AME NEWSLETTER

The latest news and updates from The Department of Automotive and Mechatronics Engineering

IN THIS ISSUE

AME Department Chair Message

Dr. Scott Nokleby

Welcome to the first newsletter of the Department of Automotive and Mechatronics Engineering. The Department celebrated its one year anniversary on July 1, 2021. There have been lots of exciting things happening in the Department. We recently welcomed to the Department two new tenure-track professors Dr. Zeinab El-Sayegh and Dr. Meaghan Charest-Finn and one new teaching-focussed professor Dr. Murat Aydin. You can learn more about our new professors in this newsletter. Sadly, we said goodbye to Dr. Dipal Patel and Dr. Carlos Rossa as they pursued new opportunities outside Ontario Tech. I would like to thank both of Dr. Patel and Dr. Rossa for their contributions to the Department.

With the ongoing COVID-19 pandemic, the Department has had to rapidly adapt to the changing situation in both teaching and research. Despite the challenges, our faculty members continue to receive significant funding to conduct innovative research in the areas of automotive and mechatronics engineering. A sample of some of the work of our professors is presented in this newsletter.

As we enter our second year, the Department of Automotive and Mechatronics Engineering will continue to offer quality teaching and world-class research. If you have any questions about the Department, please feel free to contact me at scott.nokleby@ontariotechu.ca.

Welcome New Faculty

Dr. Zeinab El-Sayegh is a new assistant professor in the department of automotive and mechatronics engineering. She completed her postdoctoral fellowship and Ph.D. in mechanical engineering at Ontario Tech University. She received her Master's degree in Mechanical Engineering from the University of Concordia, Montreal. Formally, worked at Volvo Group Trucks Technology Gothenburg, Sweden as a vehicle analyst. And, as a combustion analyst in Siemens aero-derivative gas turbines, Montreal. Her research interests are related to on-road and off-road vehicle design, autonomous and hybrid electric vehicle simulation. She is involved in research related to tire-terrain interaction in cooperation with Volvo Group Truck Technology and NSERC.

Dr. Zeinab El-Sayegh

Dr. Meaghan Charest-Finn is joining Ontario Tech from The University of New Brunswick where she completed her graduate studies at the Intelligent Controls Laboratory and where she conducted postdoctroral research with the System-level Model Design Engineering Laboratory (Sys-MoDEL). Her research interests stem from the control of complex machinery through the implementation of adaptive model predictive controls extended through the practical inclusion of machine learning tactics in autonomous systems. Meaghan's research is fundamentally industry centric in nature, where she has devised, and patented novel control algorithms. She has also fostered professional relationships with industry sponsors, and greatly values pragmatic solutions to real world problems.

Dr. Meaghan Charest-Finn

Dr. Murat Aydin got his PhD from Imperial College London, UK. He worked as a professor at Istanbul Technical University and held managerial positions there and at the Scientific and Technological Research Council of Turkey. He is expert in Computational Fluid Dynamics, Direct Energy Conversion, Automotive Aerodynamics, Aerosol Transport and Constructal Theory. He has been teaching at Ontario Tech since 2011 both undergraduate and graduate level courses. He had previously taught and performed research at Istanbul Technical University, York University, Ryerson University, and Evora University. He is the author or co-author of 63 journal and conference articles, 1 book and a book chapter.

Dr. Murat Aydin

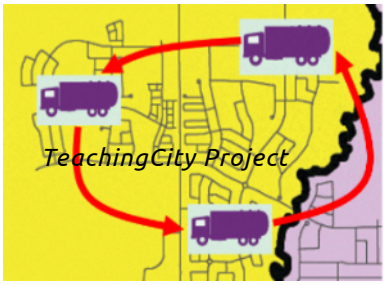
AME Research Activities

Dr. Jaho Seo

Multiscale/multiphysics modeling, optimal design and intelligent management of battery systems

Dr. Jaho Seo has received research funds from KIMM (Korea Institute of Machinery & Materials, 2021/5 -2021/11) and the City of Oshawa (2021/05-2023/05). For the KIMM contract project, Mr. Ali Afsalaghaeinaeini (MASc student) of Dr. Seo's lab (AVEC LAB, www.avec-lab.com) will develop the de-noise filtering algorithm using a Lidar sensor for mobile machines under harsh dust environments that can be applied to various industrial applications such as construction and equipment and mining equipment. Through a collaboration with the City of Oshawa for the TeachingCity project, Mr. Tyler Parsons (MASc student) of AVEC LAB will have an opportunity to generate optimal routes for waste collection/sweeping /snowplowing trucks by considering critical parameters such as road class/conditions, vehicle operating conditions, depot locations, and other constraints for optimization. This research will offer practical, scalable, and sustainable solutions to improve efficiency in the aforementioned residential activities.

