

Engineering at UWindsor

Tap Into Innovation



uwindsor.ca/engineering/research



Engineering
University of Windsor

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 labs 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.

A man in a dark blue lab coat is focused on working on a large, complex electronic assembly. The assembly consists of multiple rows of circuit boards with numerous components and connectors. The background is a cleanroom environment with various pieces of equipment and a blue-tinted lighting scheme.

1162+

**Undergraduate
Students**

2724+

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

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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

- Digital AI Negotiated Energy Contract
- Terrestrial and offshore energy systems
- Energy storage and systems optimization
- Cybernetics and applied human performance
- Amplified agricultural tech development

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

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 materials
- 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

- Development of environmentally sustainable cementitious materials
- Steel modular construction
- Construction using 3D printing (additive manufacturing)
- Behaviour of masonry structure
- Structural and fatigue behavior of steel oil and gas pipes
- Rehabilitation of structures using FRP

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



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.)

fgherib@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

clee@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) structural 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

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. 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



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 pollutants

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

Air Quality Lab

- Monitoring equipment of mercury, particulate matter (PM), ozone, CO, SO₂, NO_x & 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

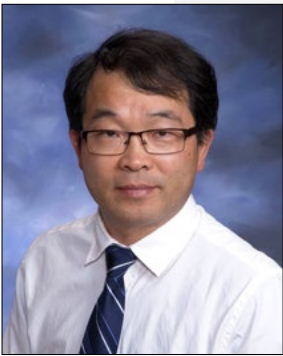
Associate Professor

- 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 electronics



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

**Director, Centre for Hybrid Automotive
Research & Green Energy (CHARGE) Lab**

- Next-generation electric machines for electric vehicles
- Intelligent traction motor control and power converters
- Innovative test solutions for motors, drives, and electric vehicles

nkar@uwindsor.ca
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Office: CEI 3035
chargelabs.ca

**Centre for Hybrid Automotive Research
& Green Energy (CHARGE)**

- Multiple e-motor and inverter dynamometer test systems with dynamic control capabilities up to 275 kW, 500 Nm, 15,000 rpm, 1,200 Vdc with 120% overload and 90% recovery load
- One all-wheel drive chassis dyno with remote and robotic control capabilities for complete system-level for light to medium-duty electric vehicle testing up to a speed of 300 Km/hour
- Drive cycle-based e-drive performance evaluation with real-time energy profile execution
- Accurate motor efficiency mapping and comprehensive torque and power characterization
- Instantaneous power analysis with YOKOGAWA power analyzer enables measurement of efficiency, mechanical losses, harmonic analysis, power factor, voltage, current, etc.
- Thorough temperature analysis and advanced thermal management (-150°C to + 250°C)
- Advanced data acquisition and analysis capabilities for in-depth motor and inverter characterization, performance evaluation, and design optimization



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)**

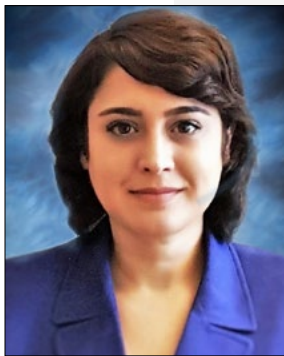
- Powerful computer workstations running state-of-the-art CAD tools
- CAD tools: VHDL/Verilog based simulation and synthesis, High Level Synthesis
- High capacity and high performance FPGA boards



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 Shahrava
Department Head
Associate Professor

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

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



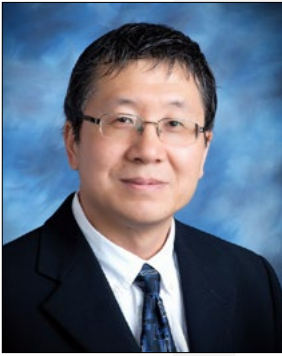
Dr. Kemal Tepe
Professor

- 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

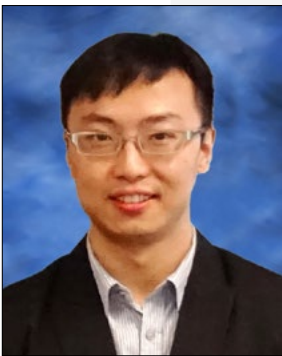
Professor

- 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

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

Computer Vision and Sensing Systems Laboratory

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



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, galvanized 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 & Operations Management
- Product Lifecycle Management
- Industry 4.0
- Operations Research & Simulation
- Data Analytics

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

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



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



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

hae@uwindsor.ca
519-253 3000, Ext. 5034
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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
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uwindsor.ca/imsc

Intelligent Manufacturing Systems Centre (IMSC)

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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

lpriet@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 theories
- 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

Applied Fluid Mechanics and Heat Transfer Research Lab

- AFM & HTR lab conducts interdisciplinary research involving fluid mechanics and heat transfer applications in engineering
- Our research explores fundamental understanding of turbulence structure to improve electric vehicles' performance and develop novel renewable hydrokinetic energy technologies



Dr. Beth-Anne Schuelke-Leech

Associate Professor

- Systems and Resilience Engineering
- Analysis of Complex, Adaptive, and Dynamic Systems
- Engineering Management, Innovation, and Entrepreneurship
- Emerging and Disruptive Technologies
- Big data, text data analytics, prompt engineering
- Future work skills and education

beth-anne.schuelke-leech@uwindsor.ca
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

dting@uwindsor.ca
519-253-3000, Ext. 2599
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
uwindsor.ca/scm



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

- Sustainable propulsion, high efficiency engines, clean combustion engines
- E-Fuel, renewable fuel, alternative fuel and biofuel combustion and management
- Spark ignition, adaptive high-power ignition control, plasma/corona ignition
- Emission control & diagnostics, active flow exhaust after-treatment

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



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

Supply Chain Management and Logistics Optimization Research Centre

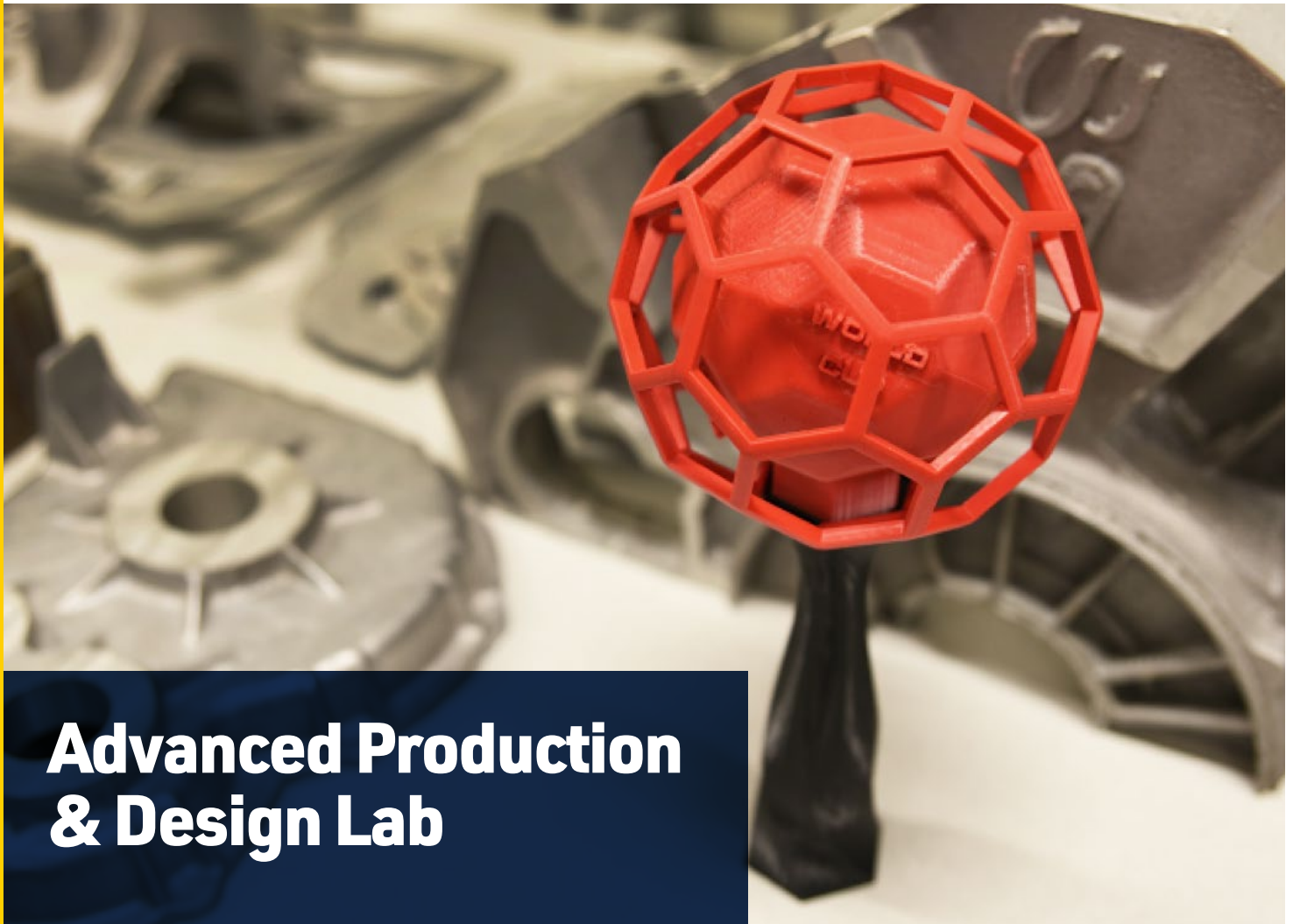
- Facilitates the applications and innovation of RFID, IoT, big data, and artificial intelligence in supply chain management, logistics, and process improvement
- Provides analysis and improvement of all stages/aspects of supply chain management, including forecasting, inventory, purchasing, production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

