manufacturing automation laboratories

MAL Manufacturing Automation Laboratories, Inc.
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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: October – November 2020.**

**Instructor: Prof. Y. Altintas**

**Five Weeks long On – Line Training, 90 minutes long- 4 sessions per week**

**Fee: US$4000 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. The course gives balanced training of basic machining principles and their hands on application on machine tools.

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

**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 |

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**Week 2: Machine tool testing**

| Period | Content | Activity |
|---|---|---|
| Lecture III | Practical fundamentals of tool/workpiece vibrations; frequency measurement of tool/workpiece; engineering interpretation of tap test measurements | Prof. Altintas |
| 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 |

**Week 3: Chatter stability lobes and chatter avoidance in machining**

| Period | Content | Activity |
|---|---|---|
| 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 |
| 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 |

**Week 4: Project Week**

| Period | Content | Activity |
|---|---|---|
| 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 |
| Tutorial VIII | Practice with advanced features of CUTPRO | MAL Inc. Engineer |

**Week 5: Machining diagnostics and virtual machining**

| **Period** | **Content** | **Activity** |
|---|---|---|
| Lecture IX | Introduction of CAM Based Part Machining Simulation and Optimizatoin: 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 CATIAL DELPRO | Lab Assistants/ Prof. Altintas |