

Thesis Topics 2018-2019 (MECH 4162)

**Dr. Balakrishnan** (Tel: 474 9688, Office: E3 370, Email: Subramaniam.Balakrishnan@umanitoba.ca)

**Title:** Experimental design of a vibration damping suspension mount for autonomous survey of HVDC transmission lines. **Description:** Design a flexural/torsion suspension coupling for a HVDC line (to meet a given set of code requirements) that serves to A) decouple select forces at the line suspension points B) damp vibration at the line suspension points, and C) permits an autonomous vehicle to traverse a parallel line crossings. Design requires a theoretical characterization of vibration isolation properties and flexural properties of the design as well as a experimental validation and prototype. **Requirements:** Strong fabrication skills, computer analysis skills (vibration and stress) with a keen research interest research in thermoplastic urethane analysis.

**Dr. E. Bibeau (Sabbatical)** (Tel: 474 7923, Office: E1 439, Email: Eric.Bibeau@umanitoba.ca)

**Dr. M. Birouk** (Tel: 474 7923, Office: E2 327F, Email: Madjid.Birouk@umanitoba.ca)

1. Improve the design of a seeding system for laser-based velocity measurements techniques.
2. Improve the design of a burner for studying turbulent flames/combustion.

**Dr. V. Chatoorgoon** (Tel: 474 8807, Office: E1 408, Email: vijay.chatoorgoon@umanitoba.ca)

1. **Description:** Adapt the computational acoustic program, TARA, to model acoustic wave phenomena in piping filled with water. The task involves some knowledge of FORTRAN.
2. **Description:** Reassemble the Acoustic Wave Experiment and perform runs to ensure it is operating properly.
3. **Description:** Help undertake small projects in the Energy Lab and the new supercritical flow. The student will work with existing graduate students.

**Dr. C. Deng** (Tel: 204 272 1662, Office: E1 486, Email: Chuang.Deng@umanitoba.ca)

1. **Title:** In-situ nano-mechanical and electrical characterization of Al-Mn nanorods

**Dr. R. Derksen (Sabbatical)** (Tel: 474 9166, Office: E1 490, Email: Robert.Derksen@umanitoba.ca)

**Dr. R. Jayaraman** (Tel: 474 7430, Office: E1 482, Email: Raghavan.Jayaraman@umanitoba.ca)

1. **Title:** Structure – Property Correlation in Flax Fiber Composite. **Description:** This project will focus on evaluating the manufacturability of flax fiber mat composites using VARTM. The student will manufacture flax composites using flax fiber mats, measure their properties and fiber volume fraction and use them to evaluate the effect of mat manufacturing parameters on properties flax fiber composites.
2. **Title:** Experimental Study of Perturbation of Stress within a Lamina of a Laminate Due to Damage, Using ARAMIS. **Description:** This project will focus on measuring stress perturbation within a lamina of a laminate when the damage develops, using non-contact photogrammetry technique based ARAMIS equipment. This study is part of an on-going research on long-term durability of polymer composites.
3. **Title:** Multi-axial Fatigue of Polymer Composite Laminates, **Description:** The overall objective of this project will be to study the effect of load path on bi-axial fatigue behavior of multidirectional composites. The fatigue behavior of thin-walled [0/90]<sub>2s</sub> graphite fiber composite tube will be experimentally studied at room temperature under uniaxial and bi-axial loading.

**Dr. M. Khoshdarregi** (Tel: 474-6153, Office: E1-458, Email: M.Khoshdarregi@umanitoba.ca)

1. **(Process Control) Title:** Design and Real-Time Implementation of a High-Performance Controller for LAKESIDE Industrial Process Control System.  
**Description:** Learn the hardware components, software, and the control architecture of the newly purchased LAKESIDE fluid control system (located in the Control Lab, E2-665). Design and implement a

high-performance controller via the open-architecture interface of the DeltaV industrial software. The project includes collaborations with and a possible visit to LAKESIDE Company in North Winnipeg. (LAKESIDE is the exclusive partner of Emerson Process Management in Ontario and Manitoba providing automation systems for controlling pressure, temperature, and flow in various plants)

**Requirements:** Keen interest in automation and control engineering and their application to fluid systems.

**2. (Instrumentation) Title:** Design and Fabrication of a Load Cell for Measuring Cutting Forces in Machining Operations.