Clean Combustion Engine Lab

- Engine dyno test cell: 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, RT 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

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)

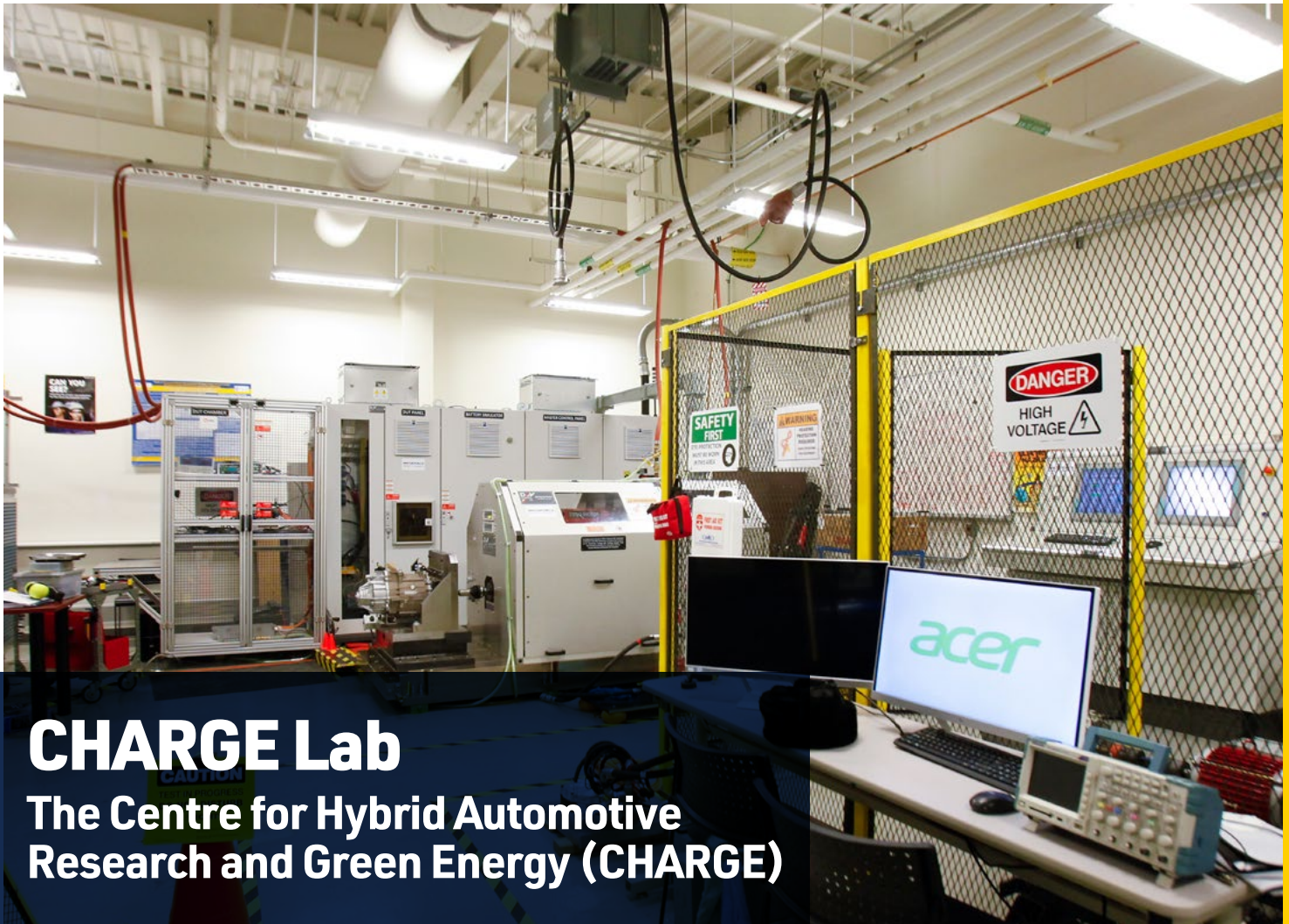


Advanced Production & Design Lab

- 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



CHARGE Lab

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

- In collaboration with academic and industry partners, CHARGE Lab focuses on innovative materials for electric machines, optimization of electromagnetic machine design, new inverter design, intelligent motor control, thermal management, and EV components and systems testing

CHARGE Lab:

- 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 academic, government, tier suppliers and OEM industry partners
- Possesses one of the best EV powertrain components and system test infrastructure in North America with a 10,000 sq. ft. experimental facility, capable of testing different types of e-motors and inverters up to 275 kW and EVs up to a speed of 300 Km/hour
- Is equipped with multiple real-time hardware-in-loop testing capabilities, variable frequency drives, thermal imagers for electric machines and power electronics, in-house prototyped e-motors and drives, as well as high-end power quality and energy analyzers, oscilloscopes, and numerous current, voltage, and speed measuring units

Visit chargelabs.ca for more information.

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

Clean Combustion Engine Lab



State-of-the-art advanced engine test facility with:

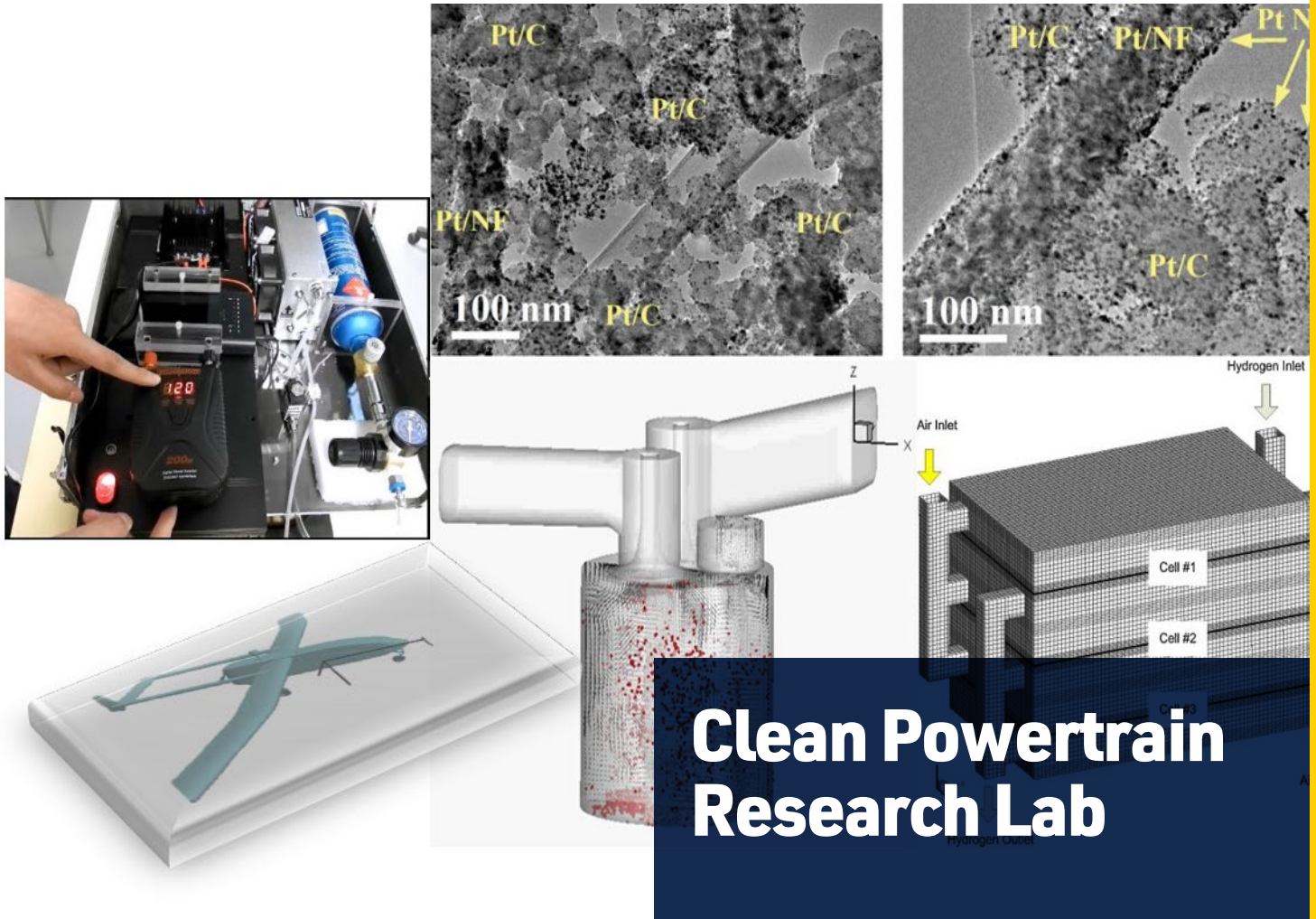
- Test engines: single-cylinder research engines and multi-cylinder engines running in single-cylinder mode
- Engine dynamometers: double-ended direct current, alternating current, and eddy current dynos
- Fuels: diesel, gasoline, renewable fuel, and blends
- Independent and adaptive control systems 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
- Schlieren imaging, laser diagnosis and spectroscopy
- Rapid compression machine
- Full range of emission analysis equipment including direct in-cylinder gas sampling

