Engineering at UWindsor

Tap into innovation

University of Windsor
Faculty of Engineering

uwindsor.ca/engineering/research

Engineering at UWindsor

Tap into innovation

At the University of Windsor, our dynamic team of engineers employs innovative and progressive solutions to solve the most pressing industrial challenges.

Tap into our world-class facilities, expert researchers and enthusiastic graduate students to turn your business challenges into opportunities.

The University of Windsor is home to some of the most unique engineering research in Canada. Whether it is vehicle light-weighting, alternative fuels, hybrid engines, renewable energy technology, new materials, reconfigurable manufacturing, casting technology, sensor development or micro-technology, the University of Windsor offers a wide variety of engineering expertise.

Much of this research happens in the Ed Lumley Centre for Engineering Innovation, a 300,000-sq. ft., state-of-the-art facility that features more than 80 research labs, an industrial workspace for collaborative work with commercial partners, one of the largest structures lab in Canada and will soon house a state-of-the-art clean room that will put UWindsor at the forefront of the rapidly growing field of nanotechnology.

This R&D hub directly connects education, research and industrial innovation.

The University of Windsor actively encourages faculty and their teams to engage industrial partners, and provides these collaborations with the facilities, infrastructure and resources to improve their capability and capacity to compete in a global market place.

The Windsor-Essex region boasts a highly educated and skilled workforce and provides quick and easy access to the Canada-United States border.

Our team is committed to building bridges between industry, research and education that will accelerate the transformation of ideas to products and competitive advantages.

1,500+
Undergraduate Students

2,000+
Graduate Students

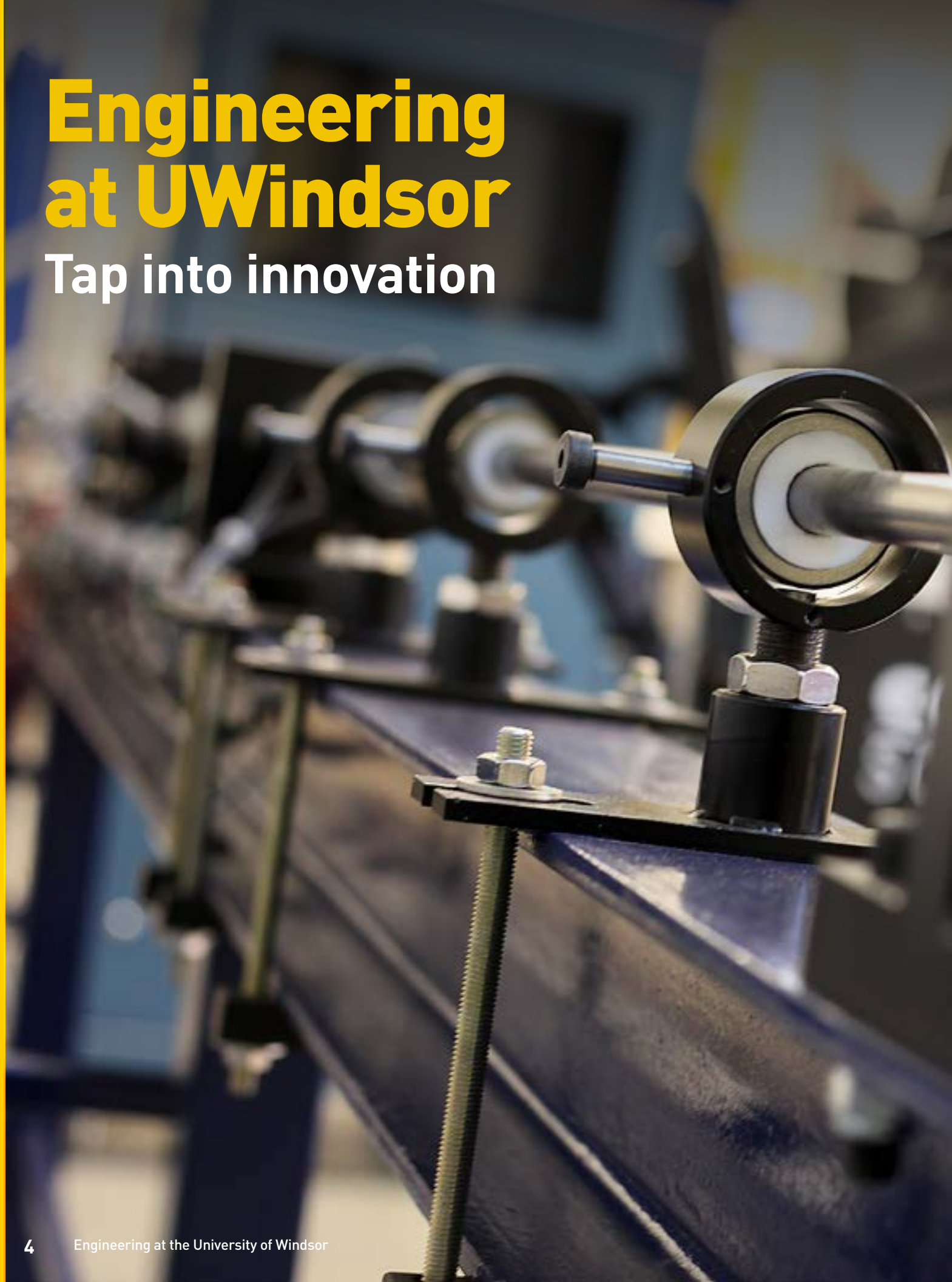
80+
State-of-the-art R&D Labs

Home to one of the largest structures labs in Canada

Construction of state-of-the-art clean room underway

Engineering at UWindsor

Tap into innovation



Contents

Engineering at UWindsor

Civil and Environmental Engineering Department

Dr. Abdul-Fattah Asfour

Professor

- Transport processes in non-electrolyte solutions in membranes
- Viscometric properties of lubricating oil

asfour@uwindsor.ca
519-253-3000, Ext. 2514

Dr. Ram Balachandar

Distinguished University Professor

- Fluid-structure interaction, sprays
- Scour and sediment transport, hydraulic structures
- Mixing, jets, wall jets
- Fluid flow with heat transfer

rambala@uwindsor.ca
519-253-3000, Ext. 3563

Computational Fluid Mechanics Laboratory
Hydraulic Engineering Laboratory
Sedimentation and Scour Laboratory

- Laser-based velocity measurement
- Water tunnel and open channel flumes
- Computational fluid dynamics
- Experimental fluid mechanics

Dr. Niharendu Biswas

Distinguished University Professor

- Water quality, drinking water disinfection
- Enzymatic treatment of industrial wastewater
- Hazardous waste treatment
- Water and wastewater in developing countries

biswas@uwindsor.ca
519-253-3000, Ext. 5032

Dr. Tirupati Bolisetti

Professor

- Hydrology and climate change impact assessment and adaptation
- Geothermal energy
- Evaporation from porous surfaces
- Grouting, scour

tirupati@uwindsor.ca
519-253 3000, Ext. 2548

Dr. Rupp Carriveau

Professor
Director of Environmental Energy Institute
Director of Turbulence and Energy Laboratory

- Terrestrial and offshore energy systems
- Energy storage and systems optimization
- Cybernetics and applied human performance
- Emerging agricultural practice

519-253-3000, Ext. 2638
rupp@uwindsor.ca

Environmental Energy Institute

- Energy analytics
- Energy policy development
- Energy training

Turbulence and Energy Lab

- Closed loop wind tunnel
- 10,000 gallon offshore testing tank
- Heat exchanger test rig

environmentalenergyinstitute.com
turbulenceandenergylab.org
osessociety.com

Dr. Shaohong Cheng

Professor

- Dynamics of structures
- Vibration and control
- Engineering application of advanced material
- Wind-induced response of structures and bluff body aerodynamics

shaohong@uwindsor.ca
519-253-3000, Ext. 2629

Boundary Layer Wind Tunnel Lab

- Open-loop boundary layer wind tunnel lab (study wind-related structural and environmental problems)
- Vibration control
- Application of advanced materials

Dr. Sreekanta Das

Professor

- Behaviour of masonry structures
- Structural and fatigue behaviour of steel pipelines
- Repair of corroded and damaged steel and concrete structures
- Application of special fibres and fibre composite in concrete and steel structures

sdas@uwindsor.ca
519-253-3000, Ext. 2507

Structural Engineering Testing Lab

- 680 m2 strong floor area with two 5m wide and 11m tall concrete strong walls with a high capacity MTS loading actuator for application of lateral load on wall specimens up to 10m tall
- Two large (500 kN and 250 kN) capacities fatigue loading frames and one small (100 kN) fatigue loading frame
- High capacity (up to 3000 kN) cyclic loading frame
- Capacity to apply pressure load up to 3000 psi
- Test frame for application of axial load along with uni-axial or bi-axial bending moments

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Dr. Faouzi Gherib

Professor

- Cable mechanics and vibration control
- Damage assessment of quasi-brittle materials (ceramics, concrete, etc.)
- Experimental mechanics (image processing, DIC)
- Seismic analysis of large structures (dams, bridges, etc.)

fghrib@uwindsor.ca
519-253-3000, Ext. 2506

Dr. Paul Henshaw

Department Head
Associate Professor

- Solar energy
- Automotive coatings application
- Greenhouse modelling

henshaw@uwindsor.ca
519-253-3000, Ext. 2588

Dr. Yong Hoon Kim

Associate Professor

- Connected and Autonomous vehicles (CAVs), Intelligent Transportation Systems (ITS), advanced traveler information systems
- Advanced driver assistance systems
- Transportation system analysis and modeling
- Traffic flow modeling and simulation

kim523@uwindsor.ca
519-253-3000, Ext. 2536

Dr. Jerald Lalman

Professor

- Waste to energy, food processing, municipal wastewater and water treatment
- Microbial destruction, petrochemical, fine chemicals and pulp and paper industries

lalman@uwindsor.ca
519-253-3000, Ext. 2519

Dr. Chris Lee

Associate Professor

- Traffic operation and control
- Traffic safety and driver behaviour
- Intelligent transportation systems
- Highway design

cclee@uwindsor.ca
519-253-3000, Ext. 2544

Transportation Systems Innovation (TSI) Lab

- Driving simulator (observe drive behaviour in various virtual traffic, road geometry and environmental conditions, and collect detailed driver maneuver data such as speed, acceleration, spacing, pedal position, etc.)
- Radar detectors and bluetooth data collectors (collect traffic counts and speed at fixed locations and estimate travel time)
- High-end computer facilities (perform analysis of large-scale traffic and crash data using statistical analysis and traffic simulation software)

Dr. Hanna Maoh
Professor

- Integrated transportation and land-use models
- Freight transportation analysis, travel demand modelling and forecasting
- GIS and big-data analysis, environmental impacts of transportation, sustainable transportation
- Micro-simulation methods and models in land use and transportation

maohhf@uwindsor.ca
519-253-3000, Ext. 4987
cbinstitute.ca/traffic-lab-general-information

Cross-Border Institute Traffic Lab

- Features LED Panasonic panels to display and analyze traffic in real time and RTMS radar sensors to detect and record border traffic in the Windsor region
- Fibre network connection with a powerful server and data storage array to enable the execution of computationally intensive traffic simulations and the storage of big data in timely fashion
- Up-to-date specialized software including, but not limited to, EMME 4.0.1, VISSIM 6.0 and ArcGIS 10.2 to promote cutting-edge transportation research

Transportation Systems Innovation Lab

- Eight professional LCD TVs to display and analyze traffic in real time
- Twelve high-end computers to accommodate 12 researchers at any given time
- A powerful, 16-core Dell server for software sharing and data storage, and high-end Intel Xeon workstations to run intensive simulations
- A partial-cab, research-driving simulator to observe driver behaviour under various driving and traffic conditions

Dr. Rajeev Ruparathna
Assistant Professor

- Infrastructure lifecycle management using building information modelling (BIM) tructural control
- Lifecycle assessment of engineering systems
- Multi stakeholder management in Sustainable procurement
- Risk based decision making

rajeev.ruparathna@uwindsor.ca
519-253-3000, Ext. 5433

Dr. Rajesh Seth
Professor

- Water and wastewater treatment
- Ozonation and advanced oxidation processes
- Microbial contamination and remediation
- Contaminant fate during sewage treatment process - monitoring/modelling/removal

rseth@uwindsor.ca
519-253-3000, Ext. 2553

Water/Wastewater Lab
- Batch/continuous flow experimentation
- Traditional and advanced water/wastewater analysis; Biohazard Safety Level 2 certified laboratory
- Instruments available include: UV-Vis Spectrophotometer; TOC/BOD/COD Analyzers; Atomic Absorption Spectrophotometer; Gas Chromatograph; High Performance Liquid Chromatograph; Ion Chromatograph

Dr. Edwin Tam
Acting Associate VP, Academic
Associate Professor

- Sustainability and resiliency in infrastructure systems and engineering
- Materials end-of-life waste management and recovery/vehicle recycling
- Brownfields renewal and redevelopment
- Life cycle assessment and approaches

edwintam@uwindsor.ca
519-253-3000, Ext. 2561

Materials Sustainability and Waste Management Lab
- Materials end-of-life classification
- Dismantling and size reduction
- Recycling feasibility investigations and assessment

Dr. Niel Van Engelen
Associate Professor

- Structural control
- Seismic and vibration isolation
- Pedestrian-induced vibrations
- Dynamic vibration absorbers

niel.vanengelen@uwindsor.ca
519-253-3000, Ext. 2509

Materials Sustainability and Waste Management Lab
- Materials end-of-life classification
- Dismantling and size reduction
- Recycling feasibility investigations and assessment

Dr. Bill Van Heyst

Dean, Faculty of Engineering
Professor

519-253-3000 ext. 2566
vanheyst@uwindsor.ca
Office: 2124 CEI

Water/Wastewater Lab

- Air quality issues associated with agricultural practices
- Odour generation & mitigation from cannabis production facilities
- Development of clean air technologies & solid state heating/cooling

Dr. Iris Xu

Professor

- Air quality monitoring and modelling
- Exposure assessment
- Emission control
- Measurement and parameterization of air-surface exchange of air pollutant

xxu@uwindsor.ca
519-253-3000, Ext. 2511

Air Quality Lab

- Monitoring equipment of mercury, particulate matter (PM), ozone, CO, SO2, NOx & ultra-fine particles

Engineering at UWindsor

Electrical and Computer Engineering Department

Dr. Esam Abdel-Raheem

Professor

- Digital signal, image and video processing
- Signal processing for communications
- VLSI implementations of signal processing algorithms and communication circuits

eraheem@uwindsor.ca
519-253-3000, Ext. 4795

Dr. Majid Ahmadi

Associate Dean of Engineering Research and Graduate Studies

Distinguished University Professor

- Digital signal processing
- Machine vision
- Pattern recognition and neural network architectures
- VLSI implementation and computer arithmetic

ahmadi@uwindsor.ca
519-253-3000, Ext. 5076

Research Centre for Integrated Microsystems

- Excels in the advancement of Microelectromechanical Systems (MEMS) including: sensors and filters, capacitive microphones and 3D-acoustical sensing, electromagnetic microactuators, acousto-magnetic transducers, optical switching MEMS, automotive sensors, custom MEMS sockets and MEMS RADAR, micropower generators atomic force microscopy.
- Invests research efforts in innovative digital signal processing and communication technologies including: massively parallel arrays and special architectures, computer vision and image processing, network security management, pattern recognition and document analysis.
- Carries out research in microelectronics including: encryption, testing of mixed signal integrated circuits, field programmable chips and systems, high-speed DSP systems, CMOS and nanoelectric circuits design.

Dr. Maher Azzouz

Associate Professor

- Modeling, analysis and control of power-electronic converters and their applications in grid integration of wind and solar farms
- Operation and control of active distribution networks
- Protection of power systems with renewable energy sources
- Power flow studies and energy management of hybrid ac/dc microgrids

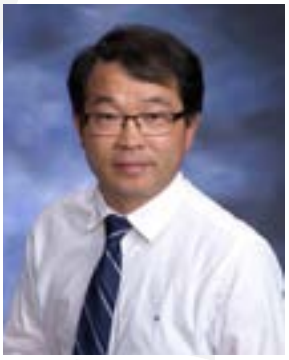
mazzouz@uwindsor.ca
519-253-3000, Ext. 5432

Dr. Balakumar Balasingam
Associate Professor

- Autonomous (cyber, physical, human) systems
- Signal processing
- Machine learning
- Information fusion

singam@uwindsor.ca
519-253-3000, Ext. 5431

Autonomous Systems Laboratory
- Battery management system development
- Human-machine system automation
- Multi-target localization, tracking and control



Dr. Chunhong Chen
Professor

- Synthesis and optimization of digital integrated circuits
- VLSI computer-aided design
- High-performance low-power systems
- Nanoelectronic circuit design

cchen@uwindsor.ca
519-253-3000, Ext. 2574

Dr. Xiang Chen
Professor

- Robust control
- Control of networked systems
- Field sensor network
- Data-driven optimization
- Automotive control

xchen@uwindsor.ca
519-253-3000, Ext. 2571

Dr. Sazzadur Chowdhury
Professor

- Microscale sensing and actuation
- Solid state radars
- Ultrasonic transducers
- 3-D packaging and integration

sazzadur@uwindsor.ca
519-253-3000, Ext. 4794

Microelectromechanical Systems (MEMS) Lab
- Dedicated to developing microsystems that improve health care, automotive safety and security. The MEMS Lab is equipped with state-of-the-art microfabrication equipment and software.

