

Mastering Soft Sensors

Practical Applications in Process Monitoring



Table of Contents

01

Course Overview

02

Course Objectives

03

Target Audience

04

Course Outcomes

05

Course Structure

06

Summary





Introduction

This course provides a comprehensive exploration of soft sensors, focusing on their role in process monitoring, real-time decision-making, and improving efficiency across various industries.

Participants will learn how to develop soft sensors using a combination of model-driven and data-driven approaches, applying cutting-edge AI techniques.

The course covers the entire lifecycle of soft sensors, from data collection and feature selection to deployment and continuous maintenance, including hands-on applications of soft sensors in real-world industrial processes.



Course Objectives

The course is aimed at exploring the role of soft sensors in sustainable development by reducing energy consumption, minimizing waste, and improving process efficiency. Participants will gain practical experience through hands-on projects, building and deploying soft sensors for various industrial processes.

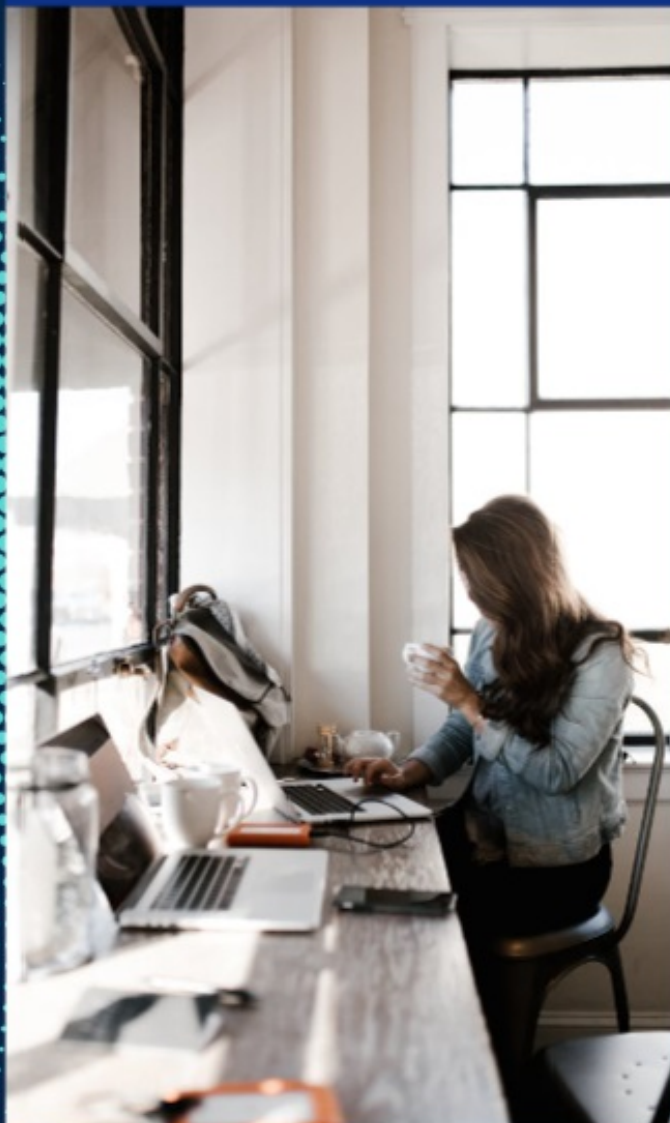
Key Findings



Target Audience

This course is designed for:

Engineers, researchers, and professionals in fields such as process control, chemical engineering, and manufacturing.



Data scientists and AI enthusiasts who are interested in the practical applications of machine learning in industrial settings.

Industrial automation professionals looking to implement soft sensor solutions in their operations.

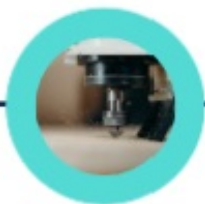
Graduate and post-graduate students in engineering or computational sciences who seek to apply data-driven models in process monitoring.

Course Outcomes

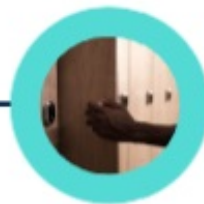
Upon successful completion of this course, participants will be able to



Key outcomes



Design, develop, and deploy soft sensors using both model-driven and AI-based data-driven approaches.



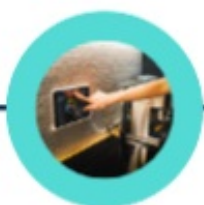
Use statistical and AI-based techniques, such as Principal Component Analysis (PCA), Partial Least Squares (PLS), neural networks, and autoencoders, to build efficient soft sensors.



Implement soft sensors in real-time for process monitoring and fault detection, ensuring optimal operational performance.

Develop strategies for sustainable manufacturing using soft sensors by optimizing energy consumption and minimizing waste.

Master advanced techniques like Kalman Filters, machine learning-based inferential sensors, and predictive maintenance using soft sensors.



Course Structure

Module 1: Introduction to Soft Sensors

- Overview of soft sensors and their importance in process industries.
- Distinctions between hardware sensors and soft sensors.
- Application areas and challenges in building soft sensors.

