FSM3001 Data-driven Methods in Engineering 7.5 credits

Datadrivna metoder inom teknisk mekanik

This is a translation of the Swedish, legally binding, course syllabus.

If the course is discontinued, students may request to be examined during the following two academic years

Establishment

Course syllabus for FSM3001 valid from Autumn 2021

Grading scale

P, F

Education cycle

Third cycle

Specific prerequisites

A good understanding of standard topics in engineering mathematical analysis will be very helpful. In particular, a strong background in linear algebra, differential equations, and optimization will be beneficial. Since hands-on data-driven modeling will invariably require some coding, familiarity with Matlab, Python or other similar languages/platforms will be helpful.

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

After taking the course the students should be able to:

- Understand the meaning and significance of mathematical operations required to process, represent, and approximate data.
- Understand the objectives, advantages, and disadvantages of various data-driven modeling techniques.
- Learn how to load and manipulate large datasets in Matlab and/or Python.
- Develop the required skills to apply various data-driven algorithms to potentially large and complex datasets
- Interpret the results of modeling algorithms to build an enhanced understanding of a given dataset.
- Interpret and understand the physics of the underlying system that the data comes from.
- Be able to assess the implications of the developed data-driven solutions for sutainable development.

Course contents

Dimensionality Reduction (Part I) This section introduces tools for finding low-dimensional representations of high-dimensional data, which allows for data to be efficiently stored, transferred, and analyzed.

Machine Learning and Data Analysis (Part II) This section will give a relatively brief tour through aspects of data analysis, from classical curve fitting to neural networks and deep learning, building on the material introduced in Part I.

Dynamics, Control and Reduced-Order Models (Part III). In this section, we assume that the data that we are studying comes from some underlying physical laws (in the context of dynamical systems, solid mechanics, fluid mechanics, etc.), which can be learned/approximated from data, or from some combination of data and physics.

Final Project (Part IV).

The students will apply the techniques developed in this course (or extensions thereof) to a dataset/problem of their own choosing.

Examination

- PRO1 - Project, 3.5 credits, grading scale: P, F
- TEN1 - Written exam, 2.0 credits, grading scale: P, F
- ÖVN1 - Home work, 2.0 credits, grading scale: P, F

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.