University of Victoria | Graduate Studies

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

of

MANISH KUMAR JODDAR

B.Tech. (Hons) (Indian Institute of Technology, 1995)

"Estimating machining forces from vibration measurements"

Department of Mechanical Engineering

Wednesday November 20, 2019
3:00 P.M.
Engineering Office Wing
Room 430

Supervisory Committee:
Dr. Keivan Ahmadi, Department of Mechanical Engineering, University of Victoria (Co-Supervisor)
Dr. Ben Nadler, Department of Mechanical Engineering, UVic (Co-Supervisor)
Dr. Zuomin Dong, Department of Mechanical Engineering, UVic (Member)

External Examiner:
Dr. Panajotis Agathoklis, Department of Electrical and Computer Engineering, UVic

Chair of Oral Examination:
Dr. Neil Burford, Department of Chemistry, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies

Abstract

The topic of force reconstruction has been studied quite extensively but most of the existing research work that has been done are in the domain of structural and civil engineering construction like bridges and beams. Considerable work in force reconstruction has also being done in fabrication of machines and structures like aircrafts, gear boxes etc. The topic of force reconstruction of the cutting forces during a machining process like turning or milling machines is a recent line of research to suffice the requirement of proactive monitoring of forces generated during the operation of the machine tool. The forces causing vibrations while machining if detected and monitored can enhance system productivity and efficiency of the process. The objective of this study was to investigate the algorithms available in literature for inverse force reconstruction and apply for reconstruction of cutting forces while machining on a computer numerically controlled (CNC) machine. This study has applied inverse force reconstruction technique algorithms 1) Deconvolution method, 2) Kalman filter recursive least square and 3) augmented Kalman filter for inverse reconstruction of forces for multi degree of freedom systems.

Results from experiments conducted as part of this thesis work shows the effectiveness of the methods of force reconstruction to monitor the forces generated during the machining process on machine tools in real time without employing dynamometers which are expensive and complex to set-up. This study for developing a cost-effective method of force reconstruction will be instrumental in applications for improving machining efficiency and proactive preventive maintenance.