

Introduction to Modelling and Simulation for Sustainable Manufacturing

7.5 ECTS

Draft version undergoing final validation and provided for information only

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.

Flexible Automation and AI

7.5 ECTS

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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.

Lifecycle Performance of Aluminium Products

7.5 ECTS

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Lecturers: G. Ringen

Lectures: 24h

Tutorials: 12h

Labs: 0h

Project: 12h

Autonomy: 90h

Lang.: 

Objectives

The student shall understand basic theories for evaluating lifecycle perspectives of products based on aluminium as base material. These theories span from sciences of materials, products, business models and sustainability, thus, a cross disciplinary approach to product development challenges is highlighted. Based on these competencies the student shall be able to undertake holistic evaluations of new and improved products.

Keywords: Aluminium value chain, Life cycle performance, circular economy for aluminium. .

Programme

Aluminium as a construction material has gained increased interest in different markets and areas of application. But there are numerous factors to be considered to optimize the material utilization along the value chain and the product lifecycle. This course will present and explain new methods, frameworks and applied models for developing high complexity aluminium products under the constraints of value chain time compression, increased requirements for tailored advanced production technology and meeting higher order sustainability.

Learning outcomes

After attending this course, students will be trained and get basic understanding of :

- the aluminium value chain from ore to product end-of-life
- Global aluminium stocks and flows, circular economy for aluminium
- Environmental profile of aluminium, LCA for aluminium production
- Environmental aspects of aluminium manufacturing, processes, use and EOL
- Dispersed value chains demonstrating aspects of integrated/non-integrated business models for aluminium routes
- Economic perspectives from traditional NPV models, transaction cost theories towards real options and LCC models
- Modelling the use phase into cost elements as input to investment decisions
- Models for integrating environmental aspects in innovation and product development

Assessment

4 hours examination without any technical support:
written answers on questions and tasks based on lectures content. In addition,
compulsory assignment reporting and presentation

References

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

Industrial Communications and Sensor Technology

7.5 ECTS

Draft version undergoing final validation and provided for information only

Lecturers: M. Cheffena

Lectures: 32h

Tutorials: 32h

Labs: 0h

Project: 14h

Autonomy: 56h

Lang.: 

Objectives

After completing the course, students will have advanced knowledge on industrial communications and sensor technology, data mining and big data analysis including digital twins for manufacturing systems, and security aspects of Industry 4.0.

Keywords: Industrial internet-of-things, Sensor technology, Data mining and big data analysis, Digital twin, Security in industry 4.0

Programme

The course is seminar based. Handout research papers and/or reports will be utilized to cover the course topics. Each student (or a student group) will study the assigned papers/reports and prepare a presentation to the class. The quality of the seminar presentation and discussion will count for 20% of the final grade, and will contribute to cover the course topics of:

- Capabilities for automation based on industrial internet-of-things for sustainability
- Common Industrial communication systems and sensor technologies
- Data mining and big data analysis for industrial applications
- Concept of digital twin in manufacturing systems
- Security aspects and threats of Industry 4.0.

In preparations and in discussions in the seminars we analyze the possibilities as well as challenges of deploying sensors and communication systems in industrial use-case scenarios

Prerequisites

Basic knowledge in the field of data communications. A crash course (introduction) on data communications may be provided at the beginning of the course. Information is given at the start of the semester on course material.

Learning outcomes

After attending this course, the students can contribute to new thinking and innovation in the area of industrial communications and sensor technology, and strategies to develop sustainable, industrial information systems. The students may carry out advanced assignments and projects in this important field.

Assessment

The students will prepare a presentation on a chosen topic that they will present to the class for 45 minutes. Topics are chosen in collaboration with the lecturer. This counts 20% of the final grade. Oral examination at the end of the semester will count for 80% of the final grade.

References

References and reading material will be shared at the beginning of the semester (LMS)

Project work

7.5 ECTS

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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.