Semester 3

NTNU

Introduction to Modelling and Simulation for Sustainable Manufacturing — 7.5 ECTS

Lecturers: C.S. Assuad

Lectures: 24h | Tutorials: 24h | Labs: 0h | Project: 36h | Autonomy: 60h | Lang.:

Objectives

The course will general understanding of the digital twin paradigm and its applications. Advanced knowledge of analytical tools in the context of sustainable manufacturing. Knowledge of different simulations tools for decision-making in the context of sustainable manufacturing. This through: training on selected software tools such as discrete event, system dynamics, monte carlo , agent base. Training the ability to measure and create sustainable development indicators, ability to think critically when interpreting sustainable development indicators, Ability to write reports from quantitative analytical tools.

Keywords: Manufacturing modelling, Digital twins, system dynamics, sustainable manufacturing

Programme

Learning outcomes

After completing the course, the student is supposed to get:
Knowledge:- General understanding of the digital twin paradigm and its applications.
- Advanced knowledge of analytical tools in the context of sustainable manufacturing.
- Knowledge of different simulations tools for decision-making in the context of sustainable manufacturing.
Skills:- Training on selected software tools such as discrete event, system dynamics, monte carlo , agent base.
- Ability to measure and create sustainable development indicators.
- Ability to think critically when interpreting sustainable development indicators
- Ability to write reports from quantitative analytical tools
General competence: Be able to convert data into information that gives value in the process of decision-making in the manufacturing process and management. Have a holistic understanding of the supply chain of data: producing, processing and analysis.- Have a critical and analytical approach to sustainability assessment and decision making for sustainable development solutions within manufacture.- Understanding the difference and strong points to different modelling and simulation software/methods.

Assessment

The examination of the course is divided in three deliveries: two written assignments and one written report that includes a simulation model. The assignments accounts for 40% of the final grade, 20% each. The final report accounts for 60% of the final grade. In addition to the exam the students will deliver four mandatory simulation exercises, from the seminars. In case of failing the course, it must be taken again the next time the course is given.4 hours examination without any technical support:
written answers on questions and tasks based on lectures content.

References

Information is given at the start of the semester on course material.

Semester 3

Flexible Automation and AI — 7.5 ECTS

Lecturers: **A. Mishra**

Lectures: 12h | Tutorials: 28h | Labs: 0h | Project: 50h | Autonomy : 50h | Lang. :

Objectives

Completing the course, the students have acquired knowledge of industrial automation technologies with the focus on flexibility. Specific topics include machine vision, artificial intelligence and distributed control systems. The students will acquire hands-on experience of implementing computational models for flexible, modular automation systems.

Keywords: Industrial automation, Robotics, Machine vision, Distributed control systems, Data science, Estimation and learning.

Programme

The course is based on seminars that combine lecturing with tutoring in the given topics. Homework assignments are based on programming tasks using Jupyter notebooks and/or Python scripts, which will be discussed in-class during the tutoring sessions. Prototyping computational solutions in Python we focus on the:

- Creation of computer vision algorithms using OpenCV and Scikit-image
- Manipulation of geometric primitives in matrix form using NumPy
- Training on basic data science skills: data preparation, training of machine learning models using Pandas, Scikit-learn
- Application of the acquired knowledge and skills in assignments and project(s)

Building on assignments the students are challenged to demonstrate knowledge and skills through a report on a topic of choice, which is assessed.

Prerequisites

Familiarity with the concept of “Industry 4.0” will be given prior to the course. Students are recommended to have some prior programming skills (Python), basic knowledge of linear algebra, probability and statistics.

Learning outcomes

After attending this course, students can contribute to new thinking and innovation in manufacturing automation and can contribute to realization of novel automation solutions based on flexible architectures and intelligent algorithms.

Assessment

Student learning outcomes are assessed based on a written report that demonstrates a practical, engineering approach to automation problems within a self-guided topic/challenge that may cover knowledge, methods and skills practiced during the course.

References

Course content, tutoring and tools is structured online in the learning management system. Reading material is also shared at the beginning of the course.

Semester 3

NTNU

Project work 7.5 ECTS

Lecturers: **G. Ringen**

Lectures: 4h | Tutorials: 0h | Labs: 0h | Project: 140h | Autonomy : | Lang. :

Objectives

Students will carry out a project in cooperation with a business or organization. As part of a project, students must write a report which has to meet the academic requirements at the master level. The report shall be an academic work that must be related to current theory and practice, including the stay.

Keywords: Project work

Programme

Students will carry out a project in cooperation with a business or organization. As part of a project, students must write a report which has to meet the academic requirements at the master level. The report shall be an academic work that must be related to current theory and practice, including the stay.
The course is based on the student's own work. It is open for cooperation among students, but individual final reports are mandatory. Tutoring of students will be made through web conference-systems. In addition, for remote students there will be at least one gathering at campus with mandatory attendance. Obligatory work: Mandatory approval of project plan.

Learning outcomes

After attending this course, students will:

- After completing the course, the student is supposed to
- Knowledge: apply relevant tools and be able to find data to estimate parameters.
- Skills: carry out an independent limited research and development projects. Analyse the estimated parameters and assess the validity of the results.
- General competence: communicate about technical issues, analysis and conclusions in the field, both with the company / organization and the public. Contribute to innovation or improvements in the process.

Assessment

Mandatory approval of project plan
Re-sit of examination: New improved report within 1monthThe final grade is based on the project report

References

Information is given at the start of the semester on course material.

Semester 3 – Electives

New electives 7.5 ECTS

Lecturers: **To be defined**

Lectures: - h | Tutorials: - h | Labs: - h | Project: - h | Autonomy: - h | Lang.:

Note

Besides “Lifecycle Performance of Aluminium Products”, other electives will be proposed at NTNU and students will be able to select one among 3 to 4, tentatively:

- Lifecycle Performance of Aluminium Products
- Digital Economics
- Parametric Design
- Introduction to Machine Learning

An update of the programme is on-going and requires a validation step before providing the official list.

These syllabi will be updated accordingly as soon as possible.