IEEE CIS Distinguished Lecture Program
By Prof Yi Lu Murphey, University of Michigan-Dearborn, Michigan, USA

Speaker:	Prof Yi Lu Murphey (IEEE Distinguished Speaker, IEEE Fellow), University of Michigan-Dearborn, Michigan, USA
Hosted Chapter:	IEEE Computational Intelligence Society (CIS), Victorian Section, Australia
Coordinator:	Malka N. Halgamuge, Chair VIC CIS (malka_nisha@ieee.org)
Date of Event:	Friday 9th December 2022
Time:	12.00 -1.00 pm (AEST)
Number of Participants:	25
VIC CIS Chapter website:	https://r10.ieee.org/victorian-cis
DLP Title:	Optimal Power Management based on Q-Learning and Neuro-Dynamic Programming for Plug-in Hybrid Electric Vehicles

Abstract:

Energy optimization for Plug-in Hybrid Electric Vehicles (PHEVs) is a challenging problem due to the system complexity and many physical and operational constraints in PHEVs. In this lecture, we present a Q-learning based in-vehicle learning system that is free of physical- models, and can robustly converge to an optimal energy control solution. The proposed machine learning algorithms combine Neuro-Dynamic Programming (NDP) with future trip information to effectively estimate the expected future energy cost (expected cost-to-go) for a given vehicle state and control actions. The convergences of those learning algorithms were demonstrated on both fixed and randomly selected drive cycles. Based on the characteristics of these learning algorithms, we propose a two-stage deployment solution for PHEV power management applications. Furthermore, we introduce a new initialization strategy, which combines the optimal learning with a properly selected penalty function. This initialization scheme can reduce the learning convergence time by 70%, which is a significant improvement in in-vehicle implementation efficiency. Finally, we present a Neural Network (NN) for predicting battery –State-of-Charge (SoC), rendering the proposed power management controller completely free of physical models.

Biography:

Dr. Yi Lu Murphey is a Professor of the ECE(Electrical and Computer Engineering) department and the director of the Intelligent Systems Lab at the University of Michigan-Dearborn. She received a M.S. degree in computer science from Wayne State University, Detroit, Michigan, in 1983, and a Ph.D degree with a major in Computer Engineering and a minor in Control Engineering from the University

of Michigan, Ann Arbor, Michigan, in 1989. During 2007 ~ 2020, Professor Murphey served as the Chair of the ECE department, Associate Dean for Graduate Education and Research, and the Vice Provost for Research at the University of Michigan-Dearborn. Her current research interests are in the areas of machine learning, pattern recognition, computer vision and intelligent systems with applications to engineering diagnostics and prognostics, optimal vehicle power management, data analytics, and robotic vision systems. She has authored over 290 publications in refereed journals and conference proceedings. She is an editor for the Journal of Pattern Recognition. She has served on technical committees and session chairs for many conferences, and organized symposiums and special sessions for various conferences sponsored by the IEEE Society. Her research has been funded by the National Science Foundation (NSF), National Institute of Health (NIH), Department of Energy (DoE), US Army TARDEC, State of Michigan, Ford Motor Company, TRW, Nissan, and many others. She is a fellow of IEEE and a senior life member of AAAI. She is a Distinguished Lecturer for both IEEE Vehicular Society and IEEE Computational Intelligence Society, and the recipient of 2019 SAE Ralph H. Isbrandt Automotive Safety Engineering Award.