Dr. Arezoo Emadi
Associate Professor

- Micro Electro Mechanical Systems (MEMS)
- Bio-medical devices
- MEMS Sensors and Transducers, Chemical Sensors
- Micro and nano fabrication technologies

arezoo.emadi@uwindsor.ca
519-253-3000, Ext. 5496

Smart Sensor System Lab

- Leading multidisciplinary research on developing advanced smart sensor systems: E-nose technology
- Focuses on revolutionary cost-effective diagnostic sensor technology for cancer detection at an early stage
- Aims to accelerate the development of micromachined sensors and transducers for medical, environmental science and agriculture applications using state-of-the-art micro and nano fabrication technology
- Research and development activities to integrate robust and sensitive sensors in portable electronic

Dr. Shervin Erfani
Professor

- Computer and network security
- Data networking
- Communication network management
- Multidimensional digital filter realization

erfani@uwindsor.ca
519-253-3000, Ext. 4797

Dr. Narayan Kar
Tier 1 Canada Research Chair in Electrified Vehicles
Professor

- Optimized design of electric machines for electric vehicle application
- Electric machine control and testing
- Electric vehicle modelling, simulation and testing

nkar@uwindsor.ca
519-253-3000, Ext. 4796
chargelabs.ca

Centre for Hybrid Automotive Research & Green Energy (CHARGE)

- 150 kW and six-phase electric vehicle powertrain tester with temperature measurement and water cooling capability for the test motor
- 25 kW proof-of-concept motor endurance testers with noise and vibration testing chamber
- Custom-designed 80 kVA and 30 kVA back-back, IGBT-based converters
- Opal RT-based, rapid control prototyping motor test system and electromagnetic simulation software packages
- Electric and hybrid electric vehicles and vehicle simulation software such as Autonomie and Matlab
- Multiple oscilloscopes, power quality and energy analysers, contact and surface temperature measurement devices, DC supplies, position and speed sensors, three-phase and six-phase load banks, etc.

Dr. Mohammed Khalid
Professor

- Field programmable chips and systems, FPGA-based system design, rapid prototyping
- FPGA-based high performance computing, heterogeneous computing systems
- Electronic design automation, high level synthesis
- Embedded system design for automotive electronic systems and Internet-of-Things (IoT)

mkhalid@uwindsor.ca
519-253-3000, Ext. 2611

Research Centre for Integrated Microsystems (RCIM)

- Powerful computer workstations running state-of-the-art CAD tools
- CAD tools: VHDL/Verilog based simulation and synthesis, High Level Synthesis
- High capacity and high performance FPGA boards

Dr. Hon K. Kwan
Professor

- Digital filter, fuzzy neural network, and deep neural network design
- Discrete Gabor transform
- Evolutionary and multi-objective optimization algorithms
- Deep learning and machine learning for artificial intelligence

kwan1@uwindsor.ca
519-253-3000, Ext. 2569

Dr. Mitra Mirhassani
Professor

- Hardware realization of neural networks
- Hardware security
- Analog and mixed-signal integrated circuits

mitramir@uwindsor.ca
519-253-3000, Ext. 2585
shieldautocybersecurity.com

SHIELD Automotive Cybersecurity Centre of Excellence

- The first dedicated institution to security connected, autonomous, and electrified automotive & mobility systems with ground-breaking research, innovation, and partnerships.
- Creates research-based & application ready solutions that meet rapidly changing technology and threats
- Multi-disciplinary working on every aspect of automotive cybersecurity

Dr. Roberto Muscedere
Associate Professor

- Very Large Scale Integration (VLSI) & Application Specific Integrated Circuit (ASIC) design
- System level design
- Embedded systems

rmusced@uwindsor.ca
519-253-3000, Ext. 4798

Dr. Rashid Rashidzadeh
Adjunct Professor
Academic Planning Liaison, Faculty of Engineering

- Test methodologies for integrated circuits
- Radio Frequency Identification (RFID)
- Smart sensors and IoT

rashidza@uwindsor.ca
519-253-3000, Ext. 3931

Research Centre for Integrated Microsystems (RCIM)

- A research team with extensive auto industry experience
- Successful auto industry products in the market
- State-of-the-art tools to design and implement electrical and electronic circuits

Dr. Mehrdad Saif
Professor

- Systems and control theory
- Model based fault detection and diagnostics
- Linear and nonlinear controller/observer design
- Large scale systems, optimal and intelligent control

msaif@uwindsor.ca
519-253-3000, Ext. 2566

Dr. Ahmed Hamdi Sakr
Assistant Professor

- Connected and automated vehicles
- Vehicular Networks (V2V, V2I, V2X)
- ML/AI for wireless networks
- Internet of Things (IoT) and Wireless Sensor Networks (WSN)

ahmed.sakr@uwindsor.ca

Dr. Behnam Shahrrava
Department Head
Associate Professor

- Statistical communication theory
- Multiuser detection and channel estimation
- Iterative decoding algorithms
- Adaptive signal processing

shahrrav@uwindsor.ca
519-253-3000, Ext. 2572

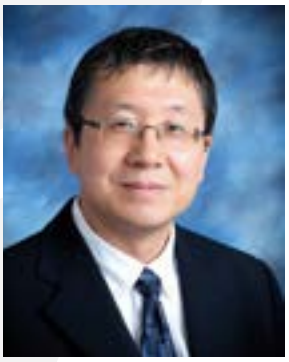
Dr. Kemal Tepe
Professor

- Wireless communication networks
- Network security
- Vehicle to Vehicle (V2V) and Vehicle to Infrastructure (V2I) communications
- Wireless sensor networks, Internet of Things (IoT) and Machine to Machine (M2M)

ktepe@uwindsor.ca
519-253-3000, Ext. 3426

Wireless Communications and Information Processing Lab (WiCIP)

- WiCIP focuses on designing reliable, energy efficient, and real-time, medium access control (MAC) and routing protocols for vehicular networks for safety and emergency applications and wireless sensor networks
- These protocols enable wireless communications to penetrate in such new applications as: smart grids; active safety and collision-avoidance systems in vehicles; control and monitoring in manufacturing and automation; data acquisition and collection from industrial processes; Internet of Things (IoT); machine-to-machine (M2M) communications; and e-health
- WiCIP's research activities are funded by Natural Sciences and Engineering Research Council of Canada, Canadian Foundation of Innovation, Federal Development Fund, and the Communication Research Centre of Canada



Dr. Huapeng Wu

Professor

- Public key cryptography, i.e., elliptic curve cryptosystem, RSA, NTRU, etc.
- Efficient computation in finite field and polynomial ring
- Cryptographic computations against cyber physical attacks

hwu@uwindsor.ca
519-253-3000, Ext. 2568

Dr. Jonathan Wu

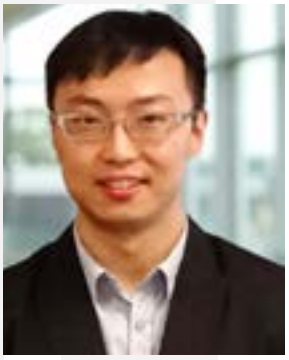
Professor

- Computer vision systems for active vehicle safety and driver assistance
- Machine learning and sensor fusion for autonomous driving
- Sensor technology and big data analytics for medicine and cross-border security
- Distributed sensing for industrial monitoring and automation

Computer Vision and Sensing Systems Laboratory

- 3D imaging, multispectral imaging, microscopic imaging
- Embedded vision systems

jwu@uwindsor.ca
519-253-3000, Ext. 2580



Dr. Ning Zhang

Canada Research Chair in Edge Computing and the Internet of Vehicles

Associate Professor

- Autonomous and connected vehicles
- Wireless networking and security, AI for networking
- Edge computing and Internet of things

ning.zhang@uwindsor.ca
519-253-3000, Ext. 5954

Engineering at UWindsor

Mechanical, Automotive and Materials Engineering Department

Dr. Walid Abdul-Kader
Professor

- Sustainable manufacturing systems, virtual factory design
- Performance optimization
- Modelling of manufacturing/remanufacturing systems
- Reverse Logistics Network

kader@uwindsor.ca
519-253-3000, Ext. 2608

Systems Optimization Research Centre
- Lean Manufacturing, 5S, Total Productive Maintenance, Value Stream Mapping
- Process modeling and optimization, facilities layout assessment and improvement
- Performance evaluation/enhancement of production systems

Dr. Jalal Ahamed
Associate Professor

- Micro/nano-electromechanical (MEMS/NEMS) based sensors and actuators
- Micro/nano-fluidic based lab-on-a-chip for biological systems
- Micro/nano-fabrication and characterization
- Mechatronics, controls and electronics

jahamed@uwindsor.ca
519-253-3000, Ext. 2682
uwindsor.ca/micronano

MicroNanoSystems Research Group
- Full cycle of development of MEMS/NEMS
- Theory, mask design, FEA modeling, fabrication, controls, electronics, packaging, imaging and testing
- Characterization expertise: SEM, TEM, AFM, XRD and Microscopy

Dr. Shahpour Alirezaee
Ancillary Academic Staff

- Control systems and automation, PLC, SCADA and DCS System
- Telecommunication systems
- Discrete-time signal processing
- Image processing and machine vision

alirezae@uwindsor.ca
519-253-3000, Ext. 7472

Mechatronics Lab
- Process Control and Automation Lab
- Manufacturing Production Systems(MPS) Lab
- PLC Lab

Dr. Ahmet Alpas
Professor

- Microstructure-mechanical property relationships
- Deformation and fracture mechanism
- Pattern recognition and neural network architectures
- Wear of materials, wear resistant coatings including plasma sprayed coatings, PVD coatings, galvannealed steels & metal matrix composites

aalpas@uwindsor.ca
519-253-3000, Ext. 2602

Tribology of Materials Research Centre
- Conducts fundamental and applied research on friction, wear and lubrication of advanced engineering materials, composites and surface coatings.
- Focuses on understanding and improving the friction and wear behaviour of lightweight materials, like aluminum, magnesium and their composites and developing novel coatings to protect them against wear.

Dr. Bill Altenhof

Professor

- Crashworthiness, impact testing, Finite Element Analysis (FEA)
- Experimental (destructive) testing, stress analysis
- Mechanical material testing and characterization under quasi-static and dynamic loading conditions
- Dynamics, machine design

altenh1@uwindsor.ca
519-253-3000, Ext. 2619

Crashworthiness, Impact and Materials Deformation (CIMD) Research Lab

- Large (45 kJ) and low (3 kJ) energy droptowers, pneumatic accelerator, split Hopkinson pressure bar apparatus allow for dynamic testing of materials and structures
- Digital image correlation system using high resolution low speed and high speed (Photron SA4) stereo cameras
- Computational deformation laboratory, allowing for large complex FE models to be studied having several millions of degrees of freedom

Dr. Ahmed Azab

Professor

- Production planning and scheduling
- Computer-assisted process and assembly planning
- Facility layout problem
- Decision Support Systems using advanced search methods and simulation

azab@uwindsor.ca
519-253-3000, Ext. 4958/5771
uwindsor.ca/pom

Production and Operations Management (POM) Research Lab

- Has partnerships primarily in the manufacturing sector, as well as healthcare, construction and agriculture
- Transformable/reconfigurable factory by Festo Inc.
- Stratasys FDM Additive Manufacturing machine
- PLM and digital manufacturing systems
- Optimization and discrete-event-simulation tools

Dr. Randy Bowers

Professor

- Steel and welding in support of North American industry and infrastructure
- Engineering education

rbowers@uwindsor.ca
519-253-3000, Ext. 2601

Dr. Aleksandr Cherniaev

Assistant Professor

- Composite materials: multiscale modeling, quasi-static and high strain-rate testing
- Impact mechanics of advanced materials: hypervelocity, high- and low-speed impact regimes
- Lightweight impact-resistant structures for space, aeronautical, automotive and other applications
- Applications of finite element (Lagrangian, Euler and ALE) and meshless (SPH, EFG) methods in structural impact and wave propagation problems
- Structural optimization for lightweight product engineering

aleksandr.cherniaev@uwindsor.ca
519-253-3000, Ext. 4136

Composite Materials and Lightweight Structures Research Centre

- Parameter identification for pre-existing and development of new constitutive material models for advanced materials to use in numerical simulations of static or dynamic processes
- Development of realistic micro-scale and meso-scale numerical models of materials with complex architecture
- Expertise in application of commercial finite element codes (LS-DYNA, AUTODYN, ANSYS) to problems involving complex composite layups, non-uniform through-the-thickness fiber distributions, static and impact loading, large deformations and erosion, composites crushing and material fragmentation
- Optimization of structures for minimal weight using commercially available tools and in-house optimization algorithms

Darryl Danelon

Learning Specialist

- Canadian colleges liaison and transfer student support
- Bachelor of Engineering Technology coordinator
- Undergraduate engineering design learning specialist

darryl.danelon@uwindsor.ca
519-253-3000, Ext. 5961

Dr. Jeff Defoe

Associate Professor

- Development and implementation of simplified models of fans and compressors for use in numerical simulations
- Assessment of the impact of non-uniform flows on the aerodynamic and acoustic performance of turbomachines
- Use of combined numerical and experimental approaches to gain insight into key physical mechanisms governing turbomachine and general fluid flow behavior

jdefoe@uwindsor.ca
519-253-3000, Ext. 5961

Turbomachinery and Unsteady Flows Research Group

- Expertise in computational fluid dynamics for internal flows (turbomachines, general flow devices)
- Expertise in computational aero-acoustics

Dr. Nickolas Eaves

Assistant Professor

- Developing fundamental and reduced numerical models for nanoparticle aerosol processes
- Combustion, internal combustion engines, gas turbines, jet engines
- Soot/particulate and other pollutant formation
- Alternative fuels and biofuels
- Atmospheric black carbon restructuring

nickolas.eaves@uwindsor.ca
519-253-3000, Ext. 5924

Nanoparticle Aerosol Computational Engineering (Nano-ACE) Group

- Development of reduced-order models for soot/particulate and other emissions from combustion devices (internal combustion engines, gas turbines, jet engines) suitable for parametric design studies

Dr. Afsaneh Edrisy

Acting Associate Dean - Academic
Professor

- Microstructures and mechanical properties relationship
- Tribology and fatigue of light weight alloys/ composites for automotive and aerospace applications
- Mechanical characterization of thin films and coatings
- Surface engineering (laser cladding and additive manufacturing)

edrisy@uwindsor.ca
519-253-3000, Ext. 2622

Materials and Tribology (MAT) Research Lab

- Tribology and fatigue of lightweight alloys/composites for automotive and aerospace
- Microstructures and mechanical properties relationship
- Titanium and aluminum alloys
- Mechanical characterization of thin films and coatings

Dr. Hoda ElMaraghy

Distinguished University Professor

- Enablers of changeable, reconfigurable and flexible manufacturing systems
- Co-evolution and co-development of products and manufacturing systems for economic and energy sustainability
- Product design, customization and variety managing
- Intelligent manufacturing systems, industry 4.0 enablers and learning factories

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uwindsor.ca/imsc

Intelligent Manufacturing Systems Centre (IMSC)

- The IMSC pursues leading-edge research in the multidisciplinary field of manufacturing systems and related topics from product design to manufacturing and the complete product life cycle
- The IMSC engages in projects with industry, networks and centres of research excellence, as well as international collaborations and exchanges. Its research is supported nationally and provincially
- The centre features the "iFactory" reconfigurable and changeable manufacturing system – a first in North America; the iDesign studio for innovation, collaboration, modelling, simulation and life cycle analysis; and digital metrology (DEA Mistral CMM) and physical prototyping (prodigy – dimensions) capabilities

Dr. Waguih ElMaraghy

Professor

- Design and development of smart products and systems
- Complexity management in design and manufacturing
- Sustainable and changeable products
- Systems and supply chains

wem@uwindsor.ca
519-253-3000, Ext. 3431
uwindsor.ca/imsc

Intelligent Manufacturing Systems Centre (IMSC)