- Flow bench for simulating engine exhaust gas for aftertreatment tests

Research focus:

- Low-temperature combustion using innovative combustion methods and controls
- Combustion control strategies using multiple injections, heat release analysis, exhaust gas recirculation
- Active-flow aftertreatment
- Combustion diagnosis and modeling
- Bio-fuels such as bio-diesel, bio-alcohol, DME, Ammonia and hydrogen as dual-fuel or single fuel
- High speed motor control (up to 50k rpm)
- Chemical sensors (H₂, O₂, NO_x)
- Hypersonic combustion research
- High-power ignition with corona, spark, and multi-coil systems with output energy characterization
- Aims to develop sustainable propulsion techniques with improved efficiency and reduced exhaust pollutant emissions by using innovative technologies

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



Research areas

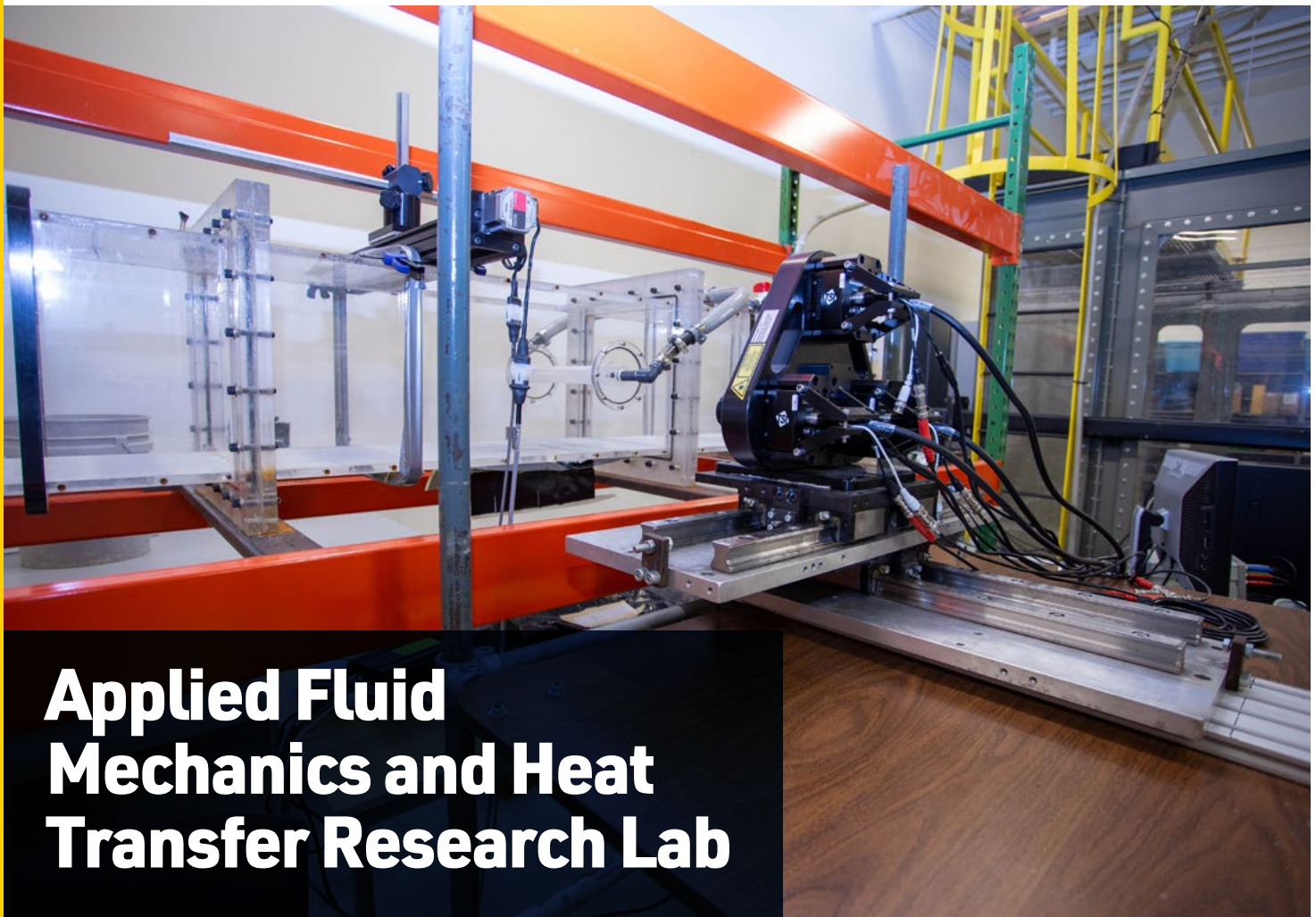
- **Clean Powertrain:** Fuel cell and hybrid powertrain technologies
- **Unmanned Aerial Vehicle (UAV):** Fuel cell power system for UAV applications; Design of UAV; Flight dynamics and control
- **Nano-Materials:** Membrane fabrication techniques; Catalyst and catalyst support; Advanced Membrane-Electrode-Assembly
- **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



Applied Fluid Mechanics and Heat Transfer Research Lab

We have three faculties who share the lab facilities: Dr. Ram Balachandar, Professor Civil and Environmental Engineering, Dr. Ron Barron, Professor Emeritus Mathematics & Statistics, Adjunct Professor MAME and Dr. Vesselina Roussinova, Associate Professor, MAME.

- AFM&HTR lab conducts interdisciplinary research involving fluid mechanics and heat transfer applications in engineering. Our research explores the fundamental understanding of turbulence structure to improve electric vehicles' performance and develop novel renewable hydrokinetic energy technologies
- Our research work is well recognized in Canada, and our work is published in first-class peer reviewed journals. There are also 4 patents that were secured in collaboration with industry
- The lab is specialized in the areas of experimental and numerical fluid mechanics and heat transfer. We also have expertise in multiphase flows, fluid-structure interactions, free surface flows, sediment transport and environmental flows

- Our group have worked with various local industries; just to name a few: Stellantis, MAGNA, SOTAES, Centreline, Rodger Industries and Valiant. We are also very successful in obtaining federal grants (NSERC DG, NSERC RTI, MITACS, NSERC Engage)

We have state of the art experimental facilities in the CEI building such as:

- Volumetric particle tracking velocimetry (V3V) system
- Stereoscopic particle image velocimetry (PIV) system
- Laser Doppler velocimetry (LDV) system
- Acoustic Doppler velocimetry (ADV) system
- Water tunnel and 2 open channel flumes
- We have access to large-scale computational infrastructure (Compute Canada and Digital Research Alliance Canada)

We have expertise in cutting-edge numerical simulations such as:

- Acceleration of computational fluid dynamics (CFD) simulation through workflow automation
- Multi-design exploration using CFD
- CFD software development



