Invited Open-Track Session on

"Incorporating Artificial Intelligence and Process Modelling to Create the Next Generation of Soft Sensors"

Registration Code: 5d874 (to be used when submitting your papers)

Organised by

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Call for Papers

Abstract:

As the need to understand a process quickly and accurately increases, the development of real-time methods becomes more important. Although laboratory samples provide accurate measurements, their availability is limited. Thus, there is a need to develop better and more efficient models. One such approach is using soft sensors. The concept of soft sensors is well established. However, with the emergence of artificial intelligence, digital twins, and other modern methods for modelling, the question becomes how these methods can be used to improve the soft sensors so that the provide better and more accurate estimate of the process. Furthermore, changes in the process need to be better reflected in the soft sensor itself.

Detailed Description:

As new methods are developed in system identification and process modelling, it is necessary to understand their effect on soft sensor. Currently, the topics of artificial intelligence, digital twins, and adaptive modelling have an effect on the development of soft sensors.

First, in terms of process modelling, the open question of modelling complex and highly interacting processes that experience changes in operating conditions and random disturbances remains a pressing problem in the development of accurate and useful process models. Furthermore, changes in the process over time need to be considered and the models updated. Failure to do so will compromise the accuracy and usefulness of the resulting control and optimisation strategies. Artificial intelligence, especially multimodal data fusion, shows promise in tackling these issues and potentially providing a viable long-term solution to the problem. Furthermore, the question of physics-informed identification of nonlinear systems needs to be addressed in order to obtain better and more powerful process models.

Second, in terms of process monitoring, the development of accurate methods for detecting and diagnosing faults and other process disturbances. Traditional methods have relied on manually labelling and determining data sets containing faults. However, the rarity of faults means that there is a corresponding lack of information about such faults. Therefore, developing and detecting faults using large-language models can be difficult. Thus, methods that can create relevant surrogate data and using reasoning assisted by generative artificial intelligence need to be perfected and improved in order to improve and perfect the area of process monitoring.

Third, in terms of process optimisation and design, the use of artificial intelligence to create optimal process-flow diagrams for existing or new designs is yet another potential area of application. Traditionally, such optimal diagrams were created manually based on an engineer's experience and textbook knowledge. Perhaps, artificial intelligence can be used to improve and create better, more energy-efficient processes. Recent work in this area has shown promise, but additional work still needs to be done.

Finally, there is a need to bring together industrial and academic researchers so that they can enrich each other's approaches to the problem. Firstly, the actual industrial problems need to be formulated and explained so that theoretical solutions can be found. Likewise, the theoretical approaches need to be properly formulated and tested so that the correct industrial application can be found. Therefore, there is a need to offer the opportunity for both sides to meet and discuss these issues.

For this open-track invited session, the topics of interest include, but are not limited to:

- Artificial intelligence, especially physics-informed methods, for modelling complex industrial processes
- Explainability of artificial intelligence with application for soft sensors
- Generalisability of artificial intelligence with application for soft sensors
- Development of methods for incorporating knowledge-based results into artificial-intelligence-driven models including soft sensors
- Development of soft sensors for generative artificial intelligence for process control, optimisation, and modelling
- Theory and application of artificial intelligence for soft sensors and process models
- Maintenance and updating of soft sensors created using artificial intelligence
- Practical implementations of the above topics and
- Survey papers discussing the impact and implications of the methods in industry.

Suggested IFAC TC: **TCs 6.1 and 1.1**
Website for the Session: https://yuri.shardt.me/SySId2027OIS.html