**Description:** Design a flexible tool holder and install strain gauges to measure the deflections. Calibrate and test the developed sensor to measure cutting forces.

**Requirements:** Keen interest in mechatronics and instrumentation.

**3. (Robotics) Title:** Identification and Pre-compensation of the LuGre Friction Effect for Precision Control of Robots.

**Description:** Identify the LuGre friction parameters of an in-house refurbished open-architecture robotic arm. Develop a pre-compensation algorithm to achieve high precision tracking in robotic manufacturing tasks. With the help of our graduate students, implement the algorithm in MATLAB Simulink and test it on the robot.

**Requirements:** Strong background in controls. Keen interest in Robotics.

**4. (Vibration and FE):** Modeling the varying structural dynamics of a thin-walled workpiece during turning operations.

**Description:** Build an FE model of a thin-walled tube and export the mass and stiffness matrices to MATLAB. Develop a code to update the FE model as the material is removed (only at discrete full-revolution intervals). (Optional: Validate the model by conducting turning experiments.)

**Requirements:** Strong background in Finite Element and vibrations.

**Dr. D. Kuhn** (Tel: 474 9803, Office: E2 327D, Email: David.Kuhn@umanitoba.ca)

1. **Title:** Measurement of Infrarenal Abdominal Aortic Aneurysm (AAA) Blood Flow using 4D MRI: Correlation with Computationally-Derived Prediction of Aneurysm Rupture Potential.

**Dr. Paul Labossiere** (Tel: 474 9803, Office: E1-546, Email: Paul.Labossiere@umanitoba.ca)

1. **Title:** Development and evaluation of CFRP aerodynamic control arms for the UMSAE formula and electric race cars.

**Dr. Y. Luo** (Tel: 474 6899, Office: E1 444, Email: Yunhua.Luo@umanitoba.ca)

1. **Title:** Mechanical testing of animal bones to study strength variations

**Dr. L. Ojo (sabbatical)** (Tel: 474 7972, Office: E3 446, Email: Olanrewaju.Ojo@umanitoba.ca)

1. **Title:** Laser Cladding of Aerospace IN 625 Superalloy

**Dr. S. Ormiston** (Tel: 474 8639, Office: E1 484, Email: Scott.Ormiston@umanitoba.ca)

1. **Title:** CFD Analysis of Branching Flow in a Compact Heat Exchanger Distributor.

**Description:** Learn to use CFD (Computational Fluid Dynamics) software to solve for branching flow in the distributor of a compact heat exchanger. Perform simulations and interpret the results.

**Requirements:** Strong heat transfer, fluid mechanics, and computing background and a keen interest in learning and using commercial CFD software. **Suitable for:** 1 student.

2. **Title:** Design and Development of a GUI for a Heat Transfer Modelling Program.

**Description:** Design and implement a Graphical User Interface (GUI) using either MATLAB or Python tools. The interface will provide easy setup and control of a computer code written in Fortran that performs a heat transfer analysis. Design, implement, and debug the GUI and write a users' guide and demonstration cases. **Requirements:** Excellent programming skills (in MATLAB or Python) and a strong background in heat transfer. **Suitable for:** 1 student.

3. **Title:** CFD Analysis of an Airlift Pump System.

**Description:** Learn to use CFD (Computational Fluid Dynamics) software to solve for two-phase (air-water) flow in an external airlift pump system. Perform simulations at different air injection rates and for various geometries. Interpret and present the results. **Requirements:** Strong fluid mechanics, and computing background and a keen interest in learning and using commercial CFD software. **Suitable for:** 1 student.

