manufacturing automation laboratories

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A Short Practical but Advanced Training Course...

"Machining Process Modeling, Machine Tap Testing and Chatter Vibrations Avoidance - ShopPro/CutPro"

Date: TBD Instructor: Prof. Y. Altintas

Location: Manufacturing Automation Laboratory, University of British Columbia, Department of Mechanical Engineering, 1050-6250 Applied Science Lane, Vancouver, B.C. V6T 1Z4, Canada.

Objective: UBC Manufacturing Automation Laboratory has developed advanced, easy- to-use machining process simulation and measurement software which is used by a number of companies around the world. ShopPro is an integrated, easy to use tap-testing, chatter stability lobe, torque, power prediction as well as giving expert advice to solve machining problems. CUTPRO is advanced software with milling, turning, boring, drilling, spindle, CNC, tap testing, modal analysis and data acquisition modules. Machining process simulation modules predict forces, torque, power, bending moment on spindle bearings, dimensional surface finish, vibrations and chatter-free depths of cut and spindle speeds. Machine tool and cutting tool designers can optimize their design choices, while process planners can significantly reduce the machining time while maintaining the accuracy and quality of the parts. The course gives balanced training of basic machining principles and their hands on application on machine tools.

Day 1: Material testing for machining process modeling

Period	Content	Activity
8:30-10:00	Orthogonal cutting model: shear stress - shear angle-friction/lubrication; cutting constants	Lecture by Prof. Altintas
10:00-10:30	Coffee break	
10:30-12:00	Oblique cutting model: turning, drilling, milling. Cutter design with CutPro	Lecture by Prof. Altintas
12:00-13:00	Lunch at UBC	Lunch will be provided
13:00-16:00	Turning and milling tests on the machine	Lab assistants
16:00-17:30	Material data base design from cutting tests (Manual calculations)	Lab assistants

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Day 2: Machine tool testing

Period	Content	Activity
8:30-10:00	Practical fundamentals of tool/workpiece vibrations; frequency measurement of tool/workpiece; engineering interpretation of tap test measurements (Manual calculations, CutPro/Modal Analysis)	Lecture by Prof. Altintas
10:00-10:30	Coffee break	
10:30-12:00	Hammer tests to measure FRF (frequency response function) of the machine tool (Manual calculations , MalTF/Modal Analysis)	Prof. Altintas
12:00-13:00	Lunch at UBC	Lunch will be provided
13:00-14:30	Modal analysis of a machine - hands on training	Prof. Altintas
14:30-15:00	Coffee break & discussions	
16:00-17:30	Forced vibrations, use of FRF's and mode shapes (CutPro/Milling)	Prof. Altintas

Day 3: Chatter stability lobes and chatter avoidance in machining

Period	Content	Activity
8:30-10:00	Construction of Chatter Stability Lobes using simple theory	Lecture by Prof. Altintas
10:00-10:30	Coffee break	
10:30-12:00	Chatter stability for milling, boring heads and drilling	Prof. Altintas
12:00-13:00	Lunch at UBC	Lunch will be provided
13:00-14:30	Obtain chatter stability lobes manually and with CutPro, select cutting conditions for testing	Prof. Altintas & Lab Assistants
14:30-15:00	Coffee break & discussions	
16:00-17:30	Cutting tests on the machine, discussion of results and the influence of tool geometry, material properties and machine tool dynamic stiffness on chatter (Manual calculations)	Prof. Altintas

Day 4: Project Day

Period	Content	Activity
8:30-10:00	Create a material data base, design cutter, optimize cutting condition to avoid chatter and prepare a report in milling Aluminum with manual and CUTPRO calculations	Lecture by Prof. Altintas
10:00-10:30	Coffee break	
10:30-12:00	Design a cutter to mill Titanium; select optimal cutting conditions and prepare report	Prof. Altintas
12:00-13:00	Lunch at UBC	Lunch will be provided
13:00-14:30	Hands on tap training on tap testing, chatter stability and generate a report	Prof. Altintas & Lab Assistants
14:30-15:00	Coffee break & discussions	
16:00-17:30	Hands on training on modal analysis, find weak fixture set up points, recommend improvement and generate a report	Prof. Altintas & Lab Assistants

Day 5: Machining diagnostics and virtual machining

Period	Content	Activity
8:30-10:00	Measure the frequency response function of the tool, construct the stability lobes with the measured material in CUTPRO	Lecture by Prof. Altintas
10:00-10:30	Coffee break	
10:30-12:00	Conduct chatter tests on the machining center. Analyze and interpret the results, understand the reasons behind the discrepancies in simulations and tests	Lab Assistants
12:00-13:00	Lunch at UBC	Lunch will be provided
13:00-14:30	Present virtual machining and automated optimization of NC programs	Lab Assistants/ Prof. Altintas
14:30-15:00	Coffee break	
16:00-17:30	Discussion of the course, questions and answers	Lab Assistants

Note:
Lunch and coffee will be provided; the textbook, "Manufacturing Automation: Principles of Metal Cutting, Machine Tool Vibrations and CNC" by Y. Altintas will be provided. The course enrolment will be limited to spend sufficient time with each attendant.