- The IMSC pursues leading-edge research in the multidisciplinary field of manufacturing systems and related topics from product design to manufacturing and the complete product life cycle
- The IMSC engages in projects with industry, networks and centres of research excellence, as well as international collaborations and exchanges. Its research is supported nationally and provincially
- The centre features the "iFactory" reconfigurable and changeable manufacturing system – a first in North America; the iDesign studio for innovation, collaboration, modelling, simulation and life cycle analysis; and digital metrology (DEA Mistral CMM) and physical prototyping (prodigy – dimensions) capabilities

Dr. Amir Fartaj

Professor

- Vehicle thermal management
- Heating, ventilation, air conditioning and refrigeration (HVACR)
- Nano fluids, heat exchangers
- Phase change materials (PCM), battery thermal management

fartaj@uwindsor.ca
519-253-3000, Ext. 2618

Thermal Management Research Laboratory

- Integrated Thermal Wind Tunnel
- Thermophysical Property Analyzer

Dr. Peter Frise

Associate Dean, Professional Programs
Professor

- Mechanical design and packaging studies
- Plastic molding technologies and machinery troubleshooting
- Fatigue of large welded structures
- Development, management and governance of R&D programs

pfrise@uwindsor.ca
519-253-3000, Ext. 3888

Dr. Daniel E. Green
Professor

- Sheet metal forming, high strain rate deformation, hot stamping
- Mechanical testing, formability testing, material anisotropy
- Finite element modelling, process optimization
- Applications to automotive manufacturing

dgreen@uwindsor.ca
519-253-3000, Ext. 3887

Development and Optimization of Metal Forming Processes
- 240-ton, double-action, hydraulic press (36" x 24" bed size)
- Mechanical testing; formability testing; forming limit diagrams
- Microstructural characterization

Dr. Henry Hu
Professor

- Mathematical modeling, solidification behavior
- Light metal casting processes, development of light alloys and composites
- Die casting process control

huh@uwindsor.ca
519-253-3000, Ext. 2623

Advanced Lightweight Materials Processing Lab
- Squeeze casting machine
- Casting simulation software (Magmasoft)
- Electric resistance furnaces for novel materials preparation

Dr. Ofelia A. Jianu
Associate Professor

- Transport phenomena in energy systems to improve their overall efficiency
- Entropy and exergy-based methods to gain insight into multiphase flows with heat transfer

ofelia.jianu@uwindsor.ca
519-253-3000, Ext. 5943
intelligentfuelsandenergy.com

Intelligent Fuels & Energy Laboratory
- Focused on all aspects of the development of next generation energy technology including numerical and analytical modeling, design, and non-intrusive experimental methods
- Conducts research in intelligent fuels generation and utilization such as hydrogen, both experimentally and numerically
- Explores inefficiencies in macro-scale projects and delivers emissions and cost reduction solutions

Dr. Jennifer Johrendt
Associate Dean of Student Affairs, WINONE
Associate Professor

- Vehicle structural durability testing and simulation
- Neural network characterization of material properties and processing parameters
- Composites design for vehicle lightweighting
- Driver modeling from simulation & real-time data collection

j.johrendt@uwindsor.ca
519-253-3000, Ext. 2625

Vehicle Dynamics and Control Research Group
- Neural network modeling of large data sets
- Full vehicle durability data analysis

Dr. Eunsik Kim
Assistant Professor

- Occupational ergonomics, ergonomic intervention, physiological measurement and analysis
- Biomechanics, musculoskeletal disorders, manual material handling
- User-centered product design
- Gamification, engineering education

eskim@uwindsor.ca
519-253-3000, Ext. 5409

Dr. Bruce Minaker
Department Head
Associate Professor

- Vehicle dynamics and control
- Multibody dynamics
- Numerical modeling and simulation
- Suspension design

bminaker@uwindsor.ca
519-253-3000, Ext. 2621

Vehicle Dynamics and Control Research Group
- Multibody dynamics and related software development

Dr. Xueyuan Nie
Professor

- Plasma surface engineering, thin films and coatings
- Micro/nanoscale mechanics and tribology, corrosion
- N/MEMS device materials
- Biomaterials, nanomaterials and nanofabrication

xnie@uwindsor.ca
519-253-3000, Ext. 4148

Plasma Surface Engineering and Nanotechnology Lab
- Hard coating deposition equipment (for wear and corrosion resistance)
- Impact-sliding surface fatigue wear tester (simulating extremely high stresses)
- High speed tribometer (up to 10 m/s sliding velocity)
- Electrochemical corrosion tester

Dr. Colin Novak
Associate Professor

- Design and test for applications in automotive noise and vibration control
- Environmental noise and vibration control
- Study of binaural hearing perception and development of psychoacoustic metrics
- Structural modal test and control design for mechanical vibration properties

novak1@uwindsor.ca
519-253-3000, Ext. 2634

Noise, Vibration and Harshness Sound Quality (NVH-SQ) Research Group
- Hemi-anechoic test facilities
- 120 channel acquisition, beamforming microphone arrays, structural modal test facilities, durability shaker facility
- Jury test facilities Including NVH driving simulator and binaural heads for product sound acquisition

Dr. Leo Oriet
Professor

- Alternative vehicle drivelines
- Engine displacement downsizing
- Commercial vehicle fuel efficiency
- Former Auto Industry Senior Management Executive

loriet@uwindsor.ca
519-253-3000, Ext. 2699

Dr. Daniela Pusca
Associate Professor

- Engineering design, computer aided design
- Design for manufacturability and assembly
- Engineering education

dpusca@uwindsor.ca
519-253-3000, Ext. 2606

Dr. Afshin Rahimi
Assistant Professor

- Model-based and data-driven fault detection, diagnostics and prognosis
- Systems and control theorys
- Linear & nonlinear controller/observer design
- Artificial intelligence, machine learning and intelligent systems
- Avionics, sensors, and measurement

arahimi@uwindsor.ca
519-253-3000, Ext. 5936

Dr. Gary Rankin
Professor

- Numerical and experimental modelling of micro-scale Ranque-Hilsch (Vortex) tubes to improve their cooling performance
- Studies of unsteady supersonic jet flows in industrial applications and fluidic devices
- Modelling of and non-moving part fluidic devices
- Synthetic jets and vortex ring flows and their applications

rankin@uwindsor.ca
519-253-3000, Ext. 2626

Fluid Dynamics Research Institute (FDRI)

- FDRI is composed of a group of faculty and student members with a common interest in thermo-fluid mechanics
- The purpose of FDRI is to foster collaborations among its members for the purposes of the advancement of research and education to better serve industry and the university community

Dr. Graham Reader
Professor

- Energy conversion
- Clean diesel engine technologies
- Underwater vehicles
- Stirling cycle machines

greader@uwindsor.ca
519-253-3000, Ext. 5105

Dr. Reza Riahi
Associate Professor

- Batteries
- Nanomaterials
- Additive manufacturing
- Tribology

ariahi@uwindsor.ca
519-253-3000, Ext. 3567

Materials and Tribology (MAT) Research Lab

- Tribological characterization of metals and polymers (low and high temperature) and evaluation of corrosion of materials (electrochemical and atmospheric)
- Surface characterization
- Metal forming simulation, investigation of cutting and forming tool interactions with the workpiece

Dr. Vesselina Roussinova
Assistant Professor

- Experimental and computational fluid dynamics
- Fluid structure interactions for energy harvesting
- Turbulent mixing
- Laser and imaging diagnostics of single and multiphase flows

vtr@uwindsor.ca
519-253-3000, Ext. 2518

Dr. Beth-Anne Schuelke-Leech
Associate Professor

- Engineering entrepreneurship
- Big data and text data analytics
- Technological innovation
- Engineering and industrial policy

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519-253-3000, Ext. 5937

STEP Disruptive Technologies Research Lab

- Examines the Socio-Technical-Economic-Political (STEP) implications of disruptive technologies
- Conducts research into the design, analysis, and implications of developing technologies on manufacturing, energy, and engineering systems
- Investigates the technological changes and disruptions that are needed to achieve the vision of Smart Cities, Sustainability, and Resilient Systems. This includes looking at the needed developments in connectivity, artificial intelligence, automation, autonomous systems, and the implications of these developments

Dr. Vesselin Stoilov
Professor

- Micro/nanoscale mechanics and tribology
- Modeling and characterization of active materials (shape memory alloys, piezoelectric, ferroelectric, and magnetostrictive materials)
- Multi-scale modeling
- Design and characterization of N/MEMS

vstoilov@uwindsor.ca
519-253-3000, Ext. 4149

Dr. David Ting
Professor

- Flow turbulence, combustion
- Flow-Induced vibration
- Energy systems, heat transfer
- Aerodynamics

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turbulenceandenergylab.org

Turbulence and Energy Lab
- Low speed wind tunnel
- Six channel hot wire anemometry
- Computational fluid dynamics

Dr. Jill Urbanic
Professor

- Additive manufacturing, 3D printing, rapid prototyping
- CAD/CAM, process planning and manufacturing systems design
- Product design for manufacturing, product and process design optimization
- Reverse engineering

jurbanic@uwindsor.ca
519-253-3000, Ext. 2633

Advanced Production and Design Lab
- Utilizes innovative technologies to improve product and process designs including: Rapid manufacturing strategies (including additive manufacturing (3D printing), rapid prototyping, machining, design for changeovers and inspection)
- Product design for manufacturing; process planning and manufacturing systems design; design recovery
- Possesses reverse engineering tools to target creating either a replicate model or an idealized model which can be utilized for subsequent downstream optimization

Dr. Michael Wang
Professor

- Product innovation
- Sustainable product design and manufacturing

wang5@uwindsor.ca
519-253-3000, Ext. 2610

Dr. Nader Zamani
Professor

- Finite element analysis
- Computational mechanics
- Computer aided engineering

zamani@uwindsor.ca
519-253-3000, Ext. 2643

Dr. Guoqing Zhang
Professor

- Optimization, operational research, operations algorithms
- Supply chain management, logistics, transportation
- Modelling of manufacturing, production scheduling, operations management
- Intelligent decision support systems and data analysis

gzhang@uwindsor.ca
519-253-3000, Ext. 2637
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Supply Chain Management and Logistics Optimization Research Centre

- Facilitates the applications and innovation of RFID, IoT, big data, and artificial intelligence in supply chain management, logistics, and process improvement
- Provides analysis and improvement of all stages/aspects of supply chain management, including forecasting, inventory, purchasing, production planning, warehousing, transportation, ERP, information system, pricing, risk and resilience, and service performance

Dr. Ming Zheng
Professor
NSERC/Ford Senior Industrial Research Chair in Clean Combustion Engine Innovations

- High efficiency engines, clean combustion engines
- Emission control and diagnostics; active exhaust after treatment
- Alternative fuel and biofuel combustion
- High-energy spark ignition, corona ignition

mzheng@uwindsor.ca
519-253-3000, Ext. 2636

Clean Combustion Engine Lab

- Test engines: single-cylinder research engines and multi-cylinder engines running in single-cylinder mode with Engine dynamometers: double-ended direct current, alternating current, and eddy current dynos with Fuels: diesel, gasoline, alcohol, n-butanol, DME, biodiesel, and blends
- Independent and adaptive control systems for air management (such as boost, temperature, back pressure) and fuel management (such as multiple-injections, dual-fuel applications) using RT-FPGA based control hardware
- Injection test bench and long-tube setup for fuel rate of injection measurement and high-speed high-intensity LED lighting system, in-cylinder combustion imaging

Dr. Biao Zhou
Professor

- Computational Fluid Dynamics (CFD), Heat Transfer, and Combustion
- Fuel Cell, Catalyst and Related Nano-Materials, Fuel Cell Hybrid Powertrain
- 3D Printing (Additive Manufacturing Technologies)
- Unmanned Aerial Vehicles (UAVs)
- Clean Combustion (Internal Combustion Engine, Jet Engine, Coal)

bzhou@uwindsor.ca
519-253-3000, Ext. 2630

Clean Powertrain Lab

- Computational Fluid Dynamics Code Development Platforms: KIVA, ANSYS FLUENT, OPENFOAM, in-house codes for two-phase flow and combustion.
- Advanced Fuel Cell Test Stand: automatic data acquisition system for temperature, pressure, pressure drop, humidity, flowrate, etc.
- Nano-Materials Lab: electro-spinning setup, furnaces, coating equipment, mixer, etc.
- Fuel Cell - Battery Hybrid Vehicle Test Bench: automatic data acquisition system for current, voltage, power, speed, motor and battery monitoring, etc.
- Battery Management System Test Bench: automatic data acquisition system for current, voltage, power, charging/discharging battery, etc.
- Access to Industry and Government Labs: automotive industry (diesel engine research), fuel cell industry (PEM fuel cell research), and National Research Council Canada (fuel cell, gas turbine research).

Advanced Production & Design Lab

- Bridges research related to advanced manufacturing and practical applications
- Utilizes innovative technologies to improve product and process designs including:

  Rapid manufacturing strategies (including additive manufacturing (3D printing), rapid prototyping, machining, design for changeovers and inspection)

  Product design for manufacturing; process planning and manufacturing systems design; design recovery

  Cognitive ergonomics related to complexity (product, process, and operations perspectives for effective systems design)
- Provides support for process improvements including modeling, simulation, and experimentation
- Possesses reverse engineering tools to target creating either a replicate model or an idealized model which can be utilized for subsequent downstream optimization
- Equipped with an industrial grade Fused Deposition Modeling machine: Fortus 400 M/C and a 3 axis CNC printer-mill machine to explore hybrid deposition and machining synergies
- Collaborates with industry to 1) assist with additive manufacturing process design and simulation tool development (to combine additive and subtractive processes seamlessly) and 2) address process planning challenges with multi-tasking machine tools

Contact: **Dr. Jill Urbanic**
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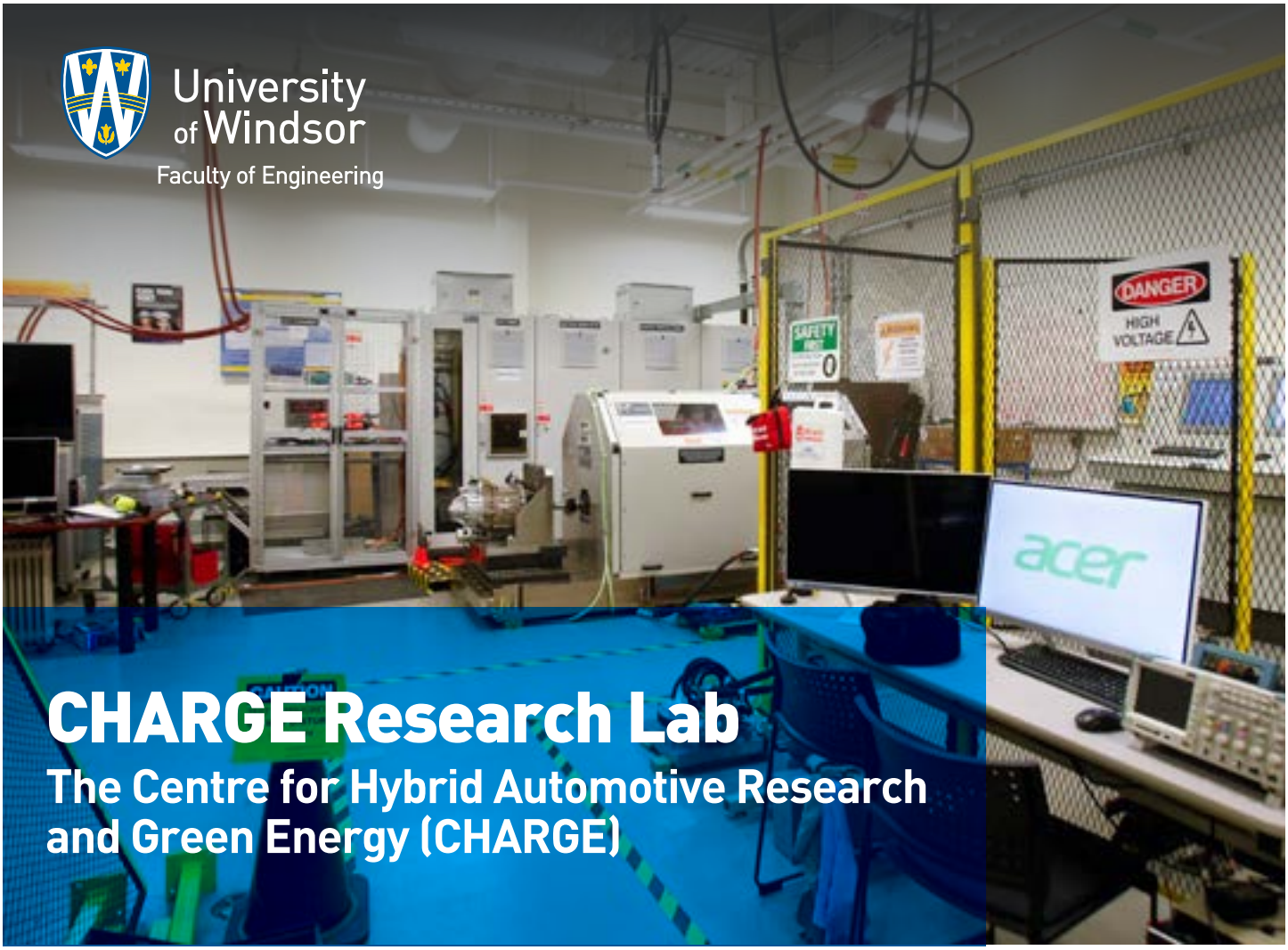
jurbanic@uwindsor.ca



CHARGE Research Lab

The Centre for Hybrid Automotive Research and Green Energy (CHARGE)

- Focuses on 5 major research areas for Electric Vehicles (EV) including: Electric machine design, Electric machine testing, Machine drives and control, Inductive & conductive charging, and Electric vehicle simulation and testing
- Conducts battery-to-powertrain-to-wheel research in an effort to promote creativity, collaboration, and practical know-how to enhance EV research landscape
- Facilitates interdisciplinary collaboration and fosters world-class transformative and innovative research through government and industry partners including CanmetMATERIALS, Ford Motor Company, and D&V electronics
- Possesses one of the best electric vehicle powertrain components and system test infrastructure in North America, capable of testing different types of electric machines and drives up to 150 kW and six phases at 14,000 rpm
- Equipped with Opal-RT hardware-in-loop testing capability, thermal imagers for electric machines and power electronics, custom designed permanent magnet, switched reluctance, brushless DC, aluminum- and copper rotor induction and wound field synchronous machines
- Has many custom designed power electronics converters up to 80 kVA to conduct research on control of machines and conductive and inductive battery charging, as well as high-end power quality analyzers, energy analyzers, oscilloscopes and numerous current, voltage and speed measuring unit

Visit **chargelabs.ca** for more information.

