



**manufacturing
automation
laboratories**

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A Short Practical but Advanced Training Course...

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

Date: January 23 – February 17, 2023.

Instructor: Prof. Y. Altintas

Four Weeks long Online Video Training with 5 live sessions per week (30-60 minutes each)

Fee: US\$6000 per attendant. Mal Inc. will provide lecture notes, CUTPRO, ShopPro and MACHPRO licenses during the course period for free use by the attendants. The fee without the temporary software licenses (i.e. current license holders of all software products): US\$3500.

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. MACHPRO is digital simulation of NC part programs which predicts the chip, torque, power, force, temperature and chatter along the tool path as the material is removed. MACHPRO also optimizes the feed along the tool path to avoid scrap rates, tool damage, spindle overload, and deflection errors. NPRO is the NX and DELPRO is the CATIA 3DS embedded versions of MACHPRO. The course gives balanced training of basic machining principles and their hands-on application on machine tools, and machining process planning and optimization.

Requirements: Machining experience with engineering or technologist training. Book "Manufacturing Automation, Y. Altintas, Cambridge University Press (~US\$70), PC Computer.

Each lecture will be listened by the attendees ahead of time followed by a review, question and answer period with Prof. Altintas for thirty minutes. Tutorials will also be available on line to be followed by questions, answers and tutorials with the MAL engineers.



Week 1: Material testing for machining process modeling

Period	Content	Activity
Lecture I	Orthogonal cutting model: shear stress - shear angle-friction/lubrication; cutting constants	Lecture by Prof. Altintas
Tutorial I	Material data base design from cutting tests (Manual calculations)	Mal Inc. Engineer
Lecture II	Oblique cutting model: turning, drilling, milling. Cutter design with CutPro	Lecture by Prof. Altintas
Tutorial II	CUTPRO : Implementation of turning, milling, drilling simulations	Mal Inc. Engineer
Lecture III	Practical fundamentals of tool/workpiece vibrations; frequency measurement of tool/workpiece; engineering interpretation of tap test measurements	Prof. Altintas

Week 2: Machine tool testing

Period	Content	Activity
Tutorial III	Manual calculations, CutPro/Modal Analysis)	Prof. Altintas and MAL Inc engineer
Lecture IV	Hammer tests to measure FRF (frequency response function) of the machine tool (Manual calculations, MalTF/Modal Analysis)	Prof. Altintas
Tutorial IV	Modal analysis, hands on training and the engineering interpretation of mode shapes for troubleshooting machine and fixture setups	Prof. Altintas and MAL Inc engineer
Lecture V	Construction of Chatter Stability lobes using simple theory	Prof. Altintas
Tutorial V	Manual construction of Chatter Stability Lobes for turning operations	Prof. Altintas and MAL Inc engineer



Week 3: Chatter stability lobes and chatter avoidance in machining & Project Week

Period	Content	Activity
Lecture VI	Advanced Chatter stability for milling, boring heads and drilling	Prof. Altintas
Tutorial VI	Chatter stability for milling, boring heads, and drilling	Prof. Altintas and MAL Inc engineer
Lecture VII	Analyze actual cutting, discussion of results and the influence of tool geometry, material properties and machine tool dynamic stiffness on chatter (Manual calculations)	Prof. Altintas
Tutorial VII	Practice design of milling operation, conduct virtual tests, analyze the results	Prof. Altintas and MAL Inc. Engineer
Lecture VIII	Variable pitch cutter design; effect of run – out, serrated cutter, frequency and time domain based stability, process damping	Prof. Altintas

Week 4: Machining diagnostics and virtual machining

Period	Content	Activity
Tutorial VIII	Practice with advanced features of CUTPRO	MAL Inc. Engineer
Lecture IX	Introduction of CAM Based Part Machining Simulation and Optimization: MACHPRO, NPRO(NX) and DELPRO (CATIA)	Prof. Altintas and MAL Inc. Engineer
Tutorial IX	Hands on training of MACHPRO	MAL Inc. Engineer
Lecture X	Virtual CNC and Current research and developments at UBC Manufacturing Automation Laboratory.	Prof. Altintas
Tutorial X	Hands on training: NPRO, MACHPRO and CATIA DELPRO	Lab Assistants/ Prof. Altintas