Module 2: Data Collection and Preprocessing

- Data collection methodologies from hardware sensors.
- Feature selection and preprocessing techniques.
- Handling noisy, missing, or inconsistent data in industrial processes.
- Introduction to tools like MATLAB for model development.

Module 3: Model-Driven Soft Sensors

- Understanding first-principles models.
- Developing mechanistic models for steady-state operating conditions.
- Limitations of model-driven soft sensors.

Module 4: Data-Driven Soft Sensors

- Introduction to data-driven models using historical data.
- Key algorithms: PCA, PLS, and regression models (OLS, PCR, PLSR).
- Training and validating models on real-world datasets.

Module 5: AI-Driven Soft Sensors

- Utilizing machine learning techniques like neural networks, deep learning, and autoencoders in soft sensor development.
- Real-world case studies: AI-based soft sensor applications in the polymer processing, oil refinery, and pharmaceutical industries.

Course Structure

Module 6: Real-Time Monitoring and Predictive Control

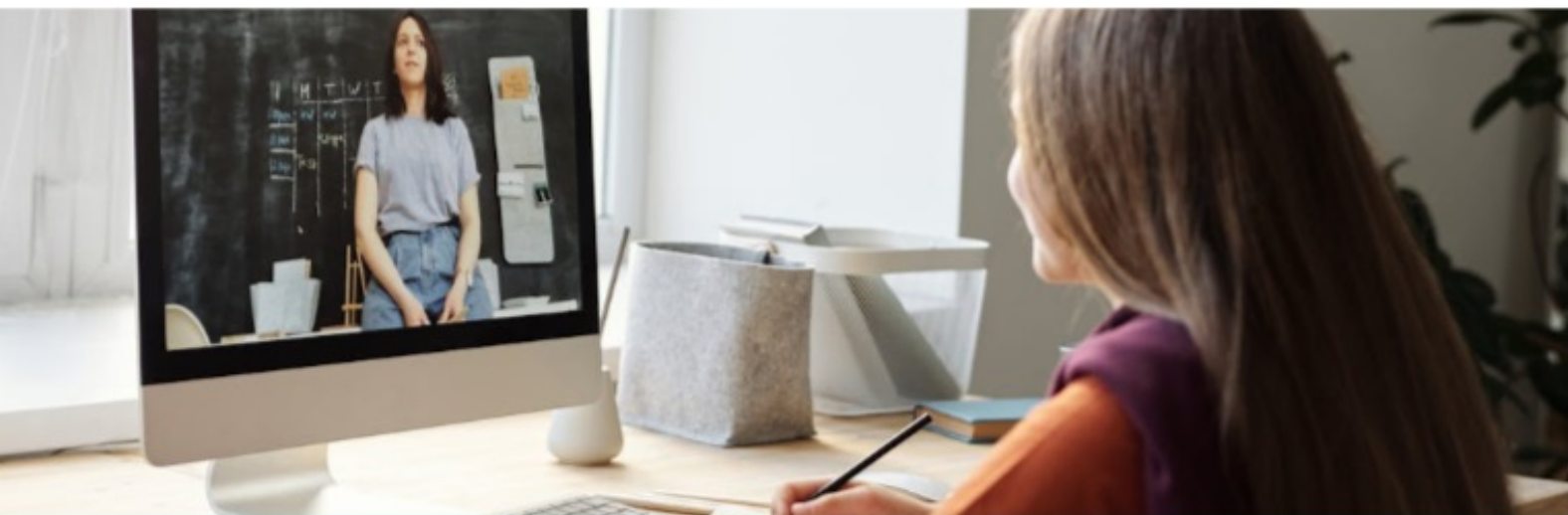
- Implementing soft sensors for real-time decision-making and control.
- Applications in predictive maintenance, process control, and optimization.
- Integration of soft sensors with existing control systems and feedback loops.

Module 7: Practical Implementation of Soft Sensors

- Building soft sensors using MATLAB/SIMULINK.
- Step-by-step development of a soft sensor for yeast fermentation.
- Practical applications: Deploying soft sensors in industrial scenarios like fermentation processes, and refinery monitoring.

Module 8: Case Studies and Sustainability

- Case studies of successful soft sensor implementations across various industries.
- Role of soft sensors in achieving sustainable development goals.
- Future trends and challenges in soft sensor technology.



Key Features of the Course

This course is designed for:



- **Hands-on Projects:** Develop real-world soft sensor models, starting from data collection and preprocessing, to model training and deployment in industrial systems.
- **Industry-Focused Case Studies:** Explore applications in various sectors like polymer processing, oil refining, and pharmaceuticals, highlighting the role of soft sensors in sustainable development.
- **Expert Lectures:** Learn from industry leaders and AI experts who have developed advanced soft sensor technologies.
- **Collaborative Learning:** Use a virtual platform for peer interaction, group projects, and feedback on soft sensor development.
- **Capstone Project:** A final real-world project where participants apply AI algorithms to create and optimize soft sensors for a selected industrial process.



Summary

The future holds exciting advancements in AI, machine learning, and sensor technology, further propelling the adoption of soft sensors across diverse applications.

This course provides both theoretical knowledge and practical tools to design and deploy soft sensors, focusing on real-world applications across multiple industries. It equips participants with the technical skills necessary to implement advanced soft sensor solutions using modern AI techniques.