12th IFAC Symposium on
Fault Detection, Supervision
and Safety for Technical Processes

safeprocess 2024

4-7 June 2024
Ferrara, ITALY

IFAC
INTERNATIONAL FEDERATION
OF AUTOMATIC CONTROL

12th IFAC Symposium on Fault Detection, Supