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

of

RUI CHENG

BEng (Beijing University of Technology, 2012)

“Modeling and Simulation of Plug-in Hybrid Electric Powertrain System for Different Vehicular Applications”

Department of Mechanical Engineering

Monday, April 4, 2016
1:00 P.M.
Engineering Office Wing
Room 502

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

External Examiner:
Dr. Kin Fun Li, Department of Electrical and Computer Engineering, Simon Fraser University

Chair of Oral Examination:
Dr. Steven Perlman, Department of Biology, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies
Abstract

The powertrain design and control strategies for three representative hybrid and plug-in hybrid electric vehicles (HEV/PHEVs), a plug-in hybrid passenger car, a plug-in hybrid race car, and a hybrid electric mining truck, have been investigated through the system modeling, simulation and design optimization. First, the pre-transmission genset couple Plug-in Series-Parallel Multi-Regime (SPMR) powertrain architecture was selected for PHEV passenger car. Rule-based load following control schemes based on engine optimal control strategy and Equivalent Consumption Minimization Strategy (ECMS) were used for the operation control of the passenger car PHEV powertrain. Secondly, the rear wheel drive (RWD) post-transmission parallel through road powertrain architecture was selected for race car PHEV. A high level supervisory control system and ECMS control strategy have been developed and implemented through the race car’s on-board embedded controller using dSPACE MicroAutobox II. In addition, longitudinal adaptive traction control has been added to the vehicle controller for improved drivability and acceleration performance. At last, the feasibility and benefits of powertrain hybridization for heavy-duty mining truck have been investigated, and three hybrid powertrain architectures, series, parallel and diesel-electric, with weight adjusting propulsion system have been modeled and studied. The research explored the common and distinct characteristics of hybrid electric propulsion system technology for different vehicular applications, and formed the foundation for further research and development.