KIMM Project



AME Research Activities

Dr. Moustafa El-Gindy

General Dynamics Land System of Canada (GDLS-C)

The department has completed 14 projects for General Dynamics Land System of Canada since 2010. The latest task was completed in 2020, In this task a new method of all-wheel-steering is introduced, as it can be seen in Figure 1, where high vehicle body slip angles are intentional; commonly referred to as crab steering. In this configuration all wheels will turned in nearly the same direction in order to move the vehicle laterally. In steady-state cornering, this type of steering produces no yaw in the frame of reference to the vehicle's hull (body).

Figure 1: All wheel steering model

Volvo Group Truck Technology (VOLVO)

Our collaboration with Volvo Group Trucks Technology Sweden to develop and validate several truck tires using Finite Element Analysis (FEA). We also model and calibrate different terrains including road, soil, snow and water using Smoothed-Particle Hydrodynamics (SPH). The tire-terrain interaction investigation helps to predict the behaviour of vehicle in different operating conditions. The modeling is done using a leading simulation software (Pam-Crash) and the results are considered highly accurate. The research is a continuous project for the last 21 years.

Phases XVIII and XIX started in 2020 and continues until present. These phases are focussing on the development of off-road tire-terrain interaction for particular soil types. In 2021, the tire-terrain interaction research focused on developing tire-terrain interaction characteristics using Genetic algorithm and advanced computation models. The tire-terrain interaction characteristics included the longitudinal and lateral forces, in addition to the self aligning and overturning moment. The genetic algorithm was utilized to develop numerical relationships between the interaction characteristics and various operating conditions. This research will continue to predict the full vehicle performance at various operating conditions including new soil models such as mud as seen in Figure 2.

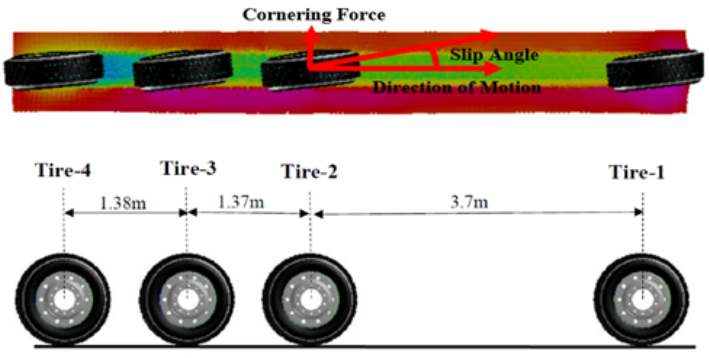


Figure 2: Truck tires-soil model

Concordia University Research Funding:

In 2020-2021 Professor Subhash Rakeja of Concordia University is funding a research project and collaborating with Dr M El-Gindy to co-supervise one of Ontario Tech University graduate student to preform research work related to off-road tire steering on soft soil.