**Dr. Q. Peng** (Tel: 474 6843, Office: E1 386, Email: Qingjin.Peng@umanitoba.ca)

1. **Title:** Design for product similarity. **Description:** Product similarity in design and manufacturing will be investigated. Group technology will be applied to model, measure and manage selected products. The solution will be evaluated using computer-aided design and simulation. **Requirement:** one or two students who have taken the manufacturing TE course, MECH 3582.

2. **Title:** Process planning for product in additive manufacturing. **Description:** Process plans using 3D printing technologies for product manufacturing will be investigated. 3D modeling tools and manufacturing knowledge will be applied to model and plan process of selected products. Quality of the solution will be evaluated using manufacturing simulation. **Requirement:** one or two students who have taken the manufacturing TE course, MECH 3582.

3. **Title:** Upper limb posture capturing and movement planning for VR-based rehabilitation. **Description:** The motion sensor will be used to capture human upper limb motions to identify and model operations of the rehabilitation process in virtual environments. **Requirement:** one or two students who have excellent programming skills in C, Unity3D or Python.

**Dr. N. Sepehri** (Tel: 474 6834, Office: E1 384, Email: Nariman.Sepehri@umanitoba.ca)

Not available 2016 2017

**Dr. M. Tachie** (Tel: 474 9589, Office: E2 327H, Email: Mark.Tachie@umanitoba.ca)

1. **Title:** Effects of offset height ratio on surface attaching twin jets (taken by Andrew Laban)

2. **Title:** Experimental study of turbulent air jets.

**Dr. I. Telichev** (Tel: 474 9812, Office E1 448, Email: Igor.Telichev@umanitoba.ca)

1. **Title:** Conceptual Design of Robotic Space Vehicle for Active Debris Removal.

**Description:** Create a design concept of space system for deorbiting of non-functional satellites and spent rocket stages. This project will require the application of FEM and SPH technique for the simulation of impact event.

**Dr. B.C. Wang** (Tel: 474 9305, Office E1 488, Email: BingChen.Wang@umanitoba.ca)

1. **Title:** Numerical Simulation of Turbulent Heat and Fluid Flows in Boundary Layers. **Description:** Learn to use supercomputers to simulate and study turbulent heat and fluid flows in boundary layers.

**Requirements:** a passion to learn parallel programming based on FORTRAN, and a strong background in fluid mechanics and heat transfer.

2. **Title:** Solar Energy Air Conditioning System. **Description:** Design a small AC system for a residential or office building powered by solar energy. **Requirements:** a strong background in thermodynamics, heat transfer and fluid mechanics.

**Dr. N. Wu** (Tel: 474 7368, Office: E1 414, Email: Nan.Wu@umanitoba.ca)

1. **Title:** Experimental realization of bladeless wind energy harvester. **Description:** A bladeless wind turbine energy harvester will be fabricated using 3D printing and piezoelectric materials. It is noted that different shapes of the beam cross sections at different positions along the beam length will affect the energy generation significantly. An experimental set up will be built to test the energy harvesters with the different design.

2. **Title:** Damage detection with piezoelectric composite paint. **Description:** A piezoelectric composite paint sensor and experimental set up will be prepared and designed to detect the fatigue damage.

3. **Title:** Calibration of piezoelectric nano-composite gum sensor or piezoelectric nano-composite paint.

**Description:** A nano-composite paint material with the piezoelectric property will be provided.

Experiment setups should be designed and built to calibrate  $e_{31}$ ,  $e_{33}$  and  $e_{11}$  piezoelectric coefficients.

**Dr. M. Xing** (Tel: 474 6301, Office: E1 538, Email: Malcolm.Xing@umanitoba.ca)

1. **Title:** 3D printing bio-inspired conductive hydrogel for electronic-skin (1-2 students)

2. **Title:** 3D printing bio-robot movement controlled by NIRt laser (1-2 students)

**Dr. G. Zhu** (Tel: 474 6301, Office: E1 538, Email: Malcolm.Xing@umanitoba.ca)

1. Title: In-situ study of nano-technical behaviours of oxide nanowire

2. Title: Strain mapping analysis of atomic-resolved images through peak-pairs analysis