# End-to-end process monitoring techniques and case studies: Hands-on workshop

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## Summary

Practical process monitoring in industry requires fault detection, identification, diagnosis, and the implementation of process recovery actions. Algorithmic design and automation of all these steps are required if the future promise of more autonomous plants is to be realised. However, theoretical research in process monitoring is overwhelmingly focused on the task of fault detection. End-to-end process monitoring (Auret and Louw, 2023a) encompasses the fully automated workflow from detection to implementation of the appropriate corrective action in a process. This workshop will discuss and demonstrate a framework for improved experimentation of end-to-end process monitoring approaches. The workshop is hands-on, making use of open access case studies and example code with implementations available in both MATLAB and Python (Auret and Louw, 2023b). The workshop will cover the motivation for an end-to-end process monitoring simulation framework and give participants the opportunity to practice implementing the various components that make up the framework, including modular designs for process, control, sensors, actuators, process monitoring, operator actions, and economic performance assessment. The importance of variability and uncertainty for robust process monitoring design will be discussed and demonstrated in the case studies.

The expected outcomes of the workshop are:

- To understand the industrial importance of end-to-end process monitoring.
- To understand and be able to implement the components of an end-to-end process monitoring test bed (process, control, sensors, actuators, operator actions, process monitoring).
- To understand and be able to implement uncertainty and variability characteristics in an end-to-end process monitoring test bed.

## Intended audience

The workshop is aimed at:

- Graduate students new to the fields of process monitoring, fault diagnosis, fault tolerant control.
- Experienced researchers in aforementioned fields (and the field of reinforcement learning) looking to expand the complexity and industrial relevance of case studies used to demonstrate their techniques.
- Industry practitioners interested in and working on problems related to industry 4.0, autonomous plants and decision-support systems may also benefit from the workshop and be able to contribute valuable insights to academic participants.

Process monitoring techniques demonstrated will typically be data-based approaches.

## Tentative schedule

- 09h00 - 10h00: (Presentation) Overview; motivation and framework structure
- 10h00 - 11h00: (Interactive example) Framework familiarisation, and experiments

- 11h00 - 11h30: Break
- 11h30 - 12h00: (Presentation) Process monitoring detail
- 12h00 - 13h00: (Interactive example) Process monitoring implementation and experiments
- 13h00 - 14h00: Lunch
- 14h00 - 15h00: (Presentation) Uncertainty and variability detail
- 15h00 - 16h30: (Interactive challenge) End-to-end process monitoring challenge

**References**

Auret, L. and Louw, T. (2023a). End-to-end process monitoring: Challenges and framework for case study design. IFAC-PapersOnLine, 56(2), 2650–2656. 22nd IFAC World Congress.

Auret, L. and Louw, T. (2023b). End-to-end process monitoring. URL https://github.com/Stellenbosch-University-Process-Eng/End-to-end-process-monitoring