University of Victoria | Graduate Studies

Notice of the Final Oral Examination for the Degree of Master of Applied Science

of

DANIEL PRESCOTT

BEng (University of Victoria, 2009)

"Development and Implementation of Control System for an Advanced Multi-Regime Series-Parallel Plug-in Hybrid Electric Vehicle"

Department of Mechanical Engineering

Tuesday, August 18, 2015
10:00 A.M
Engineering Office Wing
Room 430

Supervisory Committee:
Dr. Zuomin Dong, Department of Mechanical Engineering, University of Victoria (Supervisor)
Dr. Curran Crawford, Department of Mechanical Engineering, UVic (Member)
Dr. Brad Buckham, Department of Mechanical Engineering, UVic (Member)

External Examiner:
Dr. Kin Fun Li, Department of Electrical and Computer Engineering, UVic

Chair of Oral Examination:
Dr. Panajotis Agathoklis, Department of Electrical and Computer Engineering, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies

Abstract

Following the Model-Based-Design (MBD) development process used presently by the automotive industry, the control systems for a new Series-Parallel Multiple-Regime Plug-in Hybrid Electric Vehicle (PHEV), UVic EcoCAR2, have been developed, implemented and tested. Concurrent simulation platforms were used to achieve different developmental goals, with a simplified system power loss model serving as the low-overhead control strategy optimization platform, and a high fidelity Software-in-Loop (SIL) model serving as the vehicle control development and testing platform. These two platforms were used to develop a strategy-independent controls development tool which will allow deployment of new strategies for the vehicle irrespective of energy management strategy particulars. A rule-based energy management strategy was applied and calibrated using genetic algorithm (GA) optimization. The concurrent modeling approach was validated by comparing the vehicle equivalent fuel consumption between the simplified and SIL models. An equivalency factor (EF) of 1 was used in accounting for battery state of charge (SOC) discrepancies at cycle end. A recursively-defined subsystem efficiency-based EF was also applied to try to capture real-world equivalency impacts. Aggregate results between the two test platforms showed translation of the optimization benefits though absolute results varied for some cycles. Accuracy improvements to the simplified model to better capture dynamic effects are recommended to improve the utility of the newly introduced vehicle control system development method. Additional future work in redefining operation modes and mode transition threshold conditions to approximate optimal vehicle operation is recommended and readily supported by the control system platform developed.