Contact: **Dr. Narayan C. Kar**
519-253-3000, Ext. 4796
nkar@uwindsor.ca

The Clean Combustion Lab aims to develop sustainable heat engines with improved efficiency and reduced exhaust pollutant emissions by using innovative technologies

The state-of-the-art advanced engine test facility is equipped with the following:

- Test Engines: single-cylinder research engines and multi-cylinder engines running in single-cylinder mode
- Engine Dynamometers: double-ended direct current, alternating current, and eddy current dynos
- Fuels: diesel, gasoline, biofuels, and blends
- Independent and adaptive control systems for air management (such as boost, temperature, back pressure) and fuel management (such as multiple-injections, dual-fuel applications)
- RT-FPGA-based control hardware
- Injection test bench and long-tube setup for fuel rate of injection measurement
- High-speed high-intensity LED lighting system, in-cylinder combustion imaging
- Constant volume combustion chambers for combustion and fuel injection studies
- Full range of emission analysis equipment including direct in-cylinder gas sampling
- Flow bench for simulating engine exhaust gas for after-treatment tests

The lab engages in research focused on:

- Low-temperature combustion using innovative combustion methods and controls
- Combustion control strategies using multiple injections, heat release analysis, exhaust gas recirculation
- Active flow after treatment
- Combustion diagnosis and modeling
- Bio-fuels such as bio-diesel, bio-alcohol in dual-fuel blend or in pure state
- High-power spark ignition with corona and multi-coil systems and output energy characterization

Contact: **Dr. Ming Zheng**
519-253-3000, Ext. 2636
mzheng@uwindsor.ca

University of Windsor
Faculty of Engineering

Clean Powertrain Research Lab

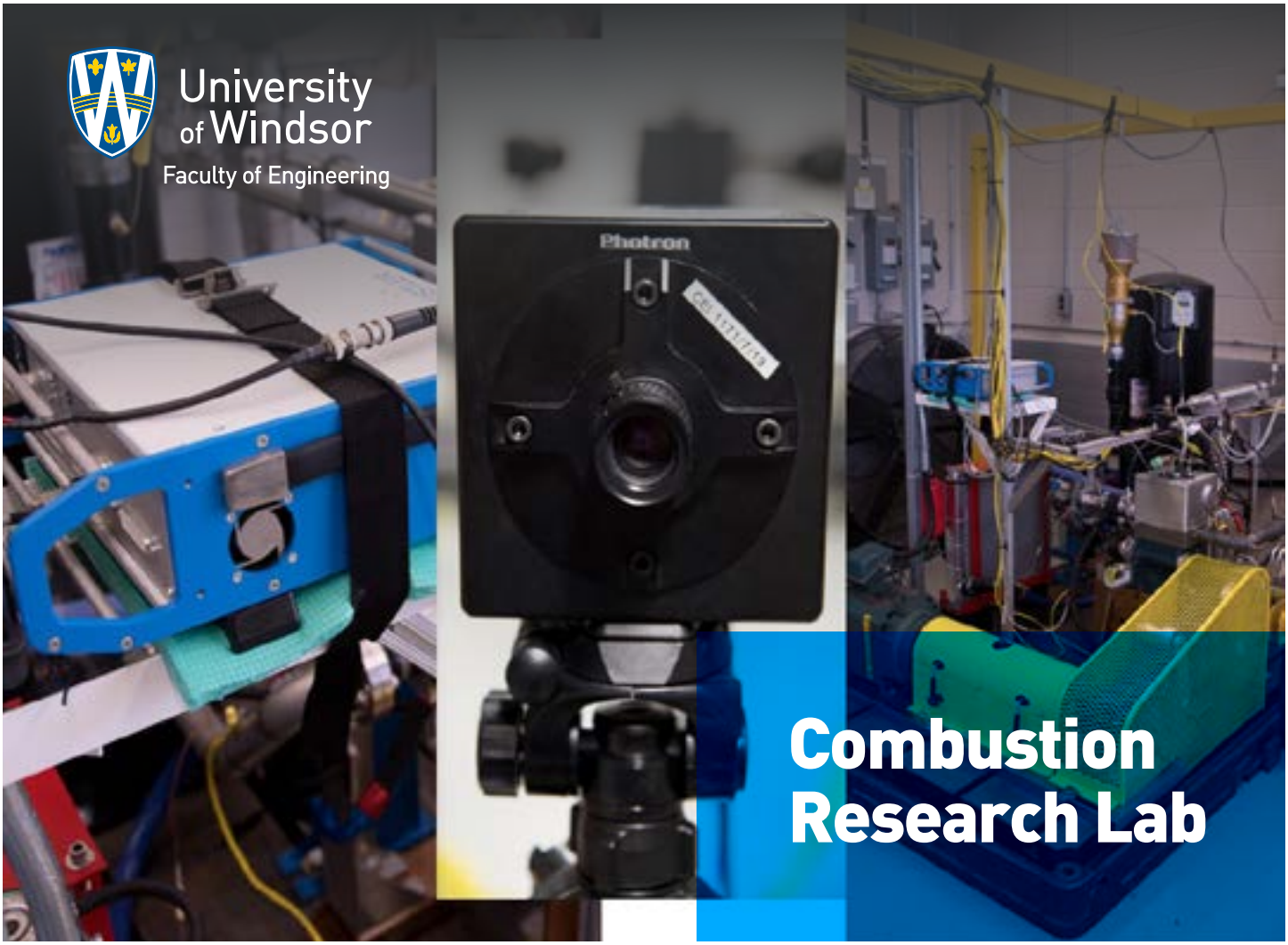
Research areas

- Clean Powertrain: Fuel cell and hybrid powertrain technologies.
- Unmanned Aerial Vehicle (UAV): Fuel cell power system for UAV applications; Design of UAV; Flight dynamics and control.
- Nano-Materials: Membrane fabrication techniques; Catalyst and catalyst support; Advanced Membrane-Electrode-Assembly.
- Fuel Cell Design and Modeling: 3D Printing; Fuel cell testing techniques; System control and monitoring technologies.
- Clean Combustion Technologies: Internal combustion engine modeling for different fuels (gasoline, bio-diesel, diesel) with detailed chemistry; Two-phase flow and combustion modeling (gas turbine, burner design, diesel/gasoline engine, pulverized-coal combustor).
- Turbulence-Spray-Combustion Interaction: Large Eddy Simulation (LES); Dynamics and combustion of droplets and sprays; Dynamics of flame and vortex.
- Computational Fluid Dynamics (CFD): Grid generation; Solver and visualization techniques; Development of GUI (Graphical User Interface) for CFD code.

Research infrastructure

- Computational Fluid Dynamics Code Development Platforms: KIVA, ANSYS FLUENT, OPENFOAM, in-house codes for two-phase flow and combustion.
- Advanced Fuel Cell Test Stand: Automatic data acquisition system for temperature, pressure, pressure drop, humidity, flowrate, current, voltage, power, etc.
- Nano-Materials Lab: Electrospinning/electrospray setup, furnaces, coating equipment, mixer, etc.
- Fuel Cell - Battery Hybrid Vehicle Test Bench & Battery Management System Test Bench: Automatic data acquisition system for current, voltage, power, speed, motor and battery monitoring, etc.
- Access to Industry and Government Labs: Automotive industry (diesel engine research); Fuel cell industry (PEM fuel cell research), and National Research Council Canada (fuel cell, gas turbine research).

Contact: **Dr. Biao Zhou**
519-253-3000, Ext. 2630
bzhou@uwindsor.ca



Combustion Research Lab

The Combustion Research Lab focuses on combustion process modifications and re-organization to reduce or even eliminate the need for after-treatment technologies for internal combustion engines and industrial burners that use both premixed and non-premixed flames.

The lab performs experimental and numerical modelling of the combustion process with the use of Star-CD software for 3D simulations, and GT Power and AVL Boost for one-dimensional approaches

Researchers engage in the development of better combustion technology based on three functional ingredients:

- Mixing of fuel with air in high-intensity and small-scale (HISS) turbulent flows
- Mixing of fuel with combustion products (EGR) or partial oxidation products to achieve fuel reformation
- Mixing of air with combustion products (EGR) or partial oxidation products in HISS flows

State-of-the-art facilities include:

- HCCI engine and split-cycle engine test benches with dynamometers
- In-cylinder pressure measurements for engines indicated performance and combustion phasing analysis,
- Emissions benches for exhaust gas characterization, instrumented flame propagation apparatus with fast imaging capability
- A unique multiple-coflows inverse flame burner

Contact: **Dr. Andrzej Sobiesiak**
519-253-3000, Ext. 2616
asobies@uwindsor.ca

Computer Vision & Sensing Systems Lab

- Researches and develops computer vision and sensing technologies including 3D vision, image analysis, biometrics, sensing, and machine learning for autonomous vehicles, manufacturing, factory automation, and bio-medical imaging.
- Core technology areas include object recognition, event detection and recognition, tracking, 3D scene modeling, multimedia big-data analysis, computational imaging, and data fusion techniques
- Real-world applications include human machine interfaces, unmanned aerial vehicles, cross-border monitoring and safety, security and surveillance, vision-guided robotics, and intelligent transportation systems

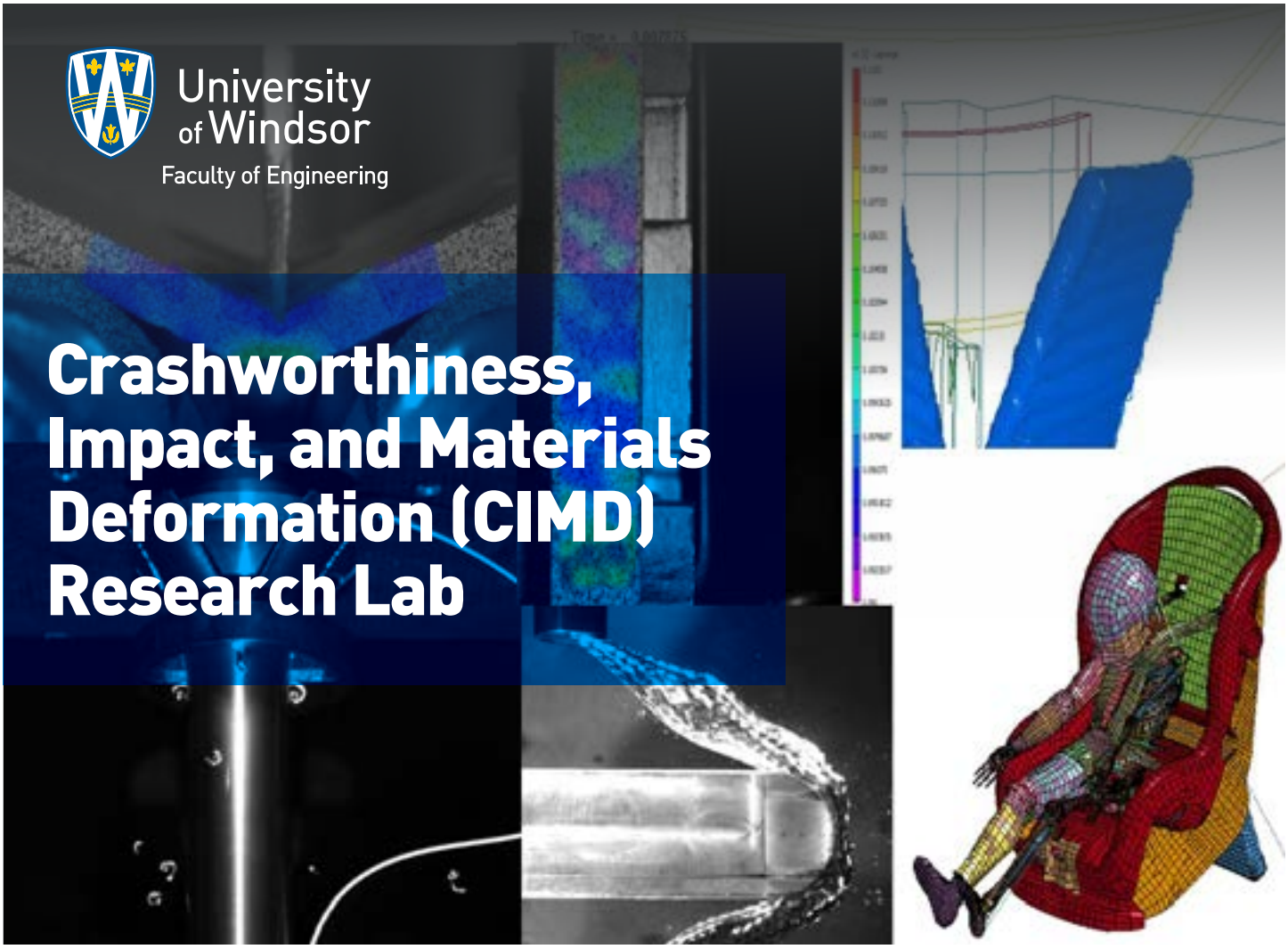
Possesses expertise in:

- **3D Vision Algorithms and Systems** – use multiple cameras or depth sensors for high resolution data acquisition to achieve a 3D map of the environment and or object and increase tracking efficiency (in comparison to 2D systems); target applications include 3D face recognition, road awareness, and factory automation
- **Novel Vision Techniques and Sensor Fusion for Safety Applications** - advanced vision technologies for safety-related applications such as hidden weapon detection and identifying potential driving hazards
- **Miniaturized Stereo-Vision System** – using a state-of-the-art embedded processor technology, developed a fully integrated and operational system that targets applications requiring power efficiency, compactness, and low cost; capable of inferring 3-D geometry of the scene in real time
- **Machine Learning Algorithms** – Focus on classification of patterns, dimension reduction of high dimensional input data to low dimensional output feature space, and sparse learning for image reconstruction from low dimensional features; algorithms can also be used for efficient hybrid system approximation
- **Brain MRI Segmentation** - Computer algorithms for the delineation of anatomical structures and other regions of interest to assist and automate specific radiological tasks
- **Algorithms and Hardware Prototyping for Human Action Recognition** – algorithms for real-time recognition of human activities using available advanced features in FPGAs

Contact: **Dr. Jonathan Wu**
519-253-3000, Ext. 2580
jwu@uwindsor.ca

University of Windsor
Faculty of Engineering

Crashworthiness, Impact, and Materials Deformation (CIMD) Research Lab



- Engages in world-class research on Impact Testing, Finite Element Analysis (FEA), Experimental Testing, Stress Analysis, Dynamics, and Machine Design
- Conducts computational deformation simulations using a large number of multi-processor workstations
- Capable of running FEA models having several millions of degrees of freedom
- Application of traditional and non-traditional element formulations in simulation of large deformation phenomena involving contact
- Capable for running both MPP and SMP version of large deformation finite element codes

