Model-Based and Data-Driven Fault Detection and Isolation

Lecturer
Michel KINNAERT (Coordinator)

Course mnemonic
MATH-H503

Language(s) of instruction
English

Course period
Second term

Course content

1. Generation of fault indicators

- Parity space approach to the generation of fault indicators (or residuals)
- Observer-based approach to residual generation

Both methods are developed in a deterministic and in a stochastic framework

2. Statistical change detection algorithms for decision system design

- Introduction for statistical process control
- Shewart and exponentially weighted moving average (EWMA) control chart
- Cumulative sum (CUSUM) algorithm and generalized likelihood ration algorithm

3. Change detection based on parameter estimation methods

Objectives (and/or specific learning outcomes)

- To master the principles of the design of fault detection and isolation systems, based on an mathematical model of the supervised process.
- To get acquainted with some on-line change detection algorithms and to be able to use them in a decision system

Teaching method and learning activities

The lectures alternate with implementation of the methods on simple case studies using the MATLAB/SIMULINK software.

Contribution to the teaching profile

This teaching unit contributes to the following competences:

- In-depth knowledge and understanding of the advanced methods and theories to schematize and model complex problems or processes
- Reformulate complex engineering problems in order to solve them (simplifying assumptions, reducing complexity)
- Correctly report on research or design results in the form of a technical report or in the form of a scientific paper
- Present and defend results in a scientifically sound way, using contemporary communication tools, for a national as well as for an international professional or lay audience
- Work in an industrial environment with attention to safety, quality assurance, communication and reporting
- Think critically about and evaluate projects, systems and processes, particularly when based on incomplete, contradictory and/or redundant information
- A creative, problem-solving, result-driven and evidence-based attitude, aiming at innovation and applicability in industry and society
- A critical attitude towards one's own results and those of others
- Consciousness of the ethical, social, environmental and economic context of his/her work and strives for sustainable solutions to engineering problems including safety and quality assurance aspects
- The flexibility and adaptability to work in an international and/or intercultural context
- An attitude of life-long learning as needed for the future development of his/her career
- Has an active knowledge of the theory and applications of electronics, information and communication technology, from component up to system level.
- Is able to analyse, specify, design, implement, test and evaluate individual electronic devices, components and algorithms, for signal-processing, communication and complex systems.

References, bibliography and recommended reading

- M. Basseville et I.V. Nikiforov (1993). Detection of Abrupt Changes: Theory and Applications, Prentice-Hall.
- T. Soderstrom and P. Stoica (1989) System Identification. Prentice-Hall International.
- M. Blanke, M. Kinnaert, J. Lunze et M. Staroswiecki (2015) Diagnosis and Fault Tolerant Control, 3rd Edition, Springer.

Other information

Contact(s)

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Evaluation method(s)

Oral examination

Evaluation method(s) (additional information)

Oral examination

Determination of the mark (including the weighting of partial marks)

- Report on the practical work: 50%
- Oral examination :50%

Main language(s) of evaluation

English

Programmes

Programmes proposing this course at the Brussels School of Engineering

MA-IRCB | Master of science in Biomedical Engineering | finalité Professional/unit 2, MA-IREL | Master of science in Electrical Engineering | finalité electronics and information technologies/ unit 2 and MA-IREM | Master of science in Electromechanical Engineering | finalité Professional/unit 2 and finalité Operations engineering and management/unit 2