Address: Michigan, United States

7. Category: Distinguished Lecturer Program (DLP)

Title: Optimal Power Management based on Q-Learning and Neuro-Dynamic Programming for Plug-in Hybrid Electric Vehicles
Speaker: Prof Yi Lu Murphey (IEEE Distinguished Speaker, IEEE Fellow), University of Michigan-Dearborn, Michigan, USA
Location (Virtual Webinar): https://us06web.zoom.us/j/86176560863?pwd=K2F6WnNXTmZwN1Eyd1Z4YWcyRFJKQT09
Time:12.00 -1.00 pm (AEST) Friday 9th December 2022
Register: https://events.vtools.ieee.org/m/323722
For further details contact: Malka N. Halgamuge, Chair VIC CIS (malka_nisha@ieee.org)
VIC CIS Chapter website: https://r10.ieee.org/victorian-cis

IEEE CIS DLP Report (Victoria Chapter)

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IEEE VIC CIS TALK ON OPTIMAL POWER MANAGEMENT

#PowerManagement #DynamicProgramming #HybridElectricVehicles #optimisation #patternrecognition

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Prof Yi Lu Murphey (IEEE Fellow) will deliver a talk on Optimal Power Management.

This is a part of the IEEE Victorian Computational Intelligence Society (CIS) series of talks. The online delivery is kindly hosted by IEEE Victorian Section and will take place 5.00 - 6.00 pm (AEST).

Join Zoom Meeting (Friday 9th December 2022, 12.00 – 1.00 pm (AEST) TBA

Meeting ID: TBAPassword: TBA

DATE AND TIME

Date: **09 Dec 2022**

Time: **12:00 PM to 01:00 PM**

All times are (UTC+10:00) Canberra

Add Event to Calendar
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LOCATION

Please use vTool for registration.