State-of-the-art facilities include:

- Dynamic testing machines such as Large Energy Droptower (45 kJ), Low Energy Droptower (3 kJ), Pneumatic Accelerator, Split Hopkinson Pressure Bar (SHPB) Apparatus, Instron instrumented Charpy Impact Testing Machine, Instron RR Moore Fatigue Testing Machine
- Quasi-static testing machines including a 300 kN Long Stroke Tension/Compression Testing Machine, MTS Universal Tension/Compression Testing Machines with capacities from 50 kN to 650 kN
- Visual data acquisition capabilities with high speed/megapixel resolution Photron SA4 cameras and low speed/megapixel Point Grey research cameras
- Digital Image Correlation (DIC) Analysis system
- Motion tracking software (ProAnalyst 2D and 3D versions)
- Large array of transducers for measurement during quasi-static and dynamic loading conditions including non-contact laser displacement transducers, accelerometers (MEMS- and ICP/IEPE-based technologies), and load cells (Strain gauge- and ICP/IEPE-based technologies)
- Data acquisition (DAQ) systems including National Instruments CompactDAQ system, DTS SLICE micro DAQ system, National Instruments LabVIEW and DIAdem

Contact: **Dr. Bill Altenhof**
519-253-3000, Ext. 2619
altenh1@uwindsor.ca

Embedded & FPGA-Based System Design Research Lab

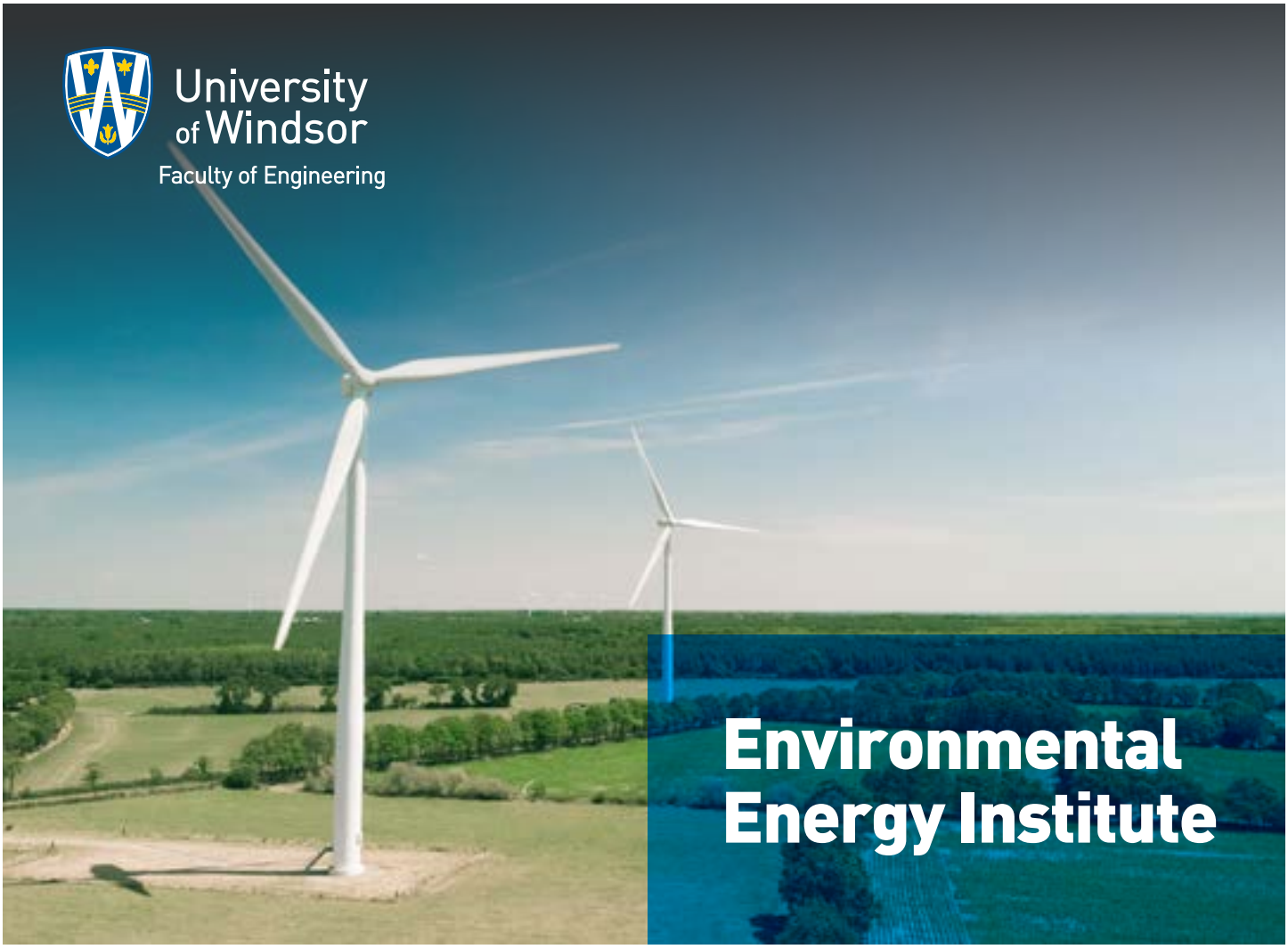
Research areas

- FPGA-based power efficient hardware acceleration for High Performance Computing (HPC), high level synthesis (HLS) for FPGAs and automotive embedded systems, especially for autonomous vehicles (AVs) and advanced driver assistance systems (ADAS).
- Development of large scale software systems using C/C++ for Electronic Design Automation (EDA), HPC and embedded systems.
- FPGA-based system design for real world applications in Automotive, Networking, DSP, etc.
- Computer-Aided-Design (CAD) algorithms and tools for FPGAs and multi-FPGA systems.

Research infrastructure

- State-of-the-art FPGA boards from Xilinx and Intel, FPGA acceleration boards from Nallatech and Terasic.
- State-of-the-art CAD tools for HLS and FPGA-based system design from Intel and Xilinx such as Intel SDK for OpenCL and Xilinx Vivado.
- State-of-the-art CAD tools for compilation and simulation of VHDL and Verilog models from Mentor Graphics, Synopsys and Cadence. Embedded System Design tools from Mentor Graphics.
- State-of-the-art Desktop and Server workstations, compilers, debuggers and Computer-Aided Software Engineering (CASE) tools for large the development of scale software systems.

Contact: **Dr. Mohammed Khalid**
519-253-3000, Ext. 2611
mkhalid@uwindsor.ca



- Offers a holistic resource for innovative energy system planning, design, and analysis.
- Extensive multi scale energy modeling proficiency.
- Specific expertise in exergo-economic evaluation of energy operations.
- Offering pioneering innovation in energy commerce platforms.
- Novel energy procurement practices are an active research core.
- Globally collaborative study teams.
- An active voice in energy policy and market transformations.
- Comprehensive expertise in quantification of environmental attributes of energy sourcing.

Visit **environmentalenergyinstitute.com** for more information.

Partnering Institutions

The University of Edinburgh · University of Malta / L-Università ta' Malta · University of Massachusetts Amherst · The University of Nottingham · Western

Contact: **Dr. Rupp Carriveau & Dr. Lindsay Miller**
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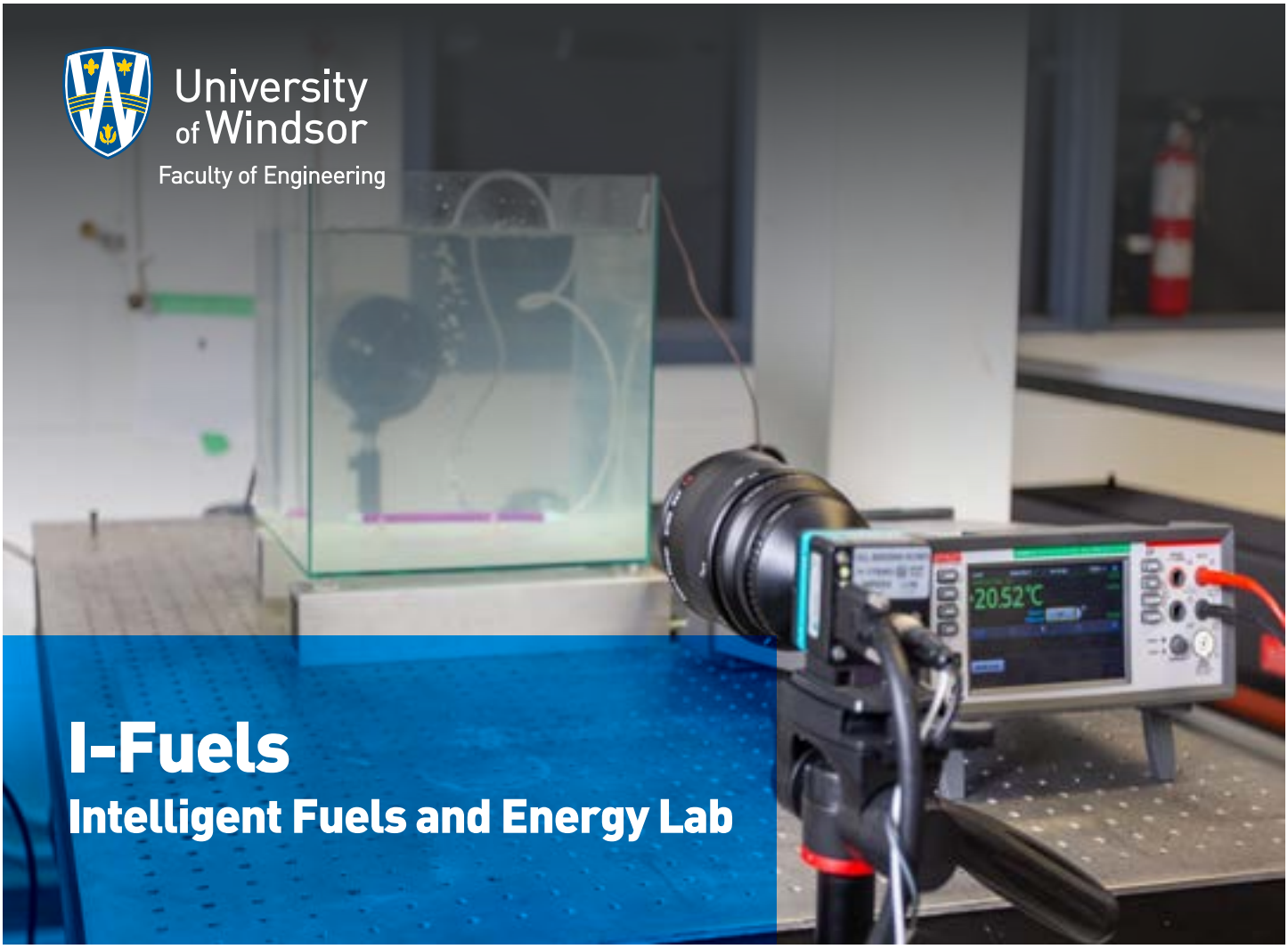

I-Fuels

Intelligent Fuels and Energy Lab

Research capabilities:

- Engages in ground-breaking research and delivers innovative contributions by applying entropy and exergy-based methods to improve performance of energy systems and maximize capital utilization.
- Top-notch research delivers predictors to control transport phenomena in energy systems to improve their overall efficiency.
- Focused on all aspects of the development of next generation energy technology including numerical and analytical modeling, design, and non-intrusive experimental methods.
- Conducts research in intelligent fuels generation and utilization such as hydrogen, both experimentally and numerically.
- Explores inefficiencies in macro-scale projects and delivers emissions and cost reduction solutions.

Cutting-edge infrastructure:

- ShaddowImager system composed of a FlowSense EO CCD camera, long range microscope lens capable for application with particles as small as 5 µm.
- Applications: high resolution particle dynamics, flow visualization, bubble mapping, and shadowgraphy applications.
- Innova 70 Coherent research laser and ANSYS & COMSOL Multiphysics software.
- Applications: flow visualization, microscopy, and Raman spectroscopy, fluorescence spectroscopy, laser pumping, and laser doppler velocimetry.
- Applications: analysis and visualisation of fluid flows, materials stresses, heat transfer characteristics, aeroacoustics, thermophysical applications and electrochemistry.
- Light and atmospherically controlled glove box for photosensitive and atmospherically dependant experiments.
- Ballard Nexa 1.2 kW fuel cell stack
- Applications: Observation of transient fuel, oxidant, pressure and temperature conditions on fuel cell performance.

Contact: **Dr. Ofelia Jianu**
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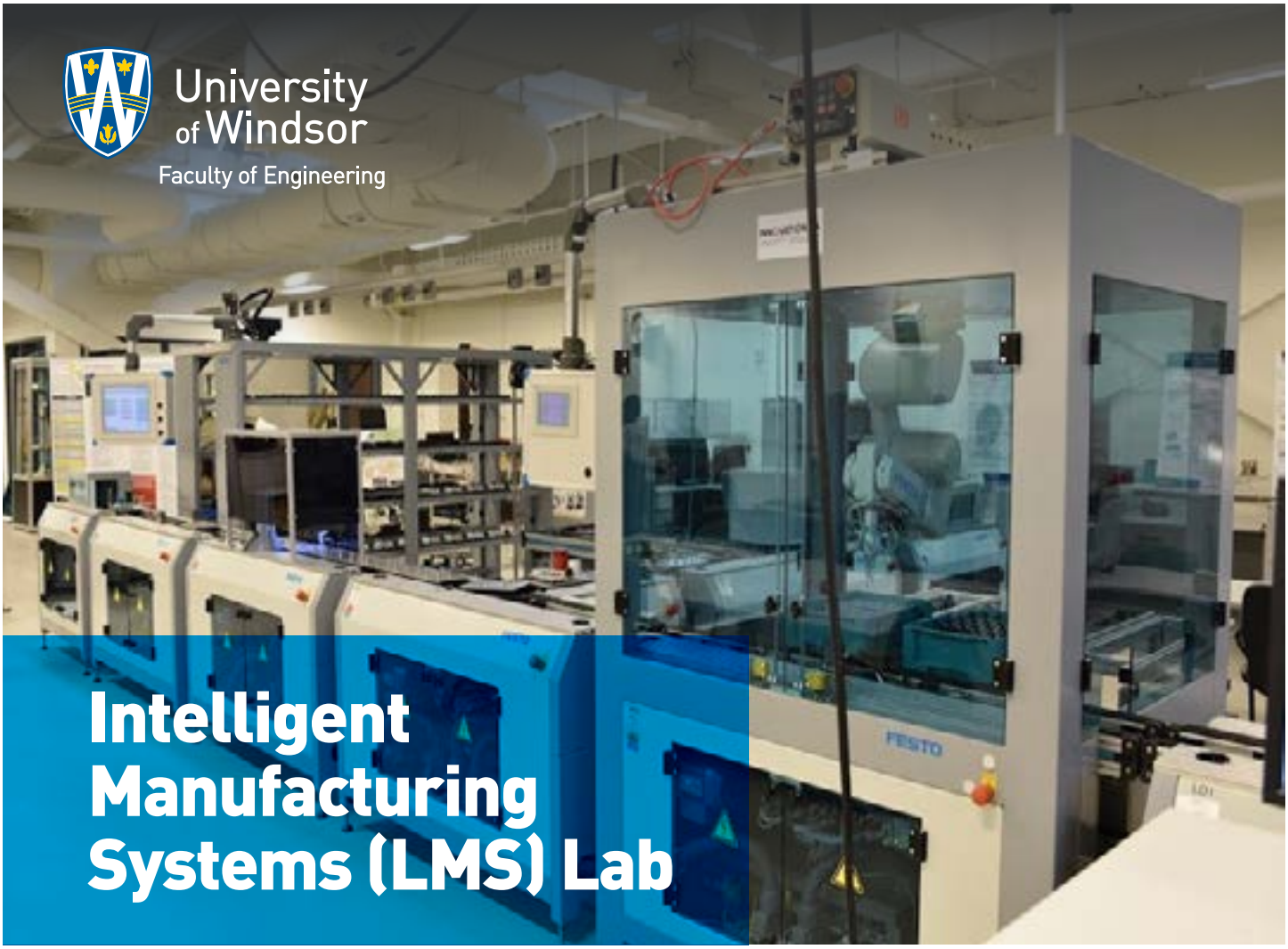
Ofelia.Jianu@uwindsor.ca