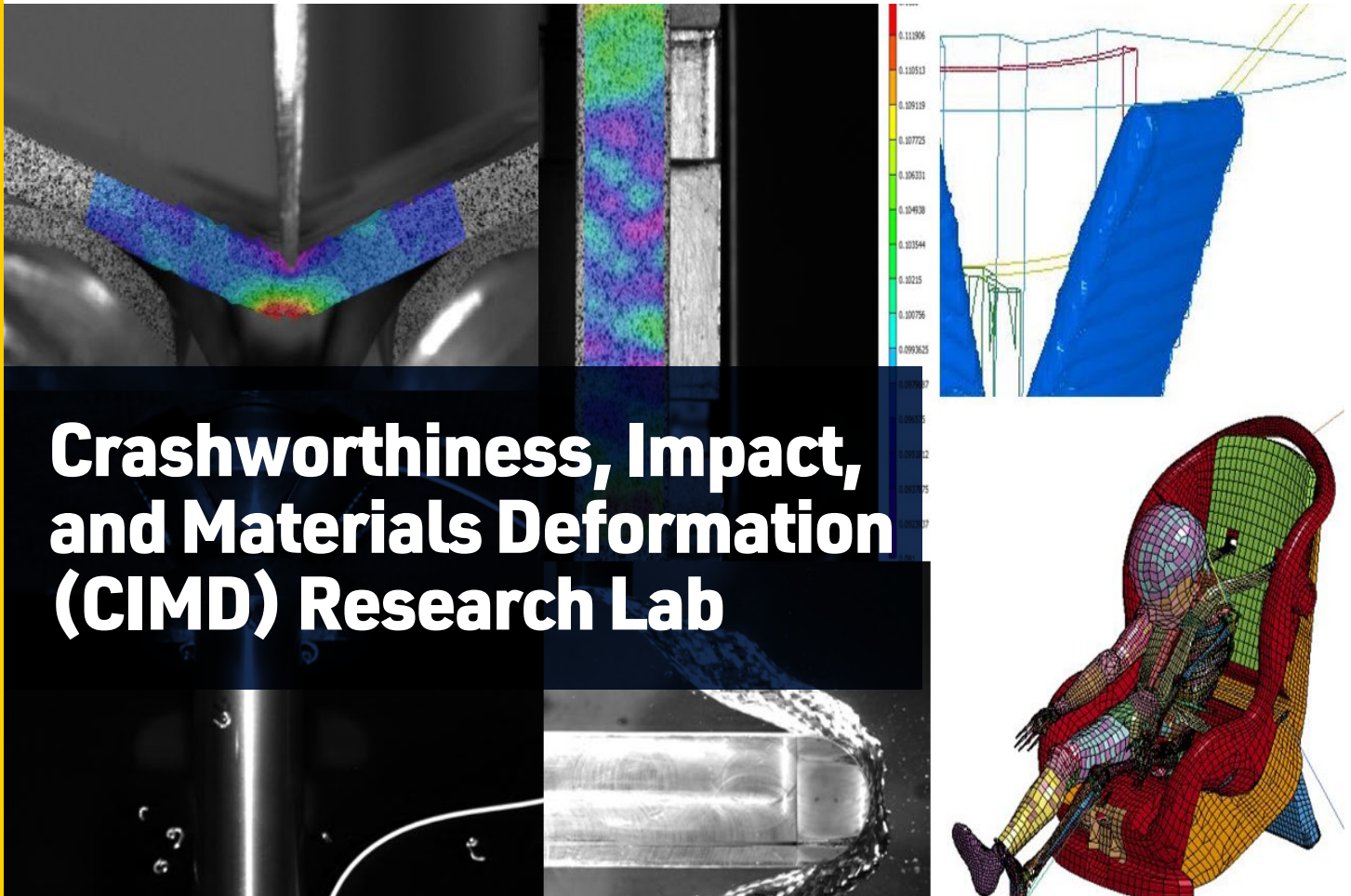
Computer Vision & Sensing Systems Lab

- 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



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
 - 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
- 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

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



Environmental Energy Institute

- 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
- Net-zero systems engineering
- 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



UNIVERSITY OF MALTA
L-Università ta' Malta



The University of Nottingham





I-Fuels

Intelligent Fuels and Energy Lab

Research capabilities:

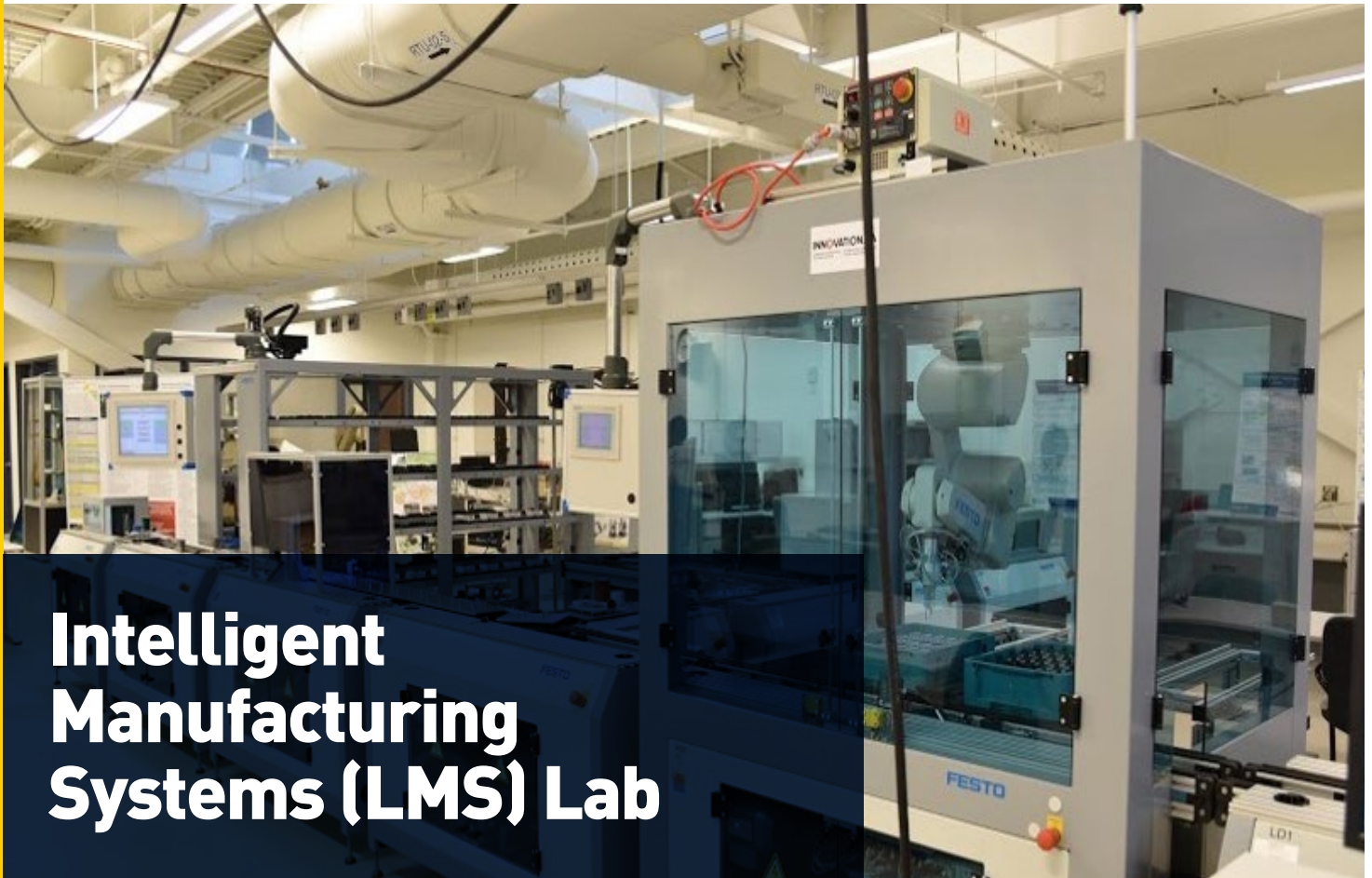
- Engages in ground-breaking research and delivers innovative contributions by applying entropy and exergy-based methods to improve performance of energy systems and maximize capital utilization
- Top-notch research delivers predictors to control transport phenomena in energy systems to improve their 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:

- ShadlowImager 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 | 519-253-3000, Ext. 5943 | 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