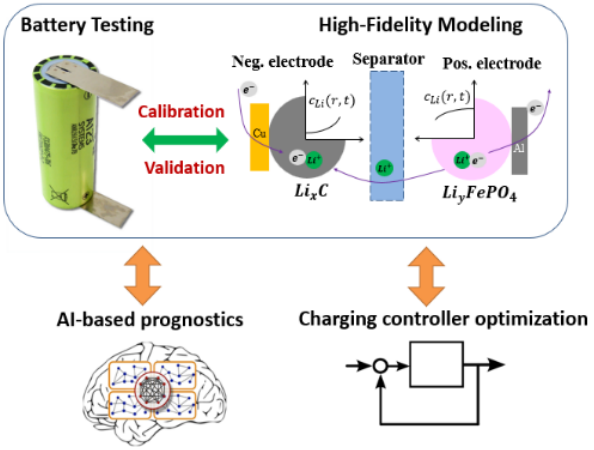
AME Research Activities

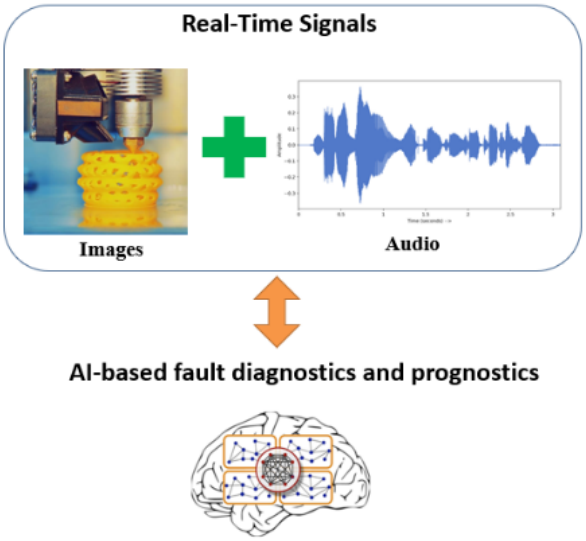
Dr. Xianke Lin

Dr. Xianke Lin is an assistant professor in the department of automotive and mechatronics engineering at Ontario Tech University. His research areas include energy storage systems, AI-based diagnostics and prognostics, and autonomous delivery vehicles.

AI-based prognostics and health-conscious fast charging of lithium-ion batteries:

Li-ion batteries have become widely used in renewable energy systems and transportation electrification. However, there are still several issues facing Li-ion batteries. One of the most important issues is the accelerated capacity fade during the fast charging process. To address this issue, Dr. Lin's team is developing health-conscious fast-charging protocols that achieve fast charging performance while minimizing the degradation during charging. Dr. Lin's team investigated the degradation mechanisms during the fast charging process and developed physics-based degradation models for charging optimization. Based on the degradation models, health-conscious fast-charging protocols have been developed, which has significantly improved charging speed while protecting battery health and cycle life. Another important issue is internal failure-induced thermal runaway. Battery systems have a huge amount of energy, which becomes very dangerous when internal failures cause thermal runaway. Fault diagnostics and prognostics are essential in battery systems. Dr. Lin's team developed AI-based prognostics algorithms for detecting and predicting internal failures to prevent thermal runaways. These research activities are partially supported by NSERC Discovery Program.





AI-based diagnostics and prognostics in industrial applications:

AI-based diagnostics and prognostics have many applications in the industry. One of the applications is in 3D printing machines. Fused Deposition Modeling (FDM) is one of the most popular types of 3D printers. However, there are still many issues related to product quality, robustness, and reliability. 3D printer operators rely heavily on the simple trial-and-error method to manufacture products. These trial-and-error iterations take a long time and also waste materials, thereby reducing productivity.

To address this issue for the industry partner, Dr. Lin's lab developed AI-based early failure detection algorithms in 3d printing for better print quality, less material waste, and a shorter trial and error process. The early failure detection system monitors the 3D printing process by collecting real-time signals from the 3D printing process, including image/acoustic signals. It detects failures using AI algorithms and notifies users right away. This real-time AI-enabled failure detection system can make 3D printing more efficient and effective for fast prototyping. The research activities are supported by NSERC Alliance Program.

AME Degree Conferrals

Doctor of Philosophy, Mechanical Engineering

- Zeinab El-Sayegh
- Tao Sun
- Smitha Vempaty
- Michael Wrock
- Reza Mohammadali Zadeh

Master of Applied Science, Automotive Engineering

- Mohammed Hammad
- Mutaz George Keldani
- Wing Yi Pao
- Priya Shastry
- Siyang Wang

Master of Applied Science, Mechanical Engineering

- Khaled Hamed
- Mohammed Al-Hamed
- Christopher Baird
- Dylan Jeffrey Bender
- Andre Anthony Bolt
- Brayden de Boon
- Heta Umeshkumar Diwan
- MD Rashidul Islam
- Davin Alexander Jankovics
- Matthew Daniel Levins
- Yunze Li
- Eric John McCormick
- William Akihiro Oishi
- Isha Raktim
- Niraj Niranjan Reginald
- Justin Roberto Rizzi
- Karim Sachedina

Doctor of Philosophy, Mechanical Engineering

- Mark Borg

Master of Applied Science, Automotive Engineering

- Kyle Hyatali
- Shaurya Rana

Master of Applied Science, Mechanical Engineering

- Zachary Guy
- Brayden Nicholas Kent
- Maciej Bartosz Lacki
- Abdullah Rasul
- Mirwais Sharifi
- Xu Ting Pamela She

Awards

STUDENT CHOICE AWARD

Dr. Murat Aydin, Faculty of Engineering and Applied Science

2021 OUTSTANDING MASTER'S THESIS AWARD

Maciej Bartosz Lacki
Thesis Title: Analysis, Development, and Control of Multi-Degree-of-Freedom Passive Haptic Devices Master of Applied Science, Mechanical Engineering