Intelligent Manufacturing Systems (LMS) Lab

- Provides an advanced research environment conducive to research excellence and innovation
- Develops new products, innovative manufacturing systems, and processes
- Conducts research in design, planning, control, and scheduling of automated, flexible and reconfigurable manufacturing systems, smart manufacturing and enablers of Industry 4.0 (Fourth Industrial Revolution)
- Engages in projects with industry, centres of research excellence, as well as international collaborations and exchanges
- Implemented the "iFactory" modular, reconfigurable and changeable manufacturing system, a first in North America
- Developed the iDesign Studio for innovation, collaboration, modeling, simulation for integrated products and systems development
- Possesses Digital Metrology facilities including mechanical coordinates measurement machine used in inspection, quality verifications by digitizing, forming 3D digital models and comparing with design specifications
- Has Rapid Prototyping facilities using a 3D printing fused deposition machine and software used in physical prototyping of CAD models and digitized components
- Conducts research and development in all stages of innovation chain from products and systems design to prototyping and realization
- Engages in the transfer of knowledge generated through research to industry

Contact: **Drs. Hoda and Waguih ElMaraghy**
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hae@uwindsor.ca or wem@uwindsor.ca

University of Windsor
Faculty of Engineering

Laboratories for Autonomous Systems and Energy Research (LASER)

LASER unites the Engineering Faculty's various disciplines of autonomous systems and energy research under one umbrella. LASER is comprised of the following University of Windsor labs:

Battery Management Systems Lab

- Testing facility for batteries and battery packs of all sizes: consumer electronics, EVs and renewable energy systems
- Prognostics and thermal management algorithms for battery cells and battery packs
- Real-time parameter estimation and system identification algorithms for Li-ion battery packs

Cyber-Physical Systems Lab

- Algorithms for big data analytics, anomaly detection, state & parameter estimation and supervisory control in complex, connected systems, and the internet of things
- Distributed information fusion in connected systems

Diagnostics and Control Lab

- Linear and nonlinear control systems; Large scale system and decentralized control; Estimation and observer design
- System monitoring; Fault diagnosis and prognosis; Intelligent control, fault diagnostics, and prognostics

With applications to:

- Automotive and transportation systems; Aerospace and autonomous systems; Power and renewable energy systems

Human-Machine Systems Lab

- Cognitive context detection using psychophysiological data especially eye-tracking measurements
- Algorithms for human-machine automation

Smart Grids Lab

Equipped with hardware-in-the-loop (HiL) and power hardware-in-the-loop (PHiL) testbeds for:

- Testing power electronic converters used to interface renewable energy sources (RES)
- Testing relays for reliable power system protection with RES
- Developing energy management systems for smart grids with RES and electric vehicles
- Designing and validating control algorithms to enhance power quality and voltage regulation of smart grids

Surveillance and Tracking Systems Lab

- Multi-sensor information fusion and multi-target tracking algorithms for radars, lidars, sonars, hyperspectral, infrared (IR) sensors, and ultrasonic sensors
- Navigation and control in autonomous vehicles

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Research areas

- Creating practical engineering solutions by integrating sensors, actuators, microcontrollers, programmable logic controllers (PLC), and robots into industrial automation applications.

Research infrastructure

- Yumi ABB robotic production which is a collaborative, double arm, little parts assembling robot that incorporates adaptable and flexible hands, parts nourishing systems, camera-based inspection system also state-of-the-art robot control.
- SIMATIC S71200 Siemens PLC/HMI training module which can be applied for fully process automation and control.
- SIMATIC S71500 Siemens PLC/HMI training module with collaborative manufacturing production system.
- Totally Integrated Automation Portal (TIA portal) with the latest updates.
- Allen Bradley Micrologix training module, equipped with the real-world industrial modules.
- Sensors, actuators, pneumatic circuits and systems embedded into complex manufacturing/industrial processes.
- Manufacturing Production Systems (MPS) including Sorting station, pick and place station, handling station, and transfer station.
- Supervisory Control and Data Acquisition (SCADA) and Distributed Control (DCS) systems.
- Industrial data communication, control network protocols, OPC platforms.

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Metal Forming Research Lab

- Conducts research and experimental testing with the following equipment:
- 240-ton double action hydraulic press for blanking, piercing, formability testing (Nakazima, Marciniak, Erichsen, bending, hole expansion, hydraulic bulge test), cyclic shear, hot stamping, die wear testing, etc.
- Tension/compression split Hopkinson bar apparatus for high strain rate characterization of work hardening behaviour of metals
- Flat rolling mill for pre-straining up to large deformations
- Instron Charpy impact tester for fracture toughness
- Metallurgical lab, optical microscope, scanning electron microscope
- FMTI optical strain measurement; high-resolution stereo-cameras; high-speed Photron cameras with digital image correlation software
- Performs Numerical simulations including finite element simulations of various metal forming processes (stamping, drawing, springback prediction, hydroforming, piercing, trimming, electrohydraulic forming etc.) using LS-Dyna or ABAQUS.
- Development of user-defined material subroutines for ABAQUS allows advanced constitutive models and damage models to be used that are not commercially available.
- Engages in constitutive and damage modeling such as the development of advanced anisotropic, rate-dependent constitutive models and ductile damage models for use in finite element simulations and for prediction of forming behaviour, of the onset of plastic instability and fracture.
- Carries out micromechanical modeling: development of micro- and mesoscale mechanical models (RVE – representative volume element, CA – cellular automata) for prediction of deformation and fracture of multi-phase steel sheets.

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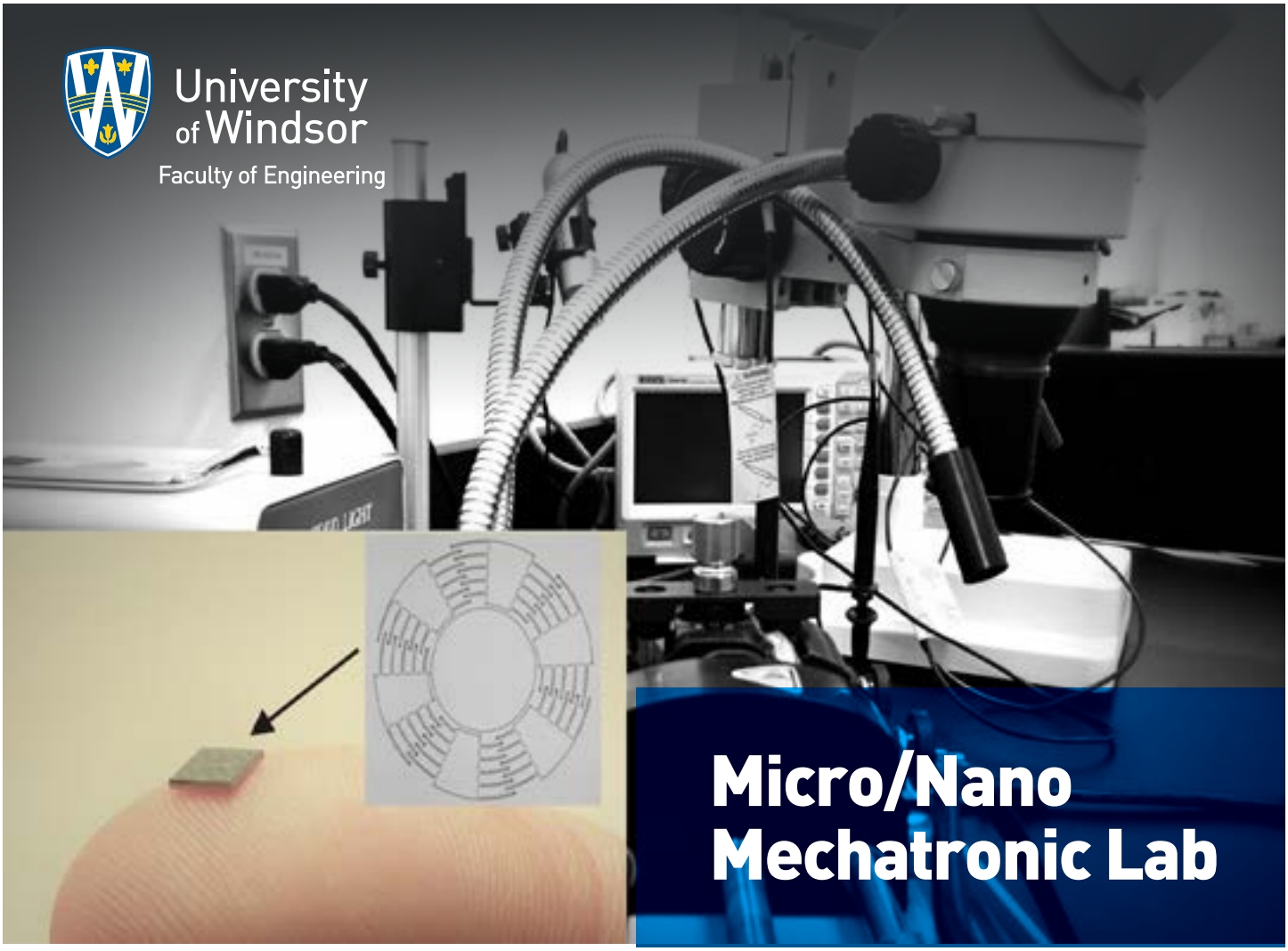

Micro/Nano Mechatronic Lab

Research areas

- Design, fabrication and characterization of futuristic 3D micro/nano mechatronic sensing and actuation systems.
- Developing micro/nano-electromechanical (MEMS/NEMS) motion sensors for improved sensitivity, high precision, reduced material footprint and low power consumption.
- Engineer micro/nano-fluidic based lab-on-a-chip (LOC) technologies to provide portable, self-powered, low cost and disposable tools for biochemical analysis.
- Develop and implement novel mechatronic principles in dynamic motion sensing as well as emerging applications in biomolecular probing and sensing.

Research infrastructure

- Mechatronics systems design, controls and testing
- Micro/nano-systems sensor design, component modelling, finite element analysis, mask design, and microscopy
- MEMS/NEMS vibration characteristics, analysis, single molecule analysis, electronics design, PCB, expertise in material characterization (SEM, AFM, TEM, XRD)
- Stand-alone and pinpoint navigation system
- Electromechanical sensor testing
- Small scale fluidic characterization
- Dynamic motion testing
- Sensor fusion and intelligent sensing

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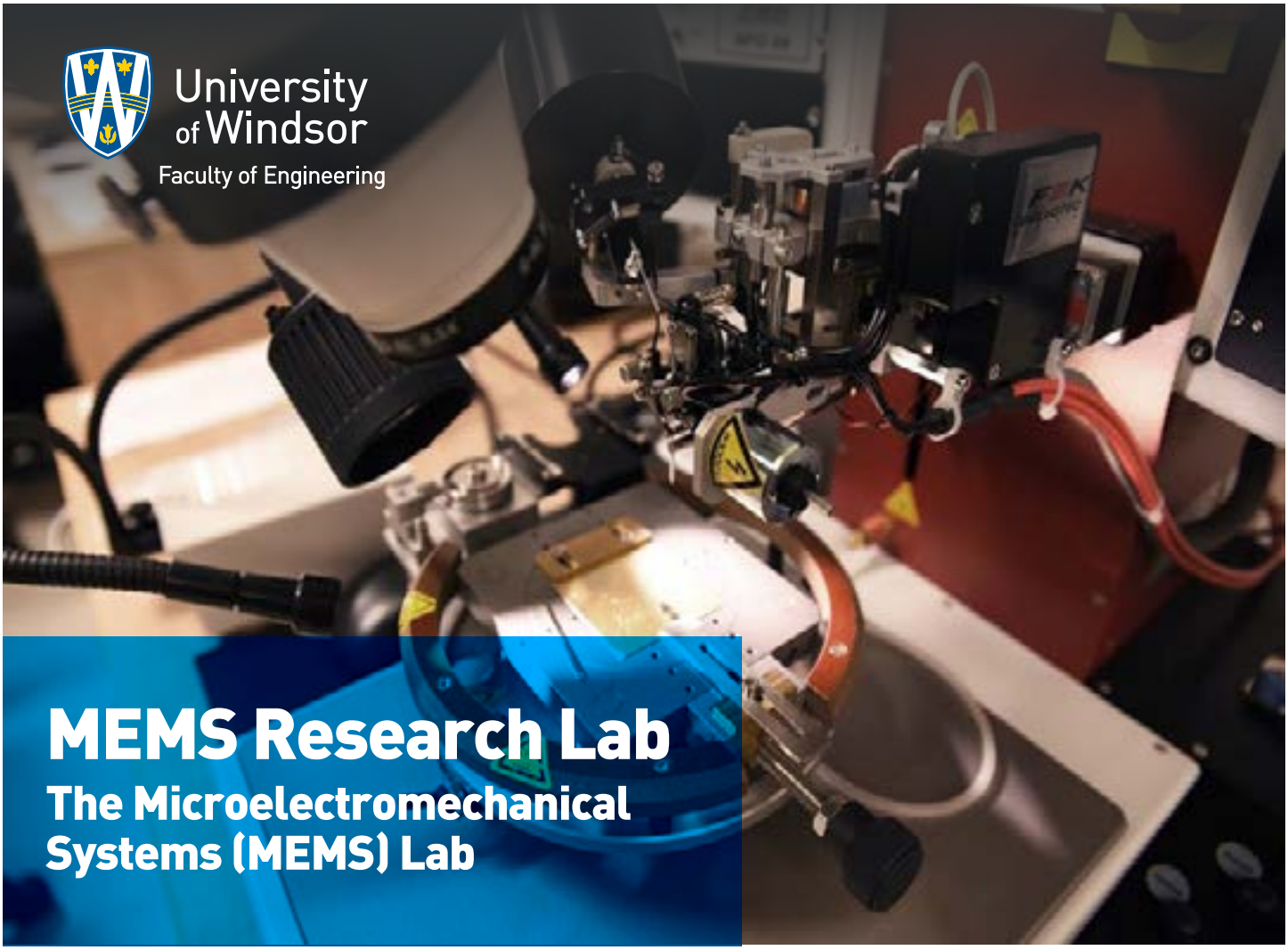

MEMS Research Lab

The Microelectromechanical Systems (MEMS) Lab

- Focused in the research of MEMS electrostatic sensors and actuators, capacitive micro machined ultrasonic transducers, planar and non-planar beamforming acoustical arrays, FMCW short and long range radars, ultra-wideband radars, sonoluminescence based MEMS transducer, MEMS multi-spectral multi-functional transducers, 3-D packaging and integration and MEMS micro-power generator
- Possesses expertise in Bio-medical ultrasound and NDE, UWB radar medical diagnostics, Automotive collision avoidance, Surveillance & security, Biometric identification, Cardiac pacemakers, 3-D Microsystems
- Is dedicated to developing microsystems to provide improved health care, automotive safety, and security

Has capabilities in:

- E-beam evaporation
- Reactive e-beam evaporation
- Thermal evaporation
- DC/RF/Reactive sputtering
- Automated mask alignment system
- Wafer bonding
- Vacuum load lock ICP RIE
- Profilometer
- Nikon microscope
- Wet benches
- Ball, wedge, and ribbon bonder
- IntelliSuite
- ADS
- Labview
- Verasonics Vantage 128 system

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Noise, Vibration & Harshness Sound Quality Lab (NVH-SQ)

- World-class research facilities with a focus on environmental, industrial, sound quality and transportation noise research
- Research partnerships with automotive, aerospace, computer, health science and manufacturing sectors
- State-of-the art Semi-Anechoic test facilities for consumer product testing, qualification, and jury evaluation
- Large shaker facility for product durability testing
- Participation in ISO and ANSI working groups for the development of acoustic test standards
- Development of leading edge metrics for sound quality and psychoacoustic problem solving and analysis
- Leading edge research in airport flight operations noise control using community engagement
- Structural Modal test and analysis for determination of natural frequencies, damping coefficients and correlation to FEA models
- Comprehensive acoustic analysis for product development and trouble-shooting using microphone arrays with beamforming tools for Noise source Identification and Sound Power determination.
- Material test for acoustic properties using impedance tube, including in-situ testing for aerospace applications
- Advanced test methodologies for buzz, squeak and rattle (BSR) detection
- Provides application of spherical beam-forming for buzz, squeak and rattle (BSR) detection
- Beamforming applications for the abatement of mining, rail and aerospace noise

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Plasma Surface Engineering and Nanotechnology Lab

Research areas

- Structural and coating materials for vehicle weight reduction (e.g., wear and galvanic corrosion prevention of Al, Mg, Ti alloys)
- Structural and coating materials for next-generation engine components (e.g., high temperature wear and oxidation, alternative fuel corrosion, fatigue and creep)
- PVD/CVD coatings for advanced manufacturing and tooling (e.g., AHSS & UHSS stamping; die cast, & machining of Ni, Ti)
- Structural and coating materials for energy-related systems (fuel cell, power generation & battery)
- Structural and coatings materials for biomedical, clinic, MEMS and sensor applications
- Hybrid/duplex surface treatment and coating technology for multifunctional surfaces
- Materials-process-property-performance relationship