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

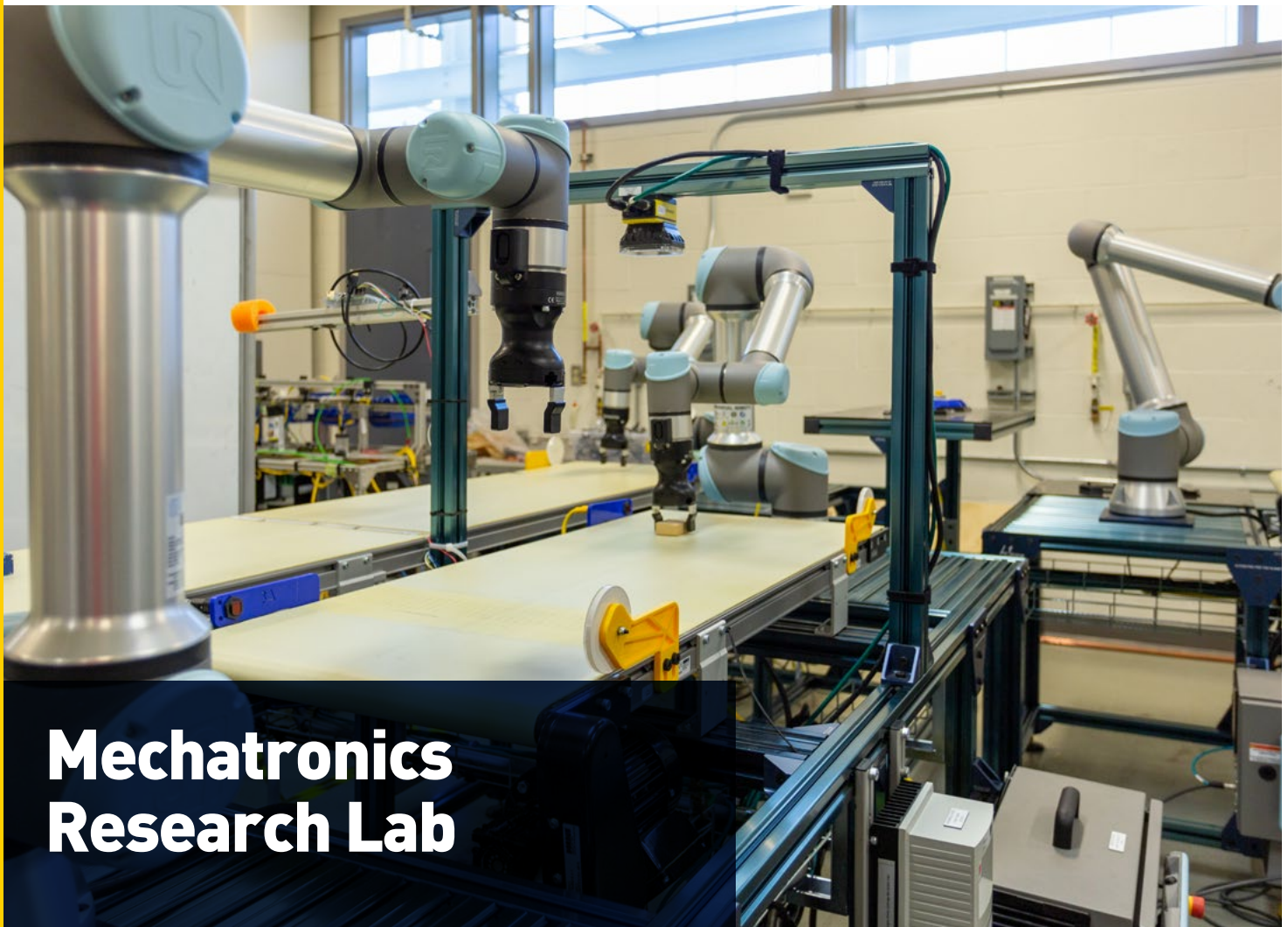
Equipped with hardware-in-the-loop (HiL) and power hardware-in-the-loop (PHiL) testbeds for:

- 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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Mechatronics Research Lab