HOSTS

Victorian Section Chapter,CIS11

Southeastern Michigan Section Chapter, CIS11/SMC28

Contact Event Hosts

Co-sponsored by IEEE VIC CIS Chapter; IEEE VIC Section

REGISTRATION

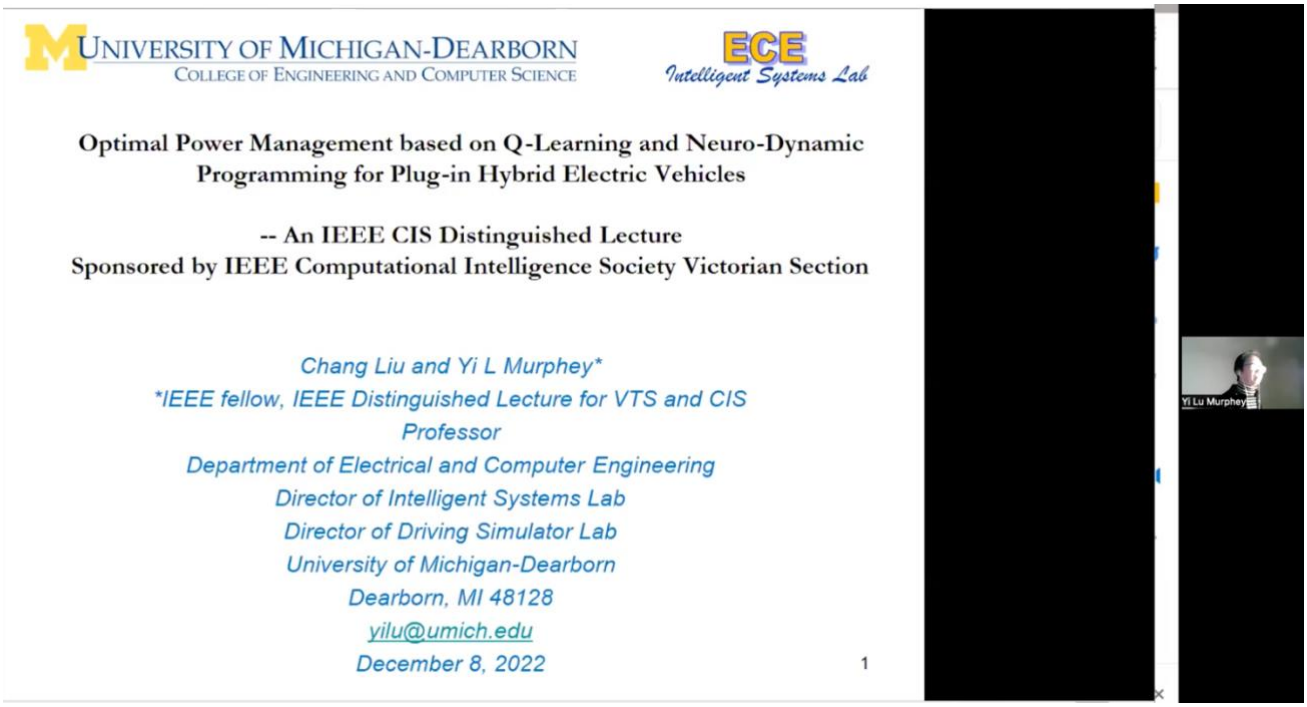
Starts **10 September 2022 06:30 PM**

Ends **09 December 2022 11:30 AM**

All times are (UTC+10:00) Canberra

No Admission Charge

Registration Closed



UNIVERSITY OF MICHIGAN-DEARBORN
COLLEGE OF ENGINEERING AND COMPUTER SCIENCE

ECE Intelligent Systems Lab

PHEV Power Management

- *PHEV Power Management:*
  - Determine the optimal power output split between engine and battery at any instance of time.
  - Objective: Minimize the energy cost of the vehicle while meeting the requirements of the vehicle performances and emission requirements.
- *Challenges*
  - A global optimization problem subject to many constraints over time
  - It is impossible to accurately obtain the mathematical models for the vehicle system and its components
  - Driving information is generally unknown before the trip.
    - Random inputs lead to the problem of optimization under uncertainty.
  - Component aging and wear cause system characteristics to change as time goes on
  - The control algorithms need to run efficiently in real-time with limited resources.

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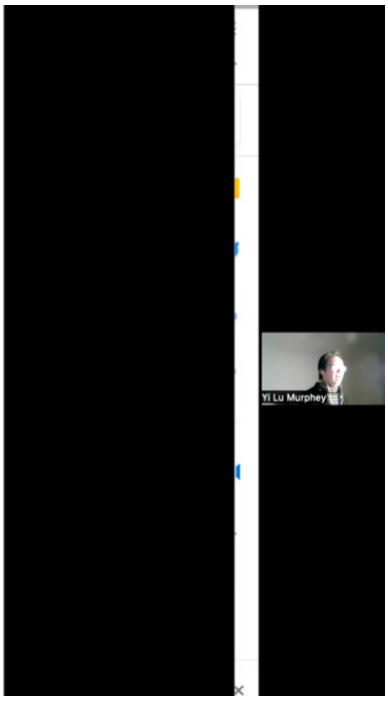

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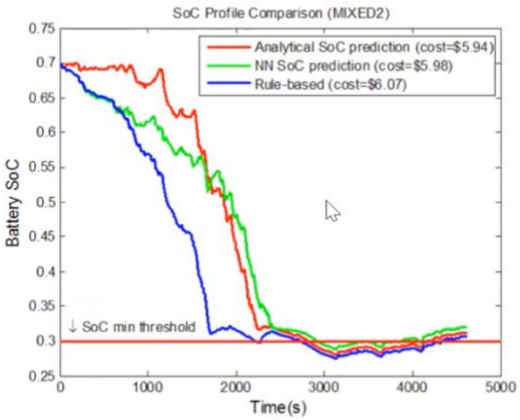
Battery SOC profiles generated by QL_LT using different methods for predicting SoCnext



- Three SoC profiles generated on the Mixed2 cycle with the initial SoC set to 70% by three controllers, analytical based on VEC-ST+W (·), VEC-ST+W (·) using NN_{soc}, and rule-based
- The two VEC-ST+W (·) based controllers (red and green curve), yielded slower discharging profile due to the SoC penalty term.
- The VEC-ST+W (·) controller with NN (green curve) stayed close to or above the min-threshold more than the other two controller
- The rule-based controller caused SoC to drop to 27.4% at the peak power demand.

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