Conference, Chiba, Japan (2013)

SCHOOL OF
Information Technology

CARLETON

From gaming and virtual worlds, to the next generation of secure wireless networks, to advanced manufacturing using lasers and photonics, the School of Information Technology examines the technologies that will shape the future of business, health care and leisure.

Research programs in the School of Information Technology have three main themes: networking, interactive multimedia technologies, and photonic and laser technologies.

NETWORKING RESEARCH

Computer communication networks play an increasingly important role in the infrastructure of every business in a modern technological society. Research in networking covers all aspects of communication networks (such as the Internet), including:

- design;
- architecture;
- protocols;
- management; and
- control, security, and information assurance schemes for wireless/wired networks.

The group has secured grants from funding sources such as CFI, NSERC and OCE, and enjoys collaborations with major government labs, universities across Canada and around the world, and global industrial leaders, such as Cisco, Alcatel-Lucent, Avaya, and Solana Networks.

Researchers in network technology investigate stealthy worm attacks, Internet traffic flow, and increasing the mobility of wireless devices.

INTERACTIVE MULTIMEDIA RESEARCH

Advances in multimedia systems, human-computer interaction, and related technologies are changing the face of art, entertainment, communication, and many other services. Interactive multimedia is a broad research area that brings together topics from computer animation and game design to virtual reality, immersive environments, and multimedia-rich web applications. It deals with how new hardware and software systems can be used to create, interact with, and perceive new digital media content.

The facilities include motion capture studio, rendering farm, sound studio, prototyping equipment, and general purpose multimedia labs with audio/video equipment. The group has close ties with industry, such as IBM, Avaya, and Microsoft, and collaborates with researchers from Canadian and international universities. Research is supported by federal and provincial funders, such as NSERC, SHHRC, OCE and ORNEC.

PHOTONICS AND LASER TECHNOLOGY (PLT)

PLT influences virtually all aspects of modern life. From the common (checking email on a smart phone) to the extraordinary (life-saving laser surgery), PLT, the science of generating and harnessing light, has profoundly affected all sectors of industry, entertainment and communication.

Industries affected by PLT research include:

• telecommunications (optical networks, components);

• health (sensors and laser surgery);

• auto/aerospace manufacturing (high-power lasers);

• oil and gas (extreme environment sensing);

• entertainment (holograms, lasers, displays, etc.);

• mobile technologies (multiple optical components);

• clean energy (solar cells); and

• lighting (interior design, architecture).

Graduate Program

graduate.carleton.ca/programs

The master in Human-Computer Interaction (HCI) is delivered in collaboration with 13 schools and departments at Carleton. Open to students from a variety of disciplinary backgrounds in the human, technological or engineering sciences, HCI allows students to explore their native discipline while researching ways interactive technologies can make life easier and more pleasant for people at work, play and home.

Capture processing for animation, games and interactive applications.

Active gaming using accelerometer sensor networks as input to a dancing game.

Read more about faculty members' research at www.csit.carleton.ca

Ali Arya
Associate Professor

RESEARCH

Human-computer interaction; educational technologies; social and collaborative virtual environments; computer games; artificial intelligence; new media and digital art.

APPLICATION

Carleton Virtual (3D Virtual Environment for Education and Research); intelligent framework for procedural animation of human behaviours; multi-modal human-computer interaction for computer games and smart homes; museum navigation systems.

ACTIVITIES

- Editorial Board, *International Journal of Computer Games Technology*
- Editorial Board, *Open Cybernetics & Systemics Journal*
- Technical Committee, Euromedia Conference

Audrey Girouard
Assistant Professor

RESEARCH

Human-computer interaction; next generation user interfaces; interactions with flexible displays; tangible user interfaces; adaptive interfaces; reality-based interaction; entertainment technologies.

APPLICATION

Flexible phones and tablets, wearable computing, and games.

