



**University
of Victoria**

Graduate Studies

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

of

CHI-KUANG YEH

BSc Hons (University of Victoria, 2016)

**“Optimal Regression Design under Second-Order Least Squares
Estimator: Theory, Algorithm and Applications”**

Department of Mathematics and Statistics

Friday, July 13, 2018
1:00 P.M.
Clearihue Building
Room B346

Supervisory Committee:

Dr. Julie Zhou, Department of Mathematics and Statistics, University of Victoria (Supervisor)
Dr. Xuekui Zhang, Department of Mathematics and Statistics, UVic (Member)

External Examiner:

Dr. Xiaodai Dong, Department of Electrical and Computer Engineering, UVic

Chair of Oral Examination:

Dr. Adam Ritz, Department of Physics and Astronomy, UVic

Dr. Stephen Evans, Acting Dean, Faculty of Graduate Studies

Abstract

In this thesis, we first review the current development of optimal regression designs under the second-order least squares estimator in the literature. The criteria include A- and D-optimality. We then introduce a new formulation of A-optimality criterion so the result can be extended to c-optimality which has not been studied before. Following Kiefer's equivalence results, we derive the optimality conditions for A-, c- and D-optimal designs under the second-order least squares estimator. In addition, we study the number of support points for various regression models including Peleg models, trigonometric models, regular and fractional polynomial models. A generalized scale invariance property for D-optimal designs is also explored. Furthermore, we discuss one computing algorithm to find optimal designs numerically. Several interesting applications are presented and related MATLAB code are provided in the thesis.