Research infrastructure

- Plasma surface coating deposition equipment (mainly for wear and corrosion resistance)
- Impact-sliding surface fatigue wear tester (simulating extremely high stresses)
- Pin-on-disc and reciprocating sliding tribometers
- High speed tribometer (up to 10m/s sliding velocity)
- Electrochemical corrosion tester
- Nanomechanical property tester (Ubi-1)
- Coin cell battery lab manufacturing kits
- Coin cell battery analyzer

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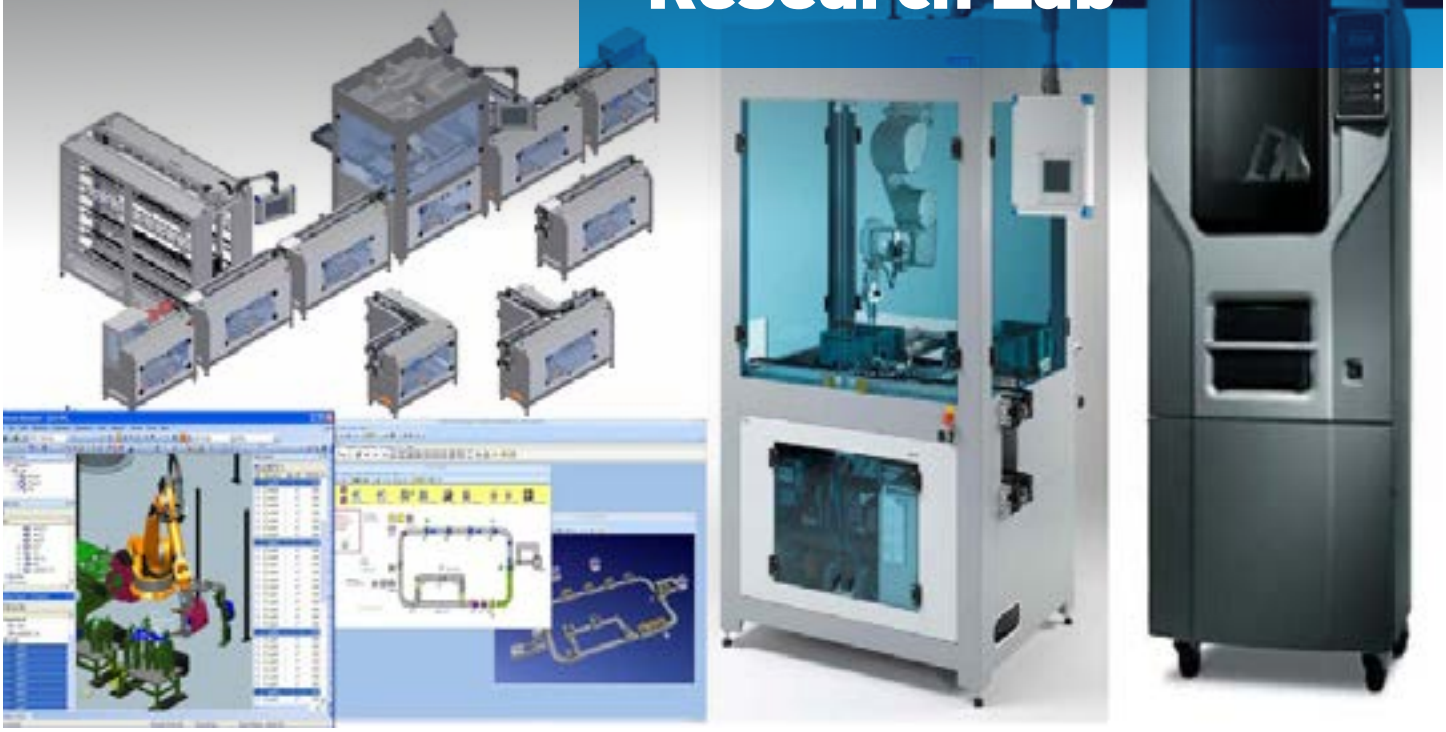
Production Operation Management (POM) Research Lab



- Covers the spectrum of Product Definition and Design, Planning Support Functions, and Product Manufacturing.
- Conducts research in Production Scheduling, Facility Layout Problem (FLP), Computer Aided Process Planning (CAPP), Reconfigurable Manufacturing Systems (RMS), Cellular Manufacturing Systems (CMS), Supply Chain Management (SCM), Inventory Control/Lot-sizing, Healthcare management, and Sustainable Design and Manufacturing.
- Emphasizes on themes and newer notions and domains of manufacturing such as distributed, multitask, and reconfigurable manufacturing as well as state of the art computations and algorithms.
- Capitalizes on application of Mathematical Programming and Non-traditional Optimization.
- Has success stories implementing customized Decision Support Systems (DSS) for production scheduling, applying Discrete Event Simulation (DES) and lean manufacturing in healthcare, and following advanced hybridized design methodologies for development of innovative designs in the fields of construction and farming.

Research infrastructure

- State-of-the-art transformable assembly system, a CNC Vertical Machining Center, fused deposition additive manufacturing machine, optimization suites (Xpress), state-of-the-art PLM solutions by Siemens PLM including NX, Teamcenter, and Tecnomatix, and simulation tools (Flexsim, Promodel, and AutoMod).
- Has partnership with different industries in different sectors, which include Manufacturing, Agriculture, Construction, and Healthcare.

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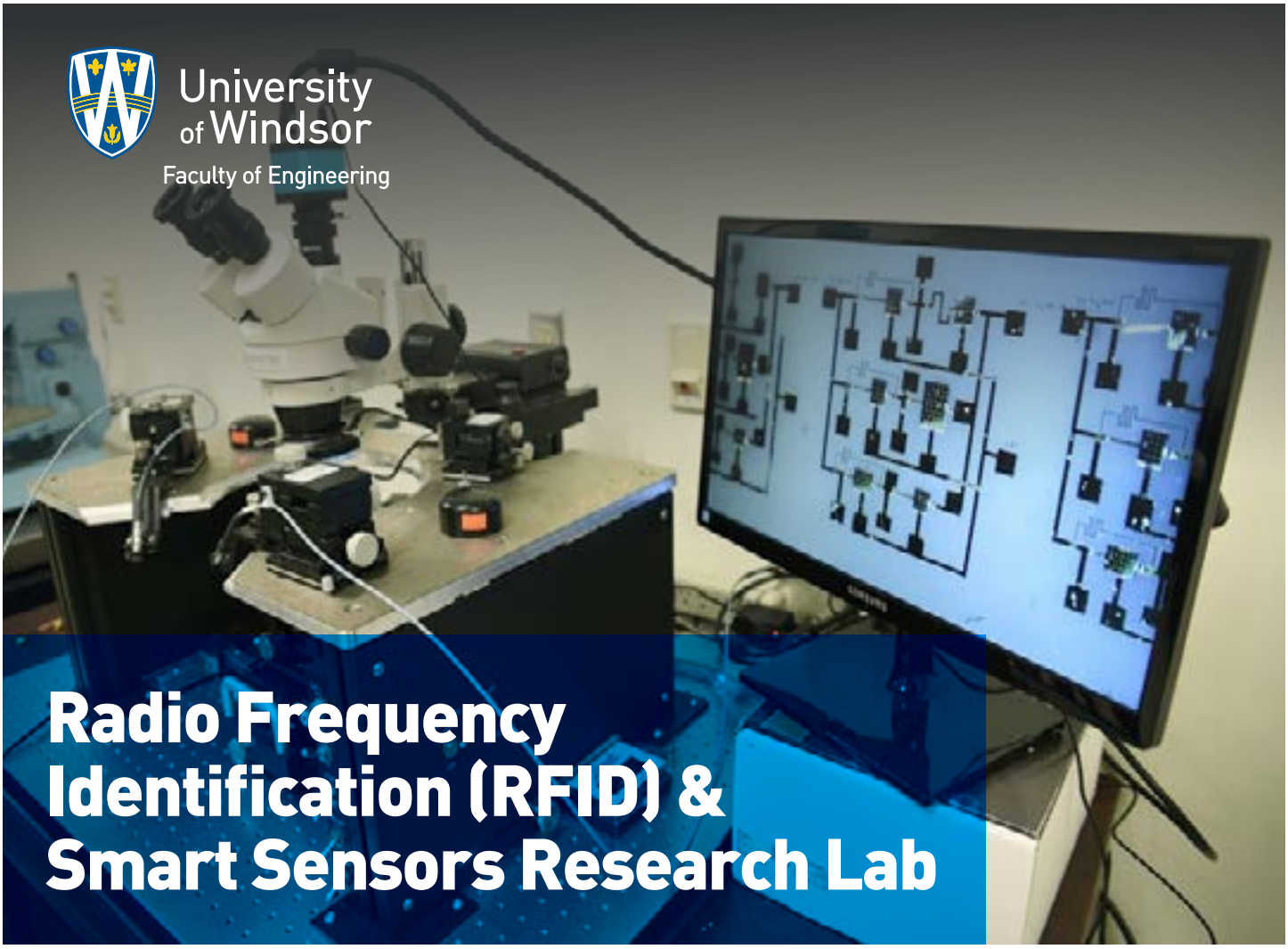

Radio Frequency Identification (RFID) & Smart Sensors Research Lab

- Focuses on the design and testing of RFID and smart sensors
- Handles the design and integration of electronic circuits and sensors for automation with expert precision and execution

Possesses a track record of successful collaboration with industry in the:

- Design and development of a laser-based Coordinate Measuring Machine (CMM)
- Design of precision circuits for medical applications
- Software and hardware development for automation

Has the expertise to collaborate with industry in various fields including:

- Automation and identification
- Smart wireless sensors
- Security and tracking
- Supply chain management
- Transport, warehousing and logistics applications
- Industrial engineering
- Radio Frequency Identification (RFID)
- Wireless charging technology

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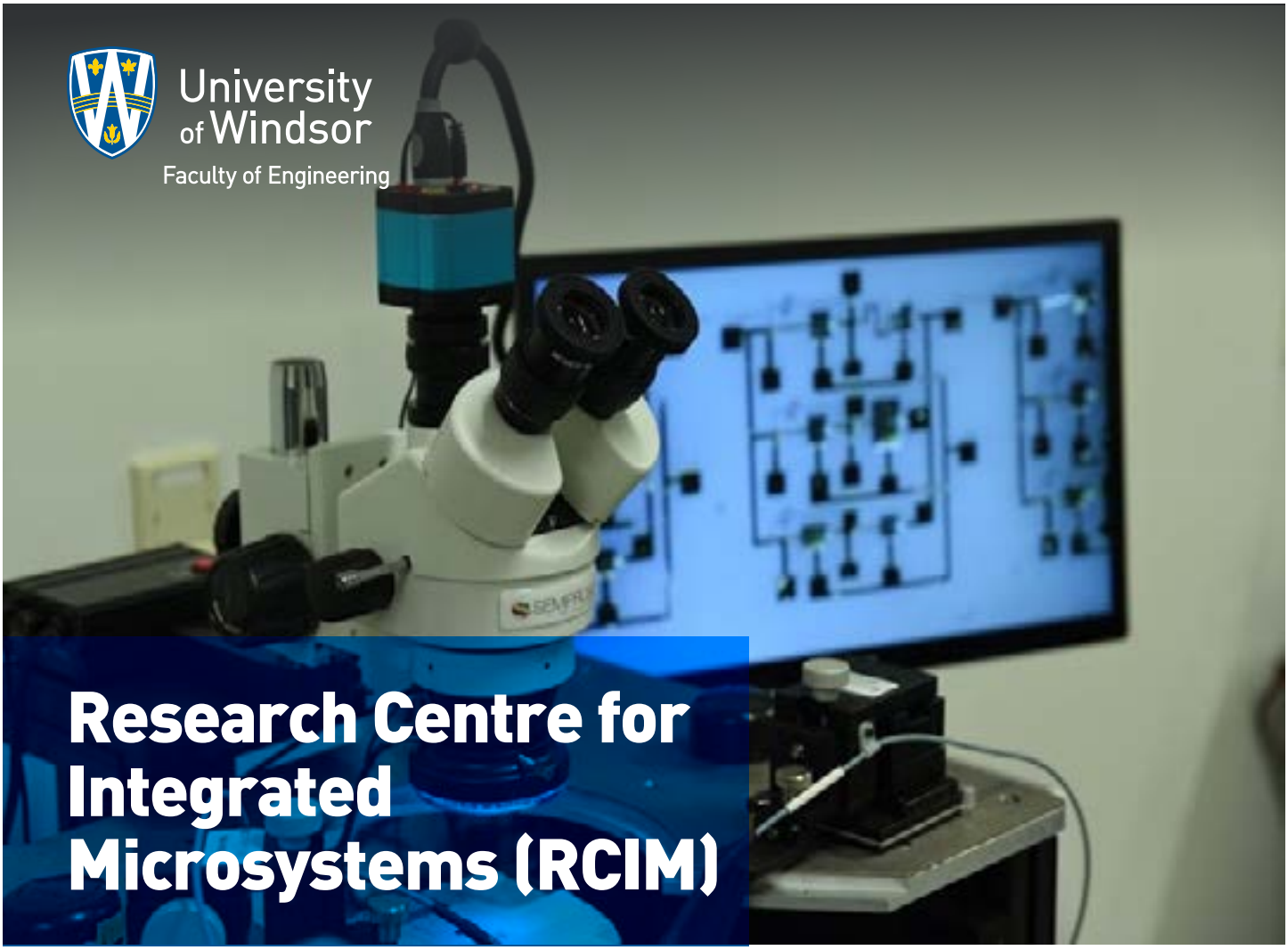

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Research Centre for Integrated Microsystems (RCIM)

Conducts leading-edge collaborative research with the direction and guidance of 11 faculty members.

Gives emphasis to problems requiring signal processing systems implemented with advanced integrated microsystems.

Excels in the advancement of Microelectromechanical systems (MEMS) including:

- Sensors and filters
- Capacitive microphones and 3D-Acoustical Sensing
- Electromagnetic Microactuators
- Acousto-magnetic transducers
- Optical Switching MEMS
- Automotive sensors
- Custom MEMS sockets and MEMS RADAR
- Micropower Generators Atomic Force Microscopy

Invests research efforts in innovative Digital Signal Processing and Communication technologies including:

- Massively Parallel Arrays and Special Architectures
- Computer Vision and Image Processing
- Network security management
- Pattern Recognition and Document Analysis

Carries out research in Microelectronics including:

- Encryption
- Testing of mixed signal integrated circuits
- Field Programmable chips and systems
- High-speed DSP systems
- CMOS and Nanoelectric circuits design
- Neural Networks
- Memristor bsed Digital and Analog Circuits

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SHIELD Automotive Cybersecurity Centre of Excellence

- The first dedicated institution to security connected, autonomous, and electrified automotive & mobility systems with ground-breaking research, innovation, and partnerships.
- With a great focus on Automotive Cyber Security, our aim is to facilitate Canadian-made solutions in training, innovation, and public awareness.
- We create research-based & application ready solutions that meet rapidly changing technology and threats
- Strong focus on institutional and industrial collaboration
- Multi-disciplinary working on every aspect of automotive cybersecurity
- Focus on relevant curriculum and training to lower the barrier for entry to cybersecurity specialties and create industry ready talent pipeline
- Training of HQP with experiential learning opportunities
- Custom-designed certificate programs for evolving industry requirements
- Removing training barriers by offering cost-effective, flexible and online training programs for students and workforce re-training
- Build digestible library of information and engagements to raise awareness for the need for mobility cybersecurity
- Reports, whitepapers, and knowledge transfer sessions
- Collaborating in creating compliance and standards for securing the integrity of the manufacturing
- Compliance with automotive ecosystem

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STEP Disruptive Technologies Research Lab

- Examines the Socio-Technical-Economic-Political (STEP) implications of disruptive technologies.
- Conducts research into the design, analysis, and implications of developing technologies on manufacturing, energy, and engineering systems.
- Investigates the technological changes and disruptions that are needed to achieve the vision of Smart Cities, Sustainability, and Resilient Systems. This includes looking at the needed developments in connectivity, artificial intelligence, automation, autonomous systems, and the implications of these developments.
- Conducts research into engineering entrepreneurship, innovation, leadership, intrapreneurship, and management and how these can be better integrated into engineering practice and education.
- Participates in the development and implications of technical and international engineering codes and standards for autonomous systems, artificial intelligence, and robotics.
- Collaborates with industry and international scholars.
- Uses Text Data Analytics on unstructured data.

