University of Victoria | Graduate Studies

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

of

SOOYONG KIM

BSc (Pusan National University, 2012)

"Predicting Regenerative Chatter in Turning Using Operational Modal Analysis"

Department of Mechanical Engineering

Monday, April 15, 2019
9:00 A.M.
Engineering and Computer Science Building
Room 468

Supervisory Committee:
Dr. Keivan Ahmadi, Department of Mechanical Engineering, University of Victoria (Co-Supervisor)
Dr. Martin Byung-Guk Jun, Department of Mechanical Engineering, UVic (Co-Supervisor)

External Examiner:
Dr. Rishi Gupta, Department of Civil Engineering, UVic

Chair of Oral Examination:
Dr. Judith Clarke, Department of Economics, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies

Abstract

Chatter, unstable vibration during machining, damages the tool and work piece. A proper selection of spindle speed and depth of cut are required to prevent chatter during machining. Such proper cutting conditions are usually determined using vibration models of the machining process. Nonetheless, uncertainties in modeling or changes in dynamics during the machining operations can lead to unstable machining vibrations, and chatter may arise even when stable cutting conditions are used in the process planning stage. As a result, online chatter monitoring systems are key to ensuring chatter-free machining operations. Although various chatter monitoring systems are available in the literature, most of the existing methods are suitable for detecting chatter after vibrations become unstable. In order to prevent poor surface finish resulting from chatter marks during the finishing stages of machining, a new monitoring system that is capable of predicting the occurrence of chatter while vibrations are still stable is required. In this thesis, a new approach for predicting the lose of stability during stable turning operations is developed. The new method is based on the identification of the dynamics of self-excited vibrations during turning operations using Operational Modal Analysis (OMA). The numerical simulations and experimental results presented in this thesis confirm the possibility of using Operational Modal Analysis as an online chatter prediction method during stable machining operations.