ACTIVITIES

- Coordinator, Interactive Multimedia and Design
- Program Co-Chair, ACM TEI Tangible, Embedded and Embodied Interaction Conference (2011)
- Guest Editor, Organic User Interfaces, *Interacting with Computers* (2013)
- Member, Technical Program Committee, ACM CHI Conference on Human Factors in Computing Systems, Work in Progress, ACM TEI, ACM ICMI International Conference on Multimodal Interaction, ACM Gamification

Chris Joslin
Associate Professor

RESEARCH

Real-time medical simulation, tracking, and imaging; scalable video coding and adaptation; physics-based and spatial audio reproduction; virtual reality and collaborative virtual environments; tracking soft surface objects.

APPLICATION

Pre-operative planning tools for surgeons and surgical training and evaluation tools for complex operations. User and device personalised video streaming, audio reproduction for games and collaborative systems, fully collaborative immersive environments for training and testing, and realistic facial animation.

ACTIVITIES

- Journal Editorial Boards: *International Scholarly Research Network Computer Graphics Journal; International Journal of Creative Interfaces and Computer Graphics; International Journal of Communications, Network, and Systems Science*
- Member, Joint Technical Committee 1, Sub-Committee 29 (Coding of Audio, Picture, Multimedia and Hypermedia Information), Standards Council of Canada (2005-present)
- Member, Technical Committee: International Conference on Multimedia Expo; ACM Multimedia; Computer Animation and Social Agents; IEEE Virtual Reality; Signal-Image Technology & Internet-Based Systems

Ashraf Matrawy, PEng, SMIEEE

Associate Director; Associate Professor

Read more

RESEARCH

Resilient and secure network and application architectures; attack-resilient network architectures; collaborative network and software architectures; geolocation, software-defined networking.

APPLICATION

Securing new computing paradigms such as cloud computing and pervasive mobile applications.

ACTIVITIES

- Coordinator, Network Technology
- Member, Editorial Board, *IEEE Communications Surveys and Tutorials Journal*
- Member, Technical Program Committee: IEEE/ACM Intl. Symposium on Cluster, Cloud and Grid Computing, IEEE International Conference on Communications, IEEE Global Communications Conference

Christopher W. Smelser

Assistant Professor

Read more

RESEARCH

Laser fabrication of optical components; light-matter interaction; fibre Bragg grating design and development; hybrid optical component design; non-linear optics.

APPLICATION

Optical sensor technology for implementation in structural, bio-chemical and environmental monitoring.

ACTIVITIES

- Coordinator, Photonics and Laser Technology
- Technical Committee, Bragg Gratings, Photosensitivity, and Poling in Glass Waveguides (2010-12)
- Session Chair, Bragg Gratings, Photosensitivity, and Poling in Glass Waveguides (2010)

Marc St-Hilaire

Associate Professor

Read more

RESEARCH

Computer networks; telecommunications network planning; network architecture; network optimization; mobile computing; next-generation wireless networks, wired and wireless communication networks; wireless sensor networks; smart home networking.

APPLICATION

Wireless/wireline communication systems; planning algorithms for service providers; smart homes.

ACTIVITIES

- Publicity Co-Chair, WiMob (2012 and 2013)
- Workshop Co-Chair, Multihop Wireless Network Testbeds and Experiments Workshop (in conjunction with IWCMC 2012 and IWCMC 2013)
- Co-Chair, Technical Program Committee, Broadband Wireless Track: IFIP Wireless Days (2012)

Anthony Whitehead
Director; Associate Professor

RESEARCH

Entertainment technologies, video processing; computational video; image processing; computer vision; sensor networks as input devices; pattern matching; graphics.

APPLICATION

Video games, medical and therapeutic devices, television and film visual effects, animation systems, and personal sensor networks.

ACTIVITIES

- Chair, Human-Computer Interaction Program
- Review for/TPC for: IET, *ACM Computers in Entertainment, International Journal of Computer Technology*, and *IEEE Transactions on Visualization and Computer Graphics*

F. Richard Yu
Associate Professor

RESEARCH

Wireless/wireline networking; cross-layer design and optimization in wireless networks; security in wireless networks; green information technology; multimedia over wireless networks.

APPLICATION

Wireless/wireline networks systems, security and health monitoring systems.

