University of Victoria | Graduate Studies

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

of

SERGE VINCENT

BEng (University of Victoria, 2013)

"Full-Vector Finite Difference Mode Solver for Whispering-Gallery Resonators"

Department of Electrical and Computer Engineering

Monday, August 24, 2015
2:00PM
Engineering Office Wing
Room 430

Supervisory Committee:
Dr. Tao Lu, Department of Electrical & Computer Engineering, University of Victoria (Supervisor)
Dr. Gordon Reuven, Department of Electrical & Computer Engineering, UVic (Member)

External Examiner:
Dr. Yang Shi, Department of Mechanical Engineering, UVic

Chair of Oral Examination:
Dr. Rustom Bhiladvala, Department of Mechanical Engineering, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies

Abstract

Optical whispering-gallery mode (WGM) cavities, which exhibit extraordinary spatial and temporal confinement of light, are one of the leading transducers for examining molecular recognition at low particle counts. With the advent of hybrid photonic-plasmonic and increasingly sophisticated forms of these resonators, the importance of supporting numerical methods has correspondingly become evident. In response, we adopt a full-vector finite difference approximation in order to solve for WGM's in terms of their field distributions, resonant wavelengths, and their quality factors within naturally discontinuous permittivity structure. A segmented Taylor series and alignment/rotation operator are utilized at such singularities in conjunction with arbitrarily spaced grid points. Simulations for microtoroids, with and without dielectric nanobeads, and plasmonic microdisks are demonstrated for short computation times and shown to be in agreement with data in the literature. Constricted surface plasmon polariton (SPP) WGM's are also featured within this document. The module of this thesis is devised as a keystone for composite WGM models that may guide experiments in the field.