University of Victoria | Graduate Studies

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

of

CASS ADAM HUSSMANN

BEng (University of Victoria, 2014)

"Reliable Design of Micro-Satellite Systems Using Combined Physics of Failure Reliability Estimation Models"

Department of Mechanical Engineering

Tuesday, June 21, 2016
10:00 A.M.
David Turpin Building
Room A144

Supervisory Committee:
Dr. Afzal Suleman, Department of Mechanical Engineering, University of Victoria (Supervisor)
Dr. Nikitas Dimopoulos, Department of Electrical and Computer Engineering, UVic (Outside Member)

External Examiner:
Dr. Alfred Ng, Space Science and Technology, Canadian Space Agency

Chair of Oral Examination:
Dr. Christopher Bose, Department of Mathematics and Statistics, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies

Abstract

Up until 2015 the rate at which cube satellite missions achieved full mission success was only 44.1% for any organizations first mission (academic or corporate), the success rate increases to only 62% for cube satellites launched as a second mission. This thesis suggests that there are two main sources for the high failure rate: improper verification, and the common use of COTs components and their reliability in a space environment. The thesis provides a means of increasing mission assurance through the use of physics of failure reliability estimation models that incorporate the intrinsic and extrinsic failures of thermal mechanical effects as well as radiation effects on EEE components, a design methodology is also presented that incorporates reliability modeling as well as thorough software and hardware in loop testing to prevent failure due to improper verification. The environment and reliability models are calculated for the on board command and data handling system of the ECOSat-II cube satellite being developed by the University of Victoria ECOSat team using NX Siemens for thermal FEA modelling, SPENVIS for radiation environment, and MATLAB for reliability calculation.