ACTIVITIES

- Editor, *IEEE Transactions on Vehicular Technology*
- Associate Editor, ACM/Springer *Wireless Networks*
- Associate Editor, *EURASIP Journal on Wireless Communications and Networking*

Fostering Entrepreneurship

Carleton's Faculty of Engineering and Design fosters creative and inspirational researchers who are recognized by their communities for their work and the projects the explore. For a full list of our research highlights and faculty achievements visit: **carleton.ca/engineering-design/news** and **carleton.ca/engineering-design/research**.

Our Faculty attracts and inspires researchers who take strategic risks and think creatively. Carleton's academic focus on entrepreneurship encourages and supports our students to identify market opportunities for their ideas and commercialize their research.

More than 100 companies and start-ups have been created by Carleton alumni and faculty members, including established industry leaders such as GasTOPS, Solantro Semiconductor Corp. and ZIM, and new game-changers such as Smart Rotor Systems Inc. and GaitTronics.

Learn more about Carleton Entrepreneurs, a unique program that offers participants access to specialized expertise and support to help transform their business ideas into successful ventures, at **ventures.carleton.ca.**

CARLETON

GRADUATE STUDENT ENROLMENT FALL 2013

STUDENT LEVEL	MASTER'S	PHD
Academic Unit		
Architecture	103	9
Civil & Environmental Eng.	128	55
Electronics	111	47
Industrial Design	25	–
Information Technology	15	–
Mechanical & Aerospace Eng.	128	49
Systems & Computer Eng.	228	99
Engineering and Design - Total	**738**	**259**

A Brief History of the Faculty of

For more highlights, visit **carleton.ca/engineering-design/about/faculty-history**.

1942
Carleton College is founded.

1957
The School of Engineering is established.

1963
The Faculty of Engineering is established.

1968
The School of Architecture is established.

1973
The School of Industrial Design is established.

1983
The Ottawa-Carleton Institute for Electrical and Computer Engineering was formed.

1984
The Ottawa-Carleton Institute for Civil Engineering and the Ottawa-Carleton Institute for Mechanical and Aerospace Engineering are established.

1992
The Minto Centre for Advanced Studies in Engineering opens.

2000
Ottawa-Carleton Institute for Environmental Engineering is created.

Engineering and Design

2002

Carleton University and Algonquin College establish the School of Information Technology, which offers the Bachelor of Information Technology.

2003

Azrieli Pavilion approved to house the School of Information Technology, the National Capital Institute of Telecommunications, and the graduate program in architecture.

2006

The Ottawa-Carleton Institute for Biomedical Engineering is established.

2007

The Centre for Advanced Visualization and Simulation and the Human-Computer Interaction building opens.

2008

The School of Architecture is renamed the Azrieli School of Architecture and Urbanism in honour of an endowment from alumnus Dr. David J. Azrieli.

2011

The Canal Building opens. It houses state-of-the-art laboratories and research facilities in biomedical engineering, and sustainable and renewable energy engineering, including the Hydro Ottawa Laboratory for Smart Grid Technologies.

2012

Carleton opens the Huawei-TELUS Innovation Centre for Enterprise Cloud Services, the BlackBerry Teaching and Collaborative Research Centre, and the Delta Controls Laboratory.

2013

Carleton celebrates the 50th anniversary of the Faculty of Engineering and Design.

RESEARCH IN THE FACULTY OF ENGINEERING AND DESIGN AT CARLETON UNIVERSITY

The Faculty of Engineering and Design at Carleton University combines the engineering disciplines of Civil and Environmental Engineering, Electronics, Mechanical and Aerospace Engineering, and Systems and Computer Engineering with the design-oriented schools of Architecture, Industrial Design, and Information Technology. This unique Faculty is research-oriented, attracting millions of dollars in research funding every year, and drawing talented researchers including several Canada Research Chairs, and industrial donations of exceptional advanced research laboratories. Our dynamic graduate programs include some of the largest in their disciplines in Canada.

Carleton
UNIVERSITY
Canada's Capital University

Faculty of Engineering and Design
Carleton University
3010 Minto Centre
1125 Colonel By Drive
Ottawa, ON K1S 5B8

Office of the Dean:
Tel: 613.520.2790 | Fax: 613.520.7481

Associate Dean (Research)
email: GradAdminEng@carleton.ca

carleton.ca/engineering-design/research