Course syllabus

Smart tillverkning
Smart Manufacturing

MMTN50, 7,5 credits, A (Second Cycle)

Valid for: 2023/24
Faculty: Faculty of Engineering, LTH
Decided by: PLED M
Date of Decision: 2023-04-11

General Information

Main field: Production and Materials Engineering.
Compulsory for: MPRR1
Elective for: I4, M4
Language of instruction: The course will be given in English

Aim

The aim of the course is an introduction to manufacturing processes, ranging from machining operations to production quality control and production cost analysis, according to requirements of the Smart Manufacturing.

The objective of the course is to provide an overview of systems and methods to monitor the machining operations and control the production quality by in- and post-process measurements. The part of the course is focused on introduction to the development of data acquisition and monitoring systems based on Artificial Intelligence (AI) and Machine Learning (ML) techniques and their implementation in manufacturing processes in academy and industry environments.

The course is given as lectures with computer exercises and laboratory sessions and a task to train the student to elaborate on the material presented in the lectures. A project gives the student an opportunity to independently solve a problem for automatized process monitoring and production control.

Learning outcomes

Knowledge and understanding
For a passing grade the student must

- understand the principles of the Smart Manufacturing concepts and importance for contemporary manufacturing
- describe and discuss fundamental principles of machining and dynamic behavior at machining operations
- be familiar with fundamental principles of assessment of surface quality with use of advanced instruments
- be familiar with methods for data collection and general methods for signal and image processing and be able to implement them on an industrial problem in a laboratory environment
- describe and discuss fundamental principles of ML and NN.
- understand the possibilities and limitations of the current metrology framework (hardware and software) with practical applications in quality control

Competences and skills
For a passing grade the student must

- be able to practically estimate tool condition and parameters of production quality
- be able to select suitable sensors and setup DAQ hardware for collection of data
- be able to, on a fundamental level, handle and analyze data obtained from different machining operations for further use in AL and ML applications
- be able to create suitable AI or/and ML model and estimate its performance

Contents

The course covers most of the current research areas in manufacturing at the department. This includes methods for studying important phenomena and processes which affect the behavior of materials under different conditions – with focus on machining. The technical approaches to monitor and control manufacturing processes as well as the technical system for production quality monitoring are considered. The course comprises the following topics of Smart Manufacturing:

- Introduction to manufacturing processes/operations with focus on the Smart Manufacturing concepts.
- Manufacturing processes and parameters to be controlled
- Data collection and data analysis applied to manufacturing processes
- Big Data concepts within the industrial metrology
- ML and NN applied to signal processing and product quality control
- Use of sensors and measurements systems for the characterization of the manufacturing processes
- AI in the process monitoring: Predictive maintenance, Fault/Anomaly detection, Tool condition monitoring
- Introduction to Image Processing
- AI in Surface metrology and Production quality monitoring/control, Tool condition monitoring
- Implementation of Smart systems in Academy and Industry: prediction, classification, assessment, automation.

Examination details

Grading scale: TH - (U,3,4,5) - (Fail, Three, Four, Five)
Assessment: Written examination, written assignments and compulsory experimental exercises.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

Admission

Assumed prior knowledge: MMT012/MMTF20 Production and Manufacturing Methods or MMTA05 Production Systems or MMTF01 Production and FKM015/FKMA01 Materials Engineering, Basic Course.
The number of participants is limited to: No

Reading list

• Course material compiled by the departmant.

Contact and other information

Course coordinator: Oleksandr Gutnichenko, oleksandr.gutnichenko@iprod.lth.se
Course homepage: http://www.iprod.lth.se