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Structural Engineering Testing Lab

- One of the largest structural engineering labs in Canada
- Total area of the lab is about 700 m2
- Total strong floor area is about 600 m2 for applying tension and/or compression gravity load
- Two strong walls equipped with high capacity (2000 kN) and large stroke (30 inches) MTS loading actuator and other loading cylinders, at right angles for application of tension and/or compression lateral loads
- Each strong wall is 11 m tall and 5.7 m long
- Ceiling height is about 14 m
- A 20-ton capacity overhead crane
- A 5-ton capacity forklift
- Two access doors for easy entry and easy exit of large flatbed and transport trucks
- Outside fenced storage area of 100 m2
- Large loading frame for testing large structural specimens like bridge deck, beam, wall etc.
- Medium loading frame which can apply 4000 kN compression and 3000 kN tension load and also 1000 kN lateral load
- Small loading frame for testing medium structural testing specimens
- MTS made fatigue testing actuator
- Loading jacks with various capacities
- Several MTS made stand-alone universal material testing loading systems
- Various pressure and other testing equipment for structural testing of oil and gas pipes

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Supply Chain Management and Logistics Optimization Research Lab

- Focuses on research on operations and supply chain management, warehouse and logistics, e-business, optimization, algorithms development, and business intelligence.
- Developed algorithms and support systems for cargo network scheduling, tools room scheduling, warehouse layout and management, production planning, optimal cyclic multiple-hoist scheduling, healthcare supply chains, and power network optimization.
- Conducts research in dual-channel supply chain management and logistics, E-commerce, pricing and revenue management, supply chain finance, and smarter supply chain management under industry 4.0.
- Engages in projects with automobile, airline, energy, foods, healthcare, finance, and IT industry, and international collaborations and exchanges.
- Develops modelling and solution approaches for green, sustainable, closed-loop supply chain management, risk management, manufacturing, and portfolio optimization.
- Equipped with RFID equipment, optimization, and simulation software.
- Facilitates the applications and innovation of RFID, big data, and artificial intelligence in supply chain management, logistics, and process improvement.
- Provides analysis and improvement of all stages/aspects of supply chain management, including forecasting, multi-stage inventory, safety inventory, supplier selection and sourcing, production planning, transportation, ERP, information system, pricing, risk and resilience, and service performance.
- Provides modeling, algorithm design and development for linear, nonlinear, mixed integer, and stochastic optimization.
- Developed a software package for large-scale linear programming.
- Developed different meta-heuristics, Lagrangian heuristics, Benders decomposition, and other advanced algorithms for optimization and data analysis.

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Sustainable Engineering & End-of-Life Management Lab

- Investigates sustainability and engineering applications, including environmental impacts from engineered products.

Research themes include:

- Evaluating end-of-life opportunities for recovered materials, including the automotive industry
- Assessing the functionality, resiliency, and sustainability for infrastructure systems
- Classifying brownfield site redevelopment opportunities
- Assessing and benchmarking engineered products and systems
- Undertaking and developing Life Cycle Assessment (LCA) and environmental metrics for applications, including:
- LCA of bio-based ethanol production alternatives
- Passenger vehicle LCA methodologies
- End-of-life vehicle life cycle inventory assessment
- LCA of Bio-based materials use in the automotive industry
- LCA of automotive paint solvent recycling alternatives
- Provides solutions for waste management and materials recycling and recoverability for the emerging circular economy.

Examples include:

- ICI (industrial, commercial, institutional) and municipal waste audits and waste minimization studies
- Comminution and liberation of plastics from commercial plastic products with and without cryogenic pre-treatment
- Assessment of organic waste management in cold weather climates using black soldier fly

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Tribology of Materials Research Centre (TMRC)

- Consists of integrated laboratories with a suite of tribometers: hot forming tribometer, in-situ observation tribometer, reciprocating, block-on-ring, pin-on-disc tribometers and instrumented CNC for tool coating assessment. Thin-film fabrication facilities: PVD sputtering and electrodeposition systems. Surface characterization facilities: digital and electron micro-scopes, surface profiling systems and micro-Raman spectrometer.
- Research programs are aimed at developing wear mechanisms maps, minimization of friction in auto-motive engines using tribological coatings on light-weight alloys, metal-matrix composites and nano-structured materials. Novel material characterization techniques are developed for identifying the physical mechanisms occurring when lightweight alloys contact another moving hard surface, such as a piston ring or a cutting tool.
- Machining research programs are focused on developing a cost-effective technology for environmentally sustainable machining of automotive and aerospace components. Near dry-machining techniques reduces the need for large amounts of metal cutting fluid and coolants extending tool life and increasing product quality, and predictive computational and numerical models to design wear resistant tool materials.
- Develops new surface engineering techniques using carbon-based materials, diamond-like carbon, graphene for die/tool surface friction reduction.
- Develops new technologies to help industrial designers select and design systems or components that are resistant to wear, yet easy to machine and form.

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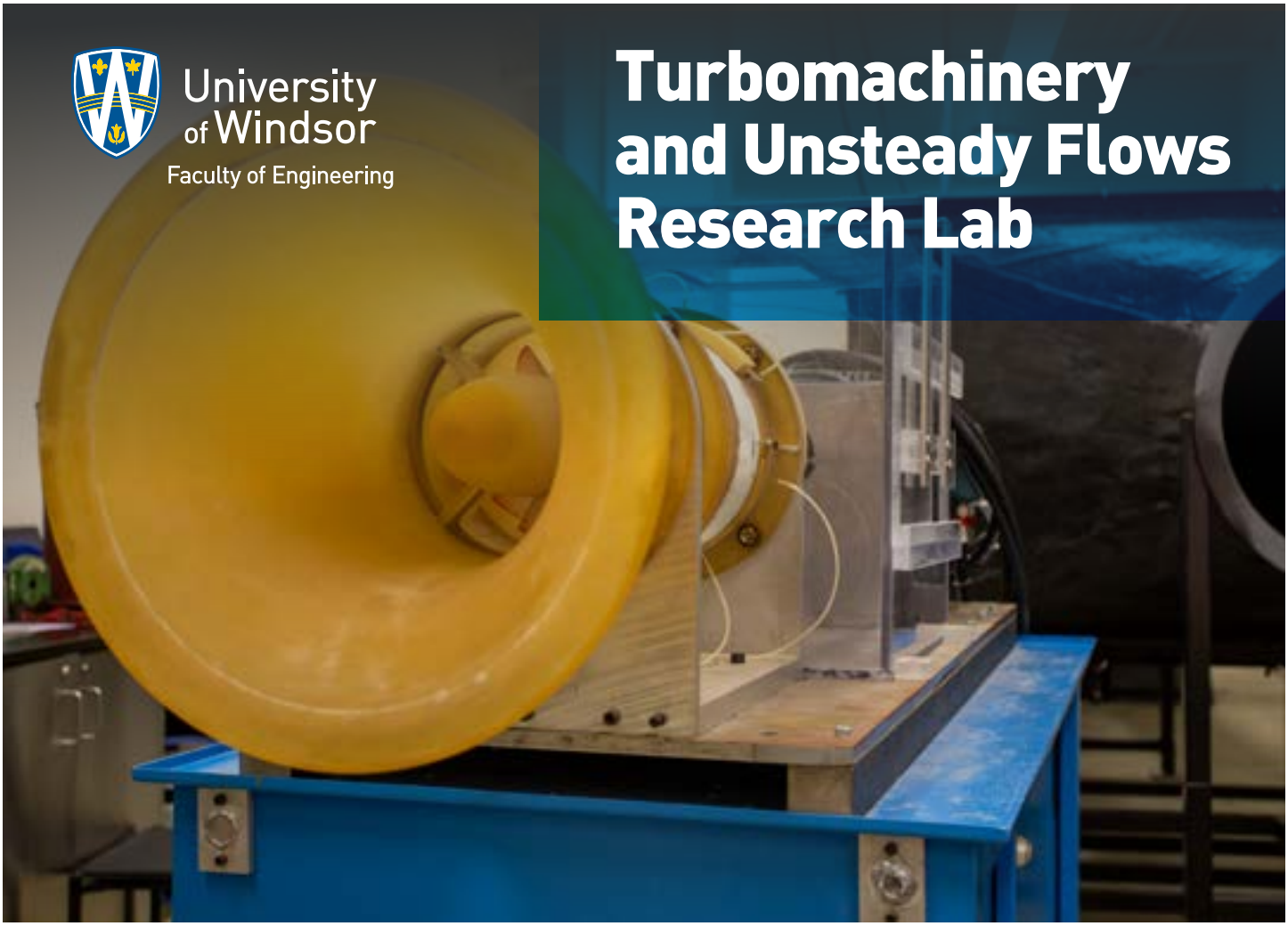
Turbomachinery and Unsteady Flows Research Lab



Research areas

- Turbomachinery, internal flows, and unsteady phenomena which occur in these systems, including aero-acoustics.
- Fan and compressor aerodynamics/acoustics are the primary focus.
- Emphasis on numerical simulations of fluid flow with supporting experiments as needed.
- Specialization in simplified modelling of fans and compressors using body forces in numerical simulations.
- Interest is in solving problems relevant to industry and empowering industrial partners through the transfer of insight into the underlying flow physics which governs phenomena of interest.Main research infrastructures:
- Expertise in Fluent and CFX software (flow solvers), Pointwise (grid generation), and CFD-Post and MATLAB (post-processing).

Research infrastructure

- Open-loop wind tunnel which can accommodate a wide variety of test sections (blade cascades, isolated airfoils, objects in jets, etc.).
- Flow capacity: 16 kg/s of air (outlet velocity: up to 40 m/s in standard configuration, higher possible at lower overall mass flows).
- Flow field traversing with hot-wire probes, Pitot-static probes are the measurement capabilities.
- Flow visualization via oil film.

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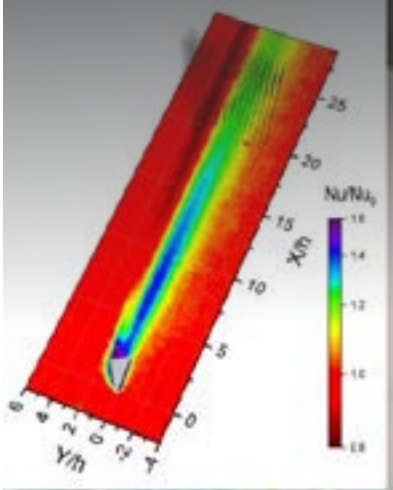
Turbulence and Energy Lab



- Investigates flow turbulence at a fundamental level and aims to harness this energy into engineering advantages
- Focuses on flow turbulence in engineering systems such as wind turbines, underwater accumulators, burners, furnaces, engines & solar panels
- Designs energy applications with an intent to escalate conventional, current, and future energy technologies through advanced thermo-fluids analyses
- Studies the heat recovery application in various power cycles, flow-induced vibration of flexible circular cylinder, and hydrodynamics of compressed air in underwater energy storage
- Possesses a four cylinder double-acting Stirling engine with rated power of 1 kW at 1500 RPM and an external combustion heat engine to convert any conventional or renewable energy
- Equipped with a high-quality closed-loop wind tunnel which can provide speeds up to 36 m/s
- Performs wind turbine design & optimization and investigates the constructive aerodynamic interaction of a group of wind turbines
- Conducts turbulence modeling of atmospheric wind flows and aftermath of the wind on solar photovoltaic systems
- Examines the hydrodynamics and engineers the mitigation of accelerating and expanding buoyant vortex rings
- Explores smart and secure commercial (greenhouse) and residential water technologies
- Enhances the power take-off strategies for wave energy harvesting
- Predicts tumour growth based on entropy maximization

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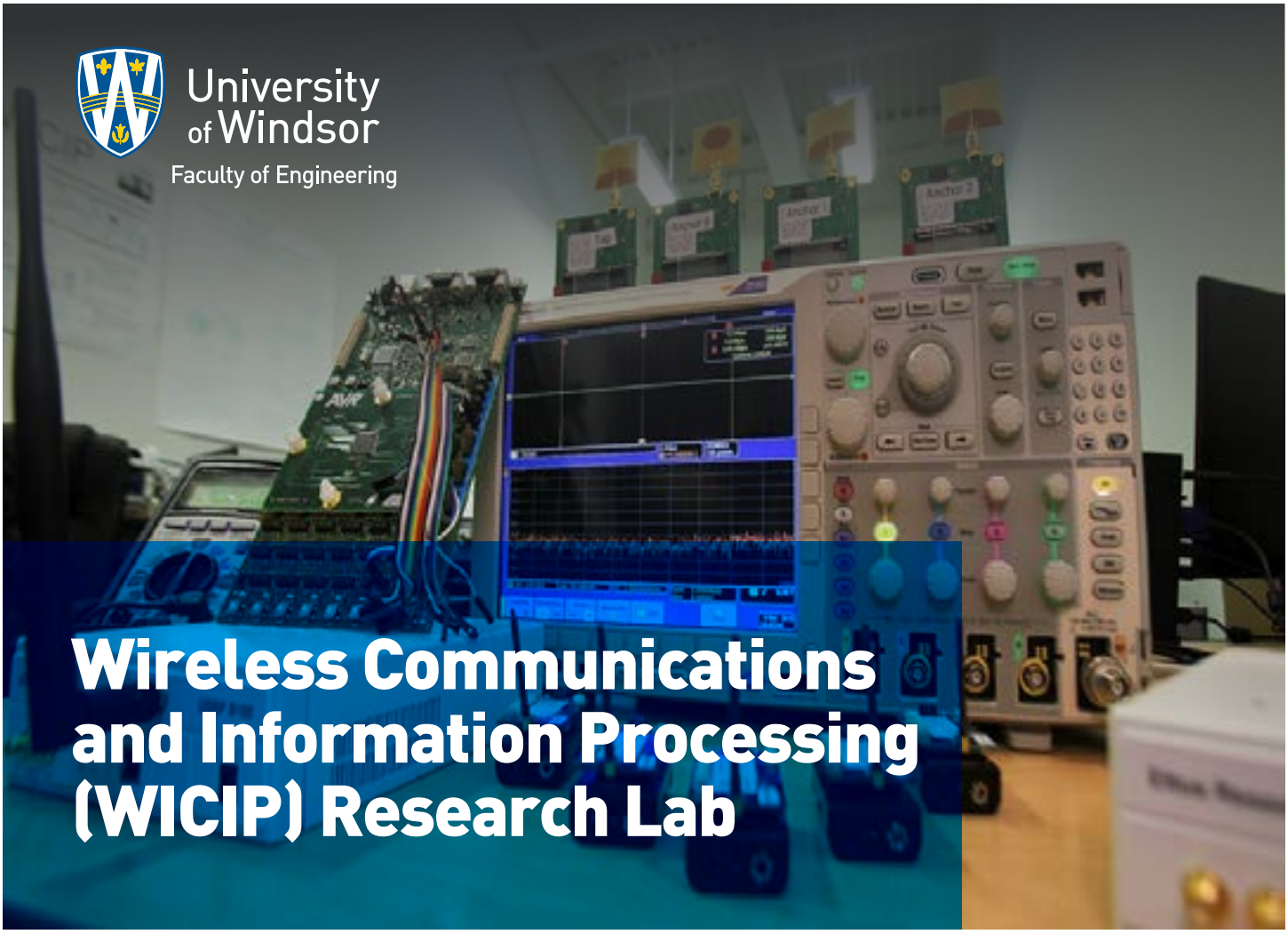

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Wireless Communications and Information Processing (WICIP) Research Lab

- Focuses on 3 major research areas of wireless and computer networking: (1) Internet of Things (IoT), Machine to Machine (M2M), Sensor Networks, and Ultra-Wide Band precise indoor positioning; (2) Vehicle to Vehicle (V2V) and Vehicle to Infrastructure (V2I) communications, connected vehicles; (3) Wireless networks, mobile networks, and network security.
- Develops real-time, reliable and energy efficient protocols for mobile and wireless networks designed for smart systems communications, smart grids, robotics and industrial networking applications.
- Innovative and transformative research project of WiCIP are funded by NSERC, FedDeV, CFI, and Communication Research Centre of Canada as well as industrial partners.
- Equipped with Network Analyzers, sensor network testbed, DSRC communication systems, vector signal analyzer, state-of-the-art wireless communication modules and systems.
- Know how in network simulation with Omnet++, NS2/3, and Matlab, simulation experience with mobility models and networks.
- Rapid prototyping of network gateways, communication protocols, wireless communications systems up to 15 thousand nodes. Rapid prototyping of protocol with real-time operating systems and off-the-shelf hardware and systems.

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