



**University  
of Victoria**

Graduate Studies

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

of

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BSc (Ferdowsi University of Mashhad, 2011)

“Instrumentation, Control, and Testing of a Small Wind Turbine Test Rig”

Department of Mechanical Engineering

Thursday April 16, 2015

10:00 A.M.

David Turpin Building

A136

Supervisory Committee:

Dr. Curran Crawford, Department of Mechanical Engineering, University of Victoria (Supervisor)

Dr. Peter Wild, Department of Mechanical Engineering, UVic (Member)

External Examiner:

Dr. Amirali Baniasadi, Department of Electrical and Computer Engineering, UVic

Chair of Oral Examination:

Dr. Wu-Sheng Lu, Department of Electrical and Computer Engineering, UVic

## **Abstract**

As a cost-effective test method, a vehicle-based test rig can be utilized in small wind turbine experimental work to facilitate turbine performance tests under a range of controlled wind speeds, as well as to validate turbulent flow models. The instrumentation of a custom trailer-based mobile wind turbine test rig has been modified to provide a platform for full rotor speed control. A control system coupled to an electric vehicle controller with regenerative braking technology was developed in five steps, namely: system modeling in Simulink, system identification, control system design and analysis, control system implementation in LabVIEW, and Proportional-Integral-Derivative (PID) controller tuning in real-time. A custom Graphical User Interface (GUI) was also developed. Furthermore, a Computational Fluid Dynamics (CFD) analysis was conducted to assess the potential impact of towing vehicle's disturbance on the free stream available to the rotor disc. This trailer rig will allow up to a 1kW wind turbine. It can be towed behind a vehicle to conduct steady state tests or it can be parked in an open area to collect unsteady field data. It has been tested in a towed scenario and the Blade Element Momentum (BEM) predictions were compared with the obtained aggregate performance curve.