Fault detection and diagnosis of technical systems

Feldetektion och diagnos av tekniska system
6 credits

Programme course

TSFS22

Valid from: 2025 Spring semester

Determined by	**Main field of study**	
Board of Studies for Electrical Engineering, Physics and Mathematics	Electrical Engineering	
Date determined	**Course level**	**Progressive specialisation**
2024-08-28	Second cycle	A1X
Revised by	**Disciplinary domain**	
Revision date	**Subject group**	
	Electrical Engineering	
Offered first time	**Offered for the last time**	
2025		
Department	**Replaced by**	
Institutionen för systemteknik		

Course offered for

- Master of Science in Applied Physics and Electrical Engineering
- Master of Science in Mechanical Engineering
- Master of Science in Applied Physics and Electrical Engineering - International
- Master of Science in Computer Science and Engineering
- Master of Science in Information Technology
- Master of Science in Computer Science and Software Engineering

Prerequisites

Automatic Control, Probability theory

Intended learning outcomes

To give both a theoretical and practical basis for how to design systems that automatically detect and isolate faulty components in technical processes.

After completing the course, the student shall be able to:

1. Based on a mathematical model of a technical process, **apply** model-based methods to analyze diagnostic performance and to detect and isolate faults.
2. Based on historical data from a technical process **apply** data-driven methods to detect and classify faults.

Course content

1. Introduction to fault diagnosis, design of diagnostic systems, examples of industrial applications.
2. Mathematical modeling for fault detection and fault isolation using models, consistency relations, analytical redundancy.
3. Structural methods for fault diagnosis, bipartite graphs, modeling for structural analysis, matching, analysis of structural diagnosis properties, algorithms for finding overdetermined equation sets for residual generation.
4. Linear and nonlinear residual generation, observers and Kalman filters for diagnosis.
5. Statistical methods for fault detection.
6. Fault isolation, decisions with structured hypothesis tests, minimal hitting set.
7. Data-driven fault diagnosis, anomaly detection, classification.
8. Hybrid fault diagnosis combining model-based and data-driven diagnosis methods.

Teaching and working methods

The course is organized in lectures, problem solving sessions, and laborations.

Examination

LAB1	Laboratory work	2 credits	U, G
DAT1	Computer exam	4 credits	U, 3, 4, 5

Grades

Four-grade scale, LiU, U, 3, 4, 5