ABSTRACTS

Learning in Machines: From Data to Models and Control

Authors: **Tom Oomen**

Abstract: The future of manufacturing equipment and scientific instruments hinges on the ability to perform precise and fast motions. Examples of such mechatronic systems include wafer scanners, printing systems, pick-and-place machines, microscopes, and telescopes. These systems are subject to ever-increasing speed, accuracy, and flexibility requirements. Learning from data provides major opportunities to meet these requirements. In this presentation, I will outline new identification methodologies that can deal with the increasing requirements and large complexity in envisaged future mechatronic systems. I will also show their successful implementation on a selection of state-of-the-art mechatronic systems. The new results pave the way for new, revolutionary, data-intensive mechatronic designs with a massive number of actuators and sensors.

Constrained identification methods for robots

Authors: **Alexandre Janot**

Abstract: Researchers have intensively investigated robot identification over the past four decades, making it a mature topic. The standard approach uses the inverse dynamic model and applies least-squares regression. Researchers have validated this IDIM-LS method on several industrial robots and other types of systems. Good results are obtained provided a well-tuned, tailor-made data filtering.

Constrained identification methods have received attention from the robotic community since, with constraints, it is hoped to get more accurate estimates. Despite the apparently good results obtained until now, the impact of constraints is rarely analysed, while the consistency of estimates is rarely tackled.

In this talk, based on the proficient literature of economics and econometrics, we show that we must be careful while using constraints, and we tackle the consistency of estimates. Besides, we present how constraints can be inserted into an instrumental variable method.

System Identification and Passive Network Techniques in Electrical Power Systems

Authors: **Gustavo Henrique da Costa Oliveira**

Abstract: In this presentation, we will showcase real-world cases where frequency-domain system identification methods have been applied to address key challenges related to the reliability of electrical power system facilities.

Power transformers are among the most valuable assets in electrical substations. Their reliable and safe operation—along with that of other inductive equipment—depends on ensuring that dielectric stresses caused by transient overvoltages remain within acceptable limits.

Passive black-box models, derived through system identification techniques, serve as terminal equivalents of transformers. These models can be used in transient studies to calculate overvoltages occurring both externally and internally to the transformer.

This presentation covers the entire process of developing these models, from experiment design and data acquisition to their integration into electromagnetic transient simulation programs, including parameter estimation and passivity enforcement.

Global terrestrial temperature modeling by using fractional models with output-error method

Author: **Stéphane Victor,** Aziz Bounouh, Rachid Malti

Abstract: The global terrestrial system is a very complex system and modeling it through the global temperature output is indeed challenging. Temperature estimation results from complex diffusion phenomena and as the fractional operator is very a well suited operator to model such phenomena thanks to its long memory property and parameter compactness, it is proposed to use such an operator for climate change modeling.

Continuous-time system identification is proposed by using an output-error (OE) model for multiple-input single-output (MISO) fractional order systems. When the model structure is assumed known, in the sense when the differentiation orders are assumed known, only the coefficients are estimated by using the MISO-oe algorithm extended to fractional MISO systems. For unknown differentiation orders, the differentiation orders are estimated together with the coefficients with a gradient-based algorithm for all parameter (both coefficients and differentiation orders) estimation. Finally, the terrestrial climate change is identified with fractional models on real input/output terrestrial climate data which provide a very good fitness of the global Earth temperature, as compared to classic rational models with the same number of parameters.

Moreover, it should de noted that the data, both inputs and output temperature ones, are used from 1850 up to 2024, which considers the latest know data.