Supplementary Course (EVA) in the MSE programme

Title: Data Analysis for Thermo-Fluid Systems

Short Code: rEVA_DataTF

Credits	3
Profile	Energy & Environment (EnEn)
Responsible Institute /Centre	Institute of Energy Systems and Fluid Engineering (IEFE)
Responsible lecturer and contact informtion	**Dr. Harish Gopalakrishnan, gopa@zhaw.ch**
Type and duration of examinations	Students prepare semester project; Exam: final presentations by student followed by viva on the project; oral assessment, 10 minutes per student
Start date and duration	Semester: Spring Detail: 2027
Location	Winterthur
Course type	Will be held as a semester course combined with 1 final day for presentation of projects • Contact hours: 40 (hrs) • Guided self-study: 10 (hrs) • Independent self-study: 40 (hrs)
Language of instruction	English
Short description (max. 300 characters)	This course is aimed at equipping students with classical and modern data-analysis techniques to obtain quantitative information from extensive spatio-temporal data of thermo-fluid systems. While the primary focus in this course will be on fluid flow, the developed tools can be more generally applied to more diverse fields such as meteorology, finance and medical imaging.
Contents and Learning Objectives	**Contents**: The course is organized into two parts. The first part of the course focusses on discrete Fourier Analysis where the student will first be introduced to the discrete Fourier transform for analyzing stationary signals. The salient properties and commonly encountered problems such as aliasing and spectral leakage will be discussed. Consequently, the analysis of non-stationary signals using Hilbert transform will be presented. In the second part of the course, techniques for structure identification from spatio-temporal data using Singular Value Decomposition (SVD), Proper Orthogonal Decomposition (POD) and Dynamic Mode Decomposition (DMD) will be presented. Accompanying every

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	theory session will also be a hands-on practical session demonstrating the application of the techniques learnt. The students will do these hands-on exercises using a programming language of their choice. **Learning Objectives**: • Knowledge of the mathematics of signal processing including applied Fourier analysis, structure identification and orthogonal decompositions (POD, DMD, PCA) • Implementation of these techniques into numerical frameworks • Extracting accurate and clear insights from experimental/numerical data of fluid flows • Understanding the role of data analysis in the investigation of thermo-fluid systems • Preparation and delivery of a technical presentation			
Prerequisites	Basic knowledge of fluid mechanics and good grasp of programming skills in any language.			
Literature	Course notes (for both theory and practical sessions) will be distributed to students during the course of the term			
Special requirements	Good programming skills in any language of preference (MATLAB, Python) and knowledge of undergraduate mathematics is required. Basic knowledge of fluid dynamics would be an additional bonus but not a must.			
Offer for profiles	Aviation (Avi)	☒	Business Engineering (BE)	☐
	Computer Science (CS)	☐	Data Science (DS)	☐
	Electrical Engineering (EIE)	☐	Energy & Environment (EnEn)	☒
	Mechanical Engineering (ME)	☒	Mechatronics & Automation (MA	☐
	Medical Engineering (Med)	☐	Photonics (Pho)	☐
	Information and Cyber Security (ICS)	☐	Civil Engineering (CE)	☐