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



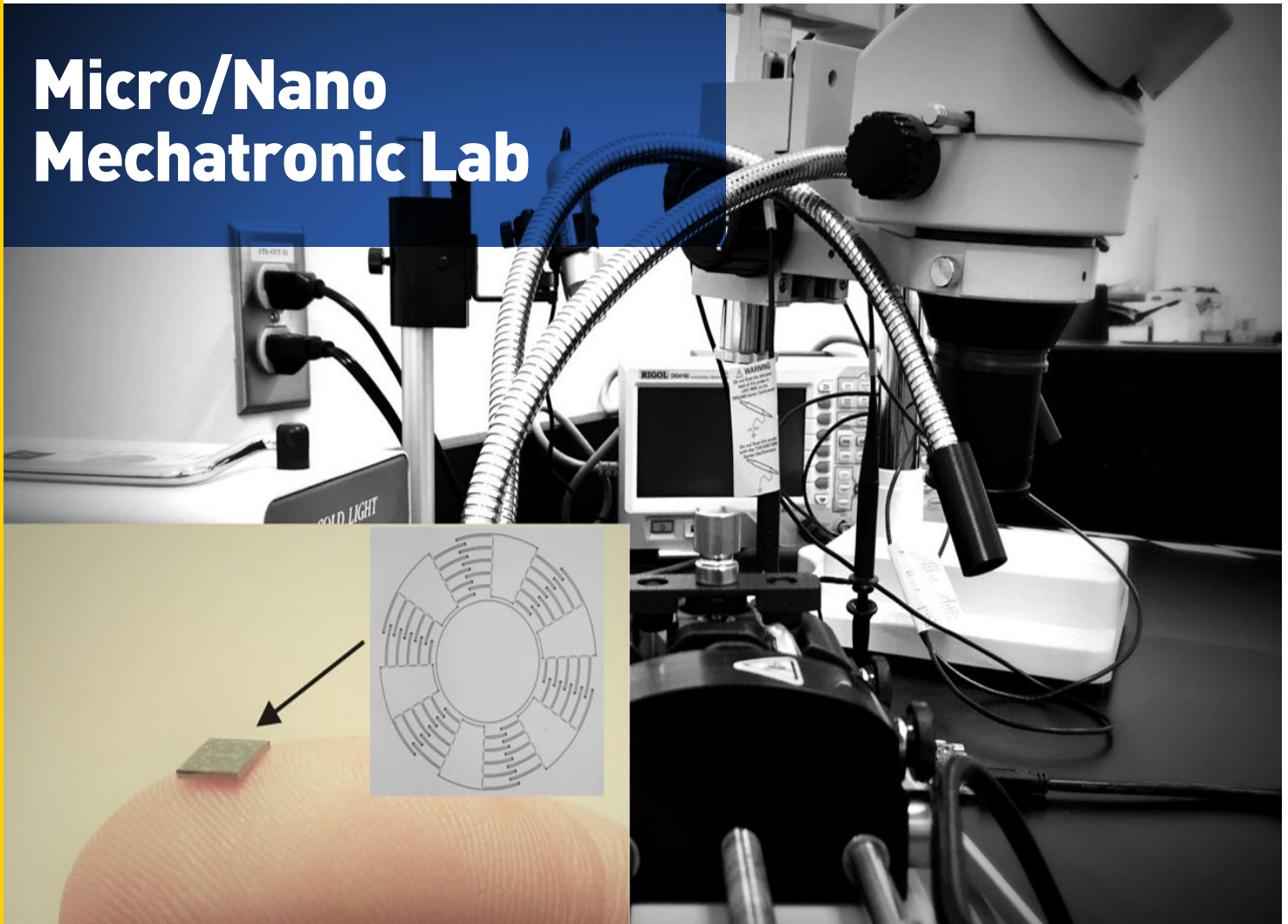
Metal Forming Research Lab

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

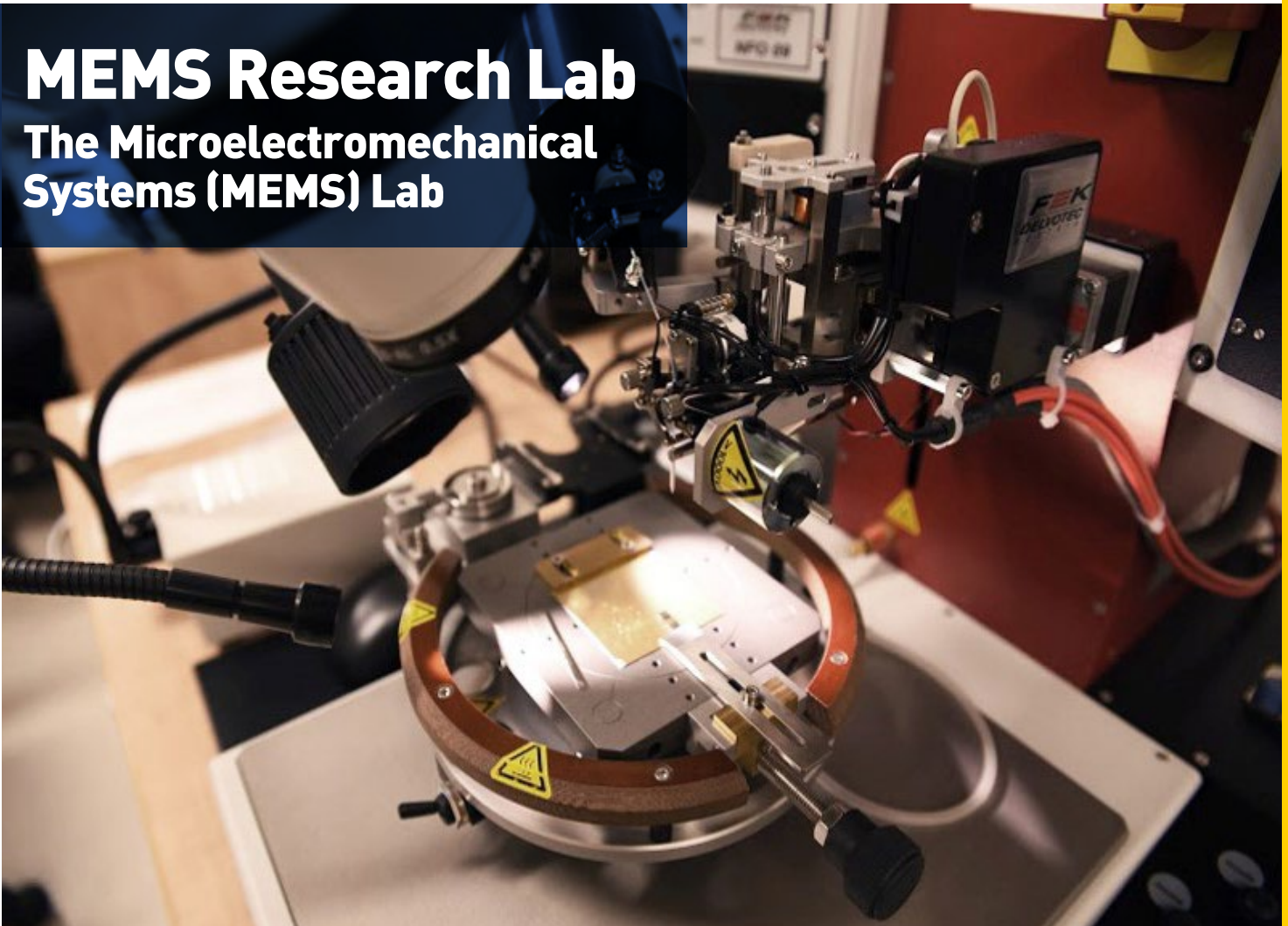
- Design, fabrication and characterization of futuristic 3D micro/nano mechatronic sensing and actuation systems
- Developing micro/nano-electromechanical (MEMS/NEMS) motion sensors for improved sensitivity, high precision, reduced material footprint and low power consumption
- Engineer micro/nano-fluidic 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

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



Plasma Surface Engineering and Nanotechnology Lab

Research areas

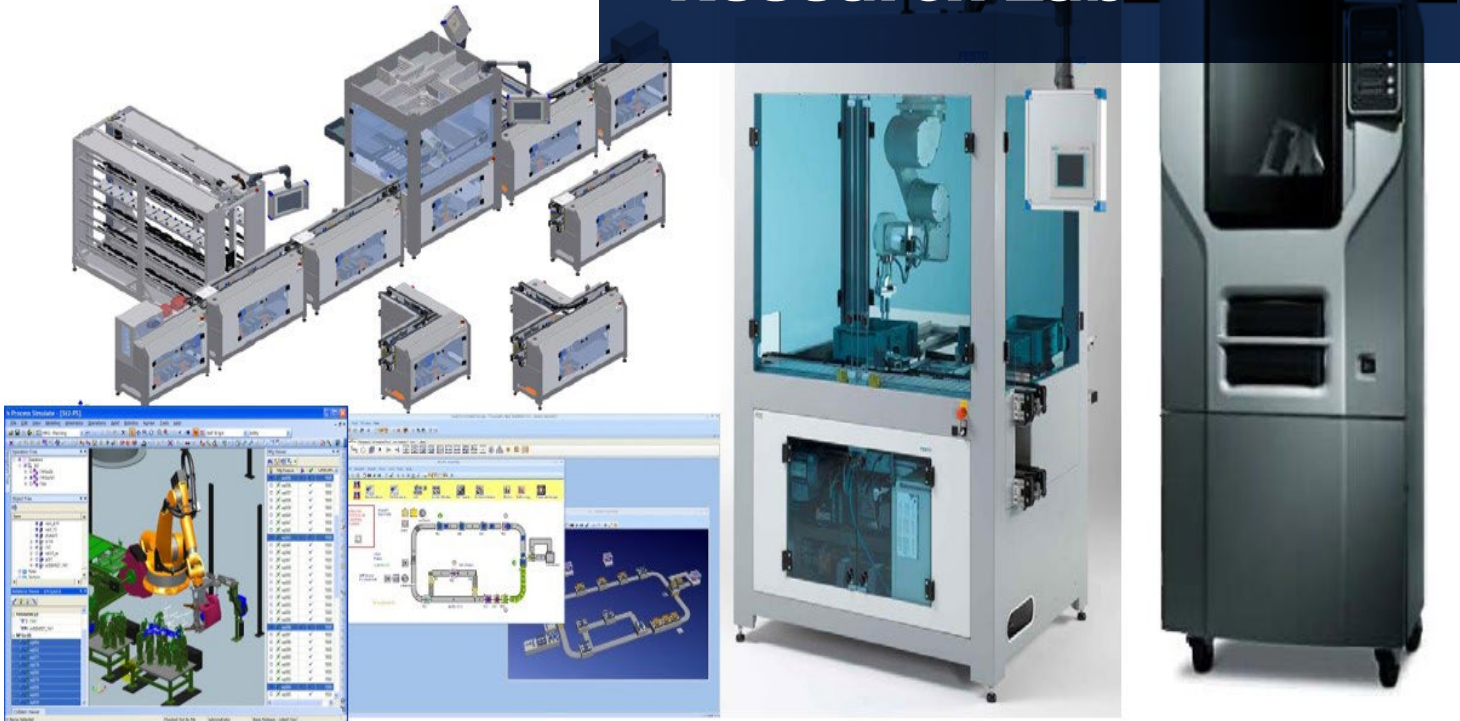
- Structural and coating materials for vehicle weight reduction (e.g., wear and galvanic corrosion prevention of Al, Mg, Ti alloys)
- Structural and coating materials for next-generation engine components (e.g., high temperature wear and oxidation, alternative fuel corrosion, fatigue and creep)
- PVD/CVD 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
- Brake disc coating equipment
- Battery test instrument

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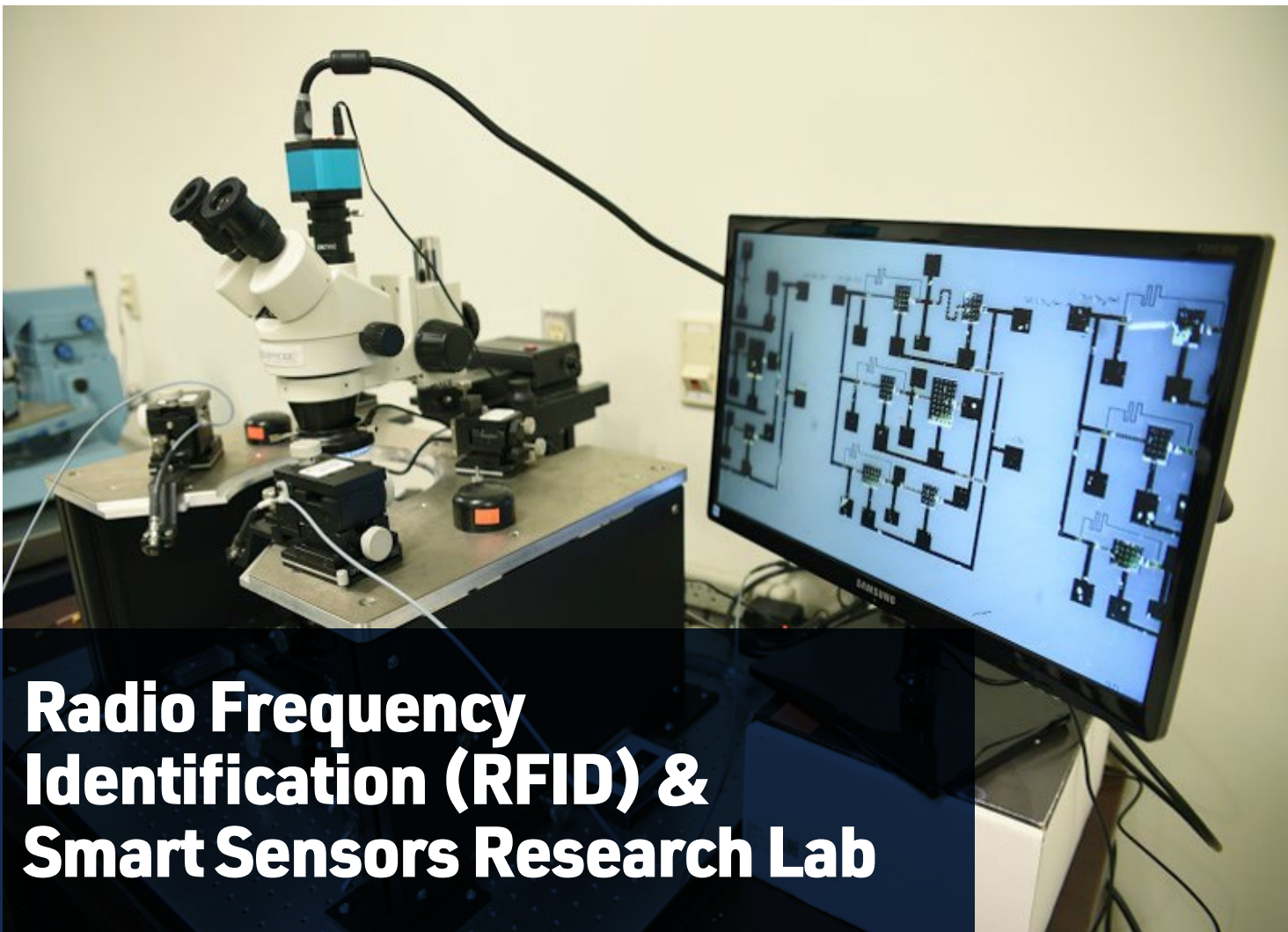
Production Operation Management (POM) Research Lab



- 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 partnerships with different industries in different sectors, which include Manufacturing, Agriculture, Construction, and Healthcare



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

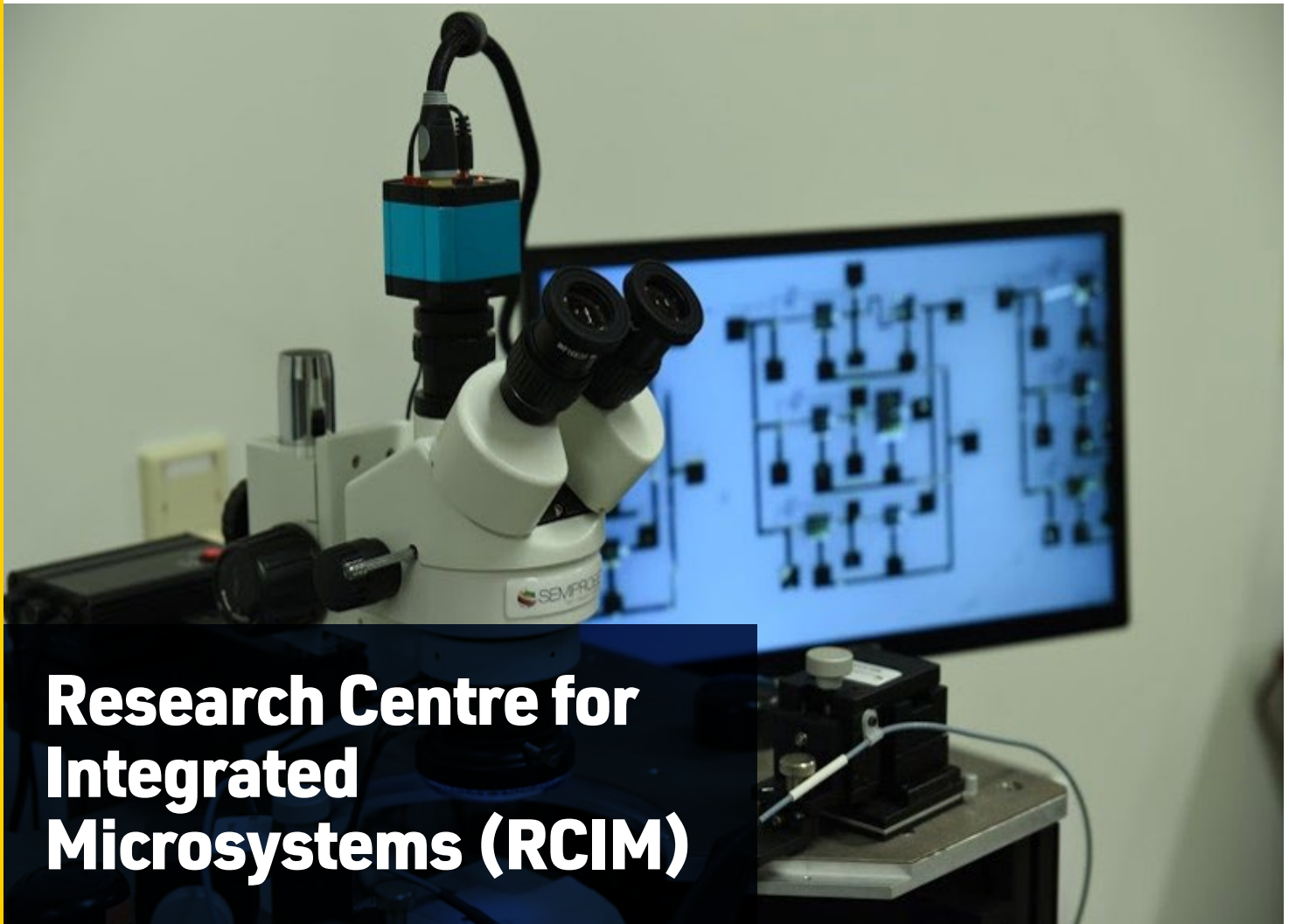
Possesses a track record of successful collaboration with industry in the:

- 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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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 based Digital and Analog Circuits



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 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



Structural Engineering Testing Lab

Structural engineering testing lab at the University of Windsor is one of the largest and tallest in Canada. It has the following key features:

- Total strong floor area of about 600 sqm., ceiling height of the lab is about 15 m
- Two strong walls (each is 11 m tall and 5.7 m long)
- It has a 20-ton capacity overhead crane, one 5-ton forklift, and one 10 m tall scissor lift
- One strong beam with adjustable height (up to 10 m) for application of up to 3000 kN tension-compression loads
- One tall testing frame for testing of walls of up to 6 m tall
- One very large 3000 kN capacity loading frame for testing large structural specimens such as bridge decks
- One loading frame for application of up to 5000 kN axial tension-compression load
- One small loading frame for testing medium structural testing specimens such as beams and columns
- Two MTS made fatigue testing actuators and test frames with 500 kN and 250 kN capacities
- One Instron made test frame for fatigue tests on small samples and materials
- One MTS made universal loading actuator (1700 kN capacity) with a 30-inch stroke
- MTS Hydraulic pump with a controller for running MTS fatigue and MTS universal actuators
- Pressure cycle test facility on pipes and pressure vessels

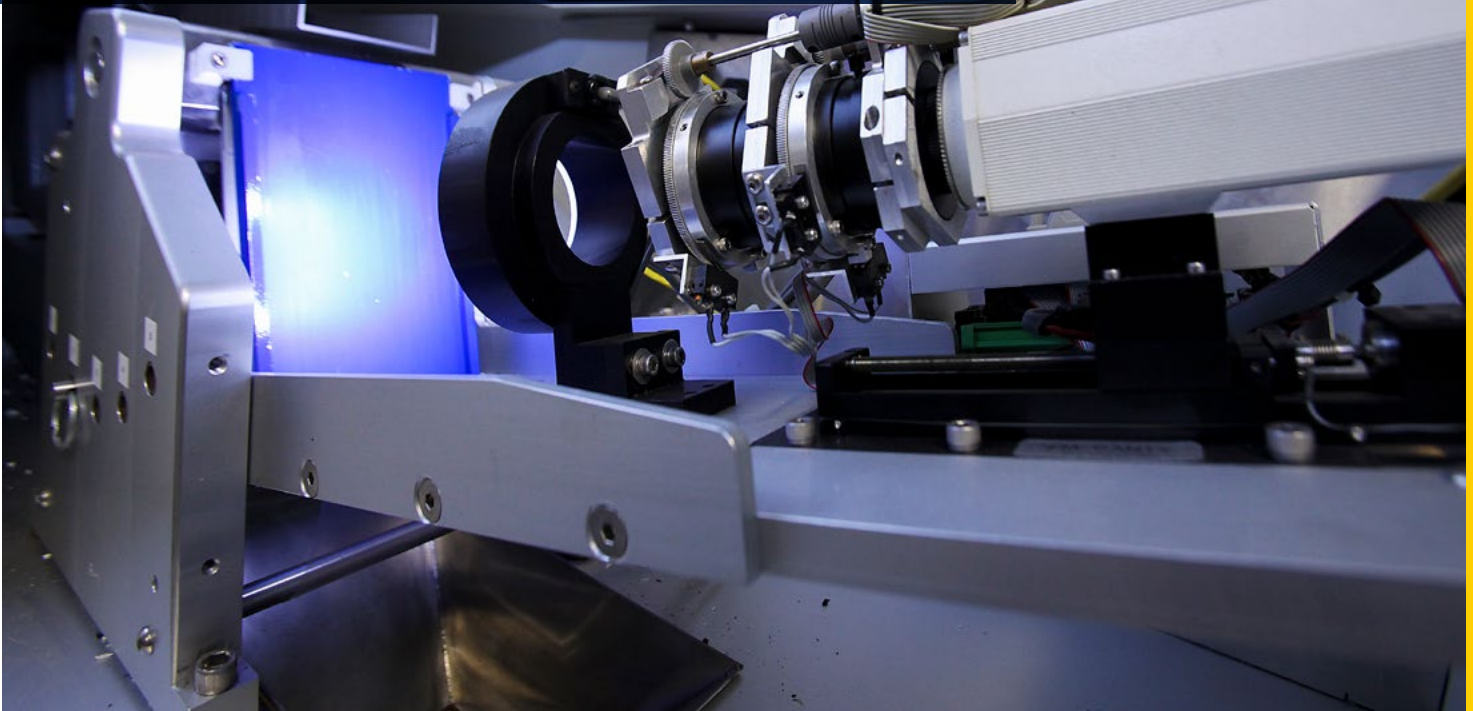
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Supply Chain Management and Logistics Optimization Research Lab

- Focuses on research of 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

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)



LIGHTWEIGHT MATERIALS & COMPOSITES

(Al, Mg, Ti)
Surface Treatments
Wear Maps

POWERTRAIN TRIBOLOGY

Engine Friction/Wear Reduction
Linerless Engines
Bio-Fuels

MACHINING

Minimum Quantity Lubricants (MQL)
Cryogenics
Wear-Resistant Coatings (DLC)

ENERGY MATERIALS

Graphene
Automatically Thin Nano-Materials (for friction control)
Electrodes for Li-Ion Batteries (Sn-Carbon)

METAL FORMING

Surface Engineering
Hot and Warm Forming
Stamping of Bipolar Plates

- 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 automotive 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



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:

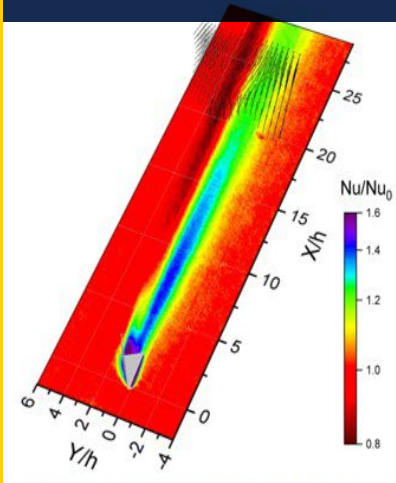
- Expertise in Fluent and CFX software (flow solvers), Pointwise (grid generation), and CFD-Post and MATLAB (post-processing)

Research infrastructure

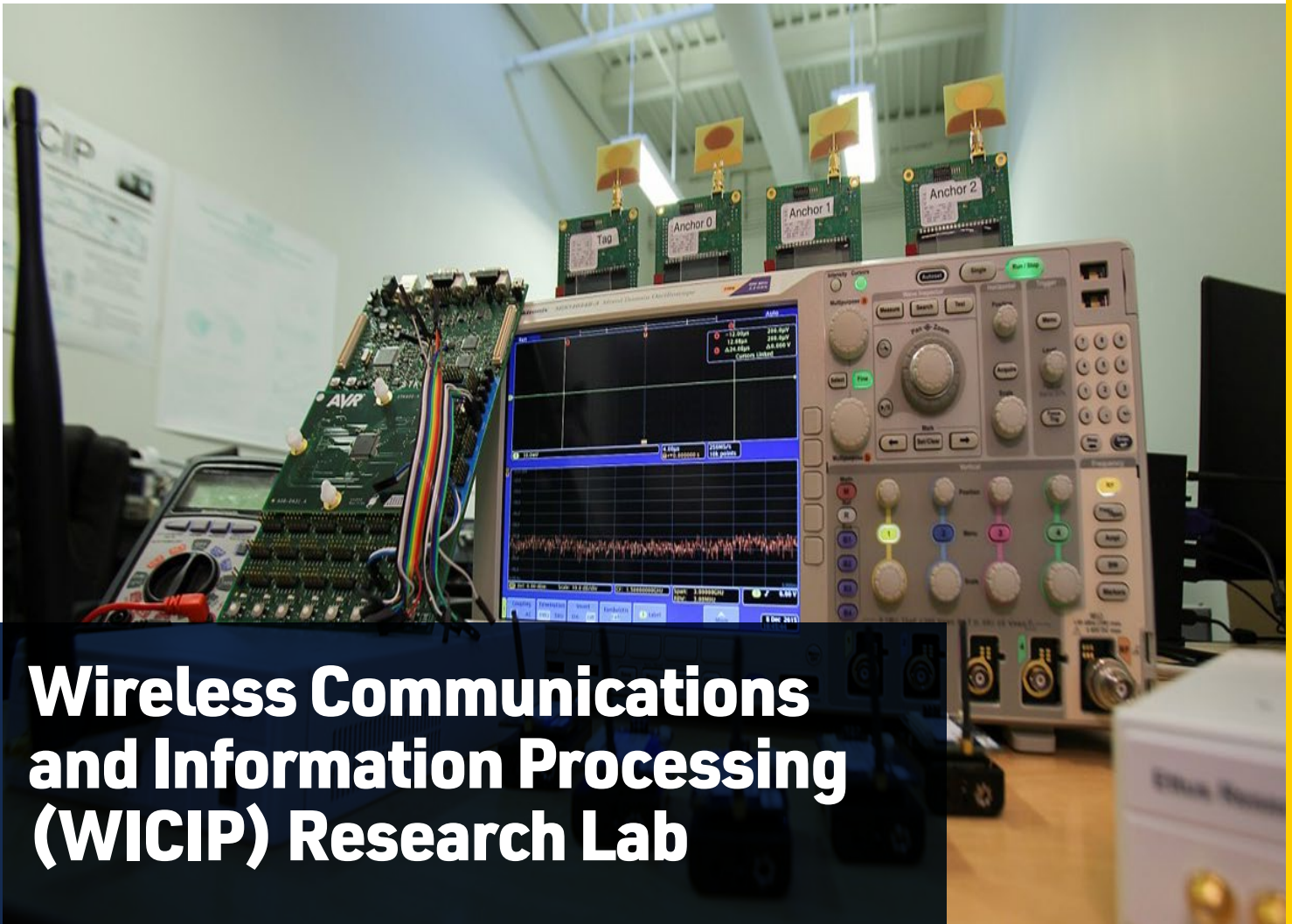
- Open-loop wind tunnel which can accommodate a wide variety of test sections (blade cascades, isolated airfoils, objects in jets, etc.)
- Flow capacity: 16 kg/s of air (outlet velocity: up to 40 m/s in standard configuration, higher possible at lower overall mass flows)
- Flow field traversing with 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 to exploit it into engineering advantages
- Focuses on flow turbulence in engineering systems such as wind turbines, underwater accumulators, heat exchangers, furnaces, engines & solar panels
- Designs energy applications 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
- Invokes phase change material to capitalize solar energy



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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Engineering at UWindsor

Tap into innovation

**One of two Canadian
universities represented
in the final round of Elon
Musk's 2019 Hyperloop
Pod Competition**

**Rocketry team medalled
at the international 2022
Spaceport America Cup**



16,645

Engineering alumni
worldwide

64

new grants in 2023

\$7.4M

estimated total in grants
and research funding for
Engineering in 2022

38

new projects with
industry and community
partners in 2023

306

active internally and
externally funded
projects in engineering

80+

research labs



Engineering

University of Windsor

Faculty of Engineering

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Windsor, ON

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Office of Research and Partnerships

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