



**University
of Victoria**

Graduate Studies

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

of

AHMED ABDELHAMID

BEng (Higher College of Technology, 2012)

**“A Non-Gradient Heuristic Topology Optimization Approach Using
Bond-Based Peridynamic Theory”**

Department of Mechanical Engineering

Monday, July 31, 2017

9:00 A.M.

Engineering Office Wing

Room 230

Supervisory Committee:

Dr. Afzal Suleman, Department of Mechanical Engineering, University of Victoria (Supervisor)

Dr. Ben Nadler, Department of Mechanical Engineering, UVic (Member)

External Examiner:

Dr. Ryan Budney, Department of Mathematics and Statistics, UVic

Chair of Oral Examination:

Dr. Edwin Nissen, School of Earth and Ocean Sciences, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies

Abstract

Peridynamics (PD), a reformulation of the classical continuum mechanics, is a new and promising meshless and nonlocal computational method in solid mechanics. To permit discontinuities, the PD integro-differential equation contains spatial integrals and time derivatives. PD can be considered as the continuum version of molecular dynamics. This feature of PD makes it a good candidate for multi-scale analysis of materials. Concurrently, the topology optimization has also been rapidly growing in view of the need to design lightweight and high performance structures. Therefore, this thesis presents the potential for a peridynamics-based topology optimization approach. To avoid the gradient calculations, a heuristic topology optimization method is employed. The minimization of the PD strain energy density is set as the objective function. The structure is optimized based on a modified solid isotropic material with a penalization approach and a projection scheme is utilized to obtain distinct results. Several test cases have been studied to analyze the suitability of the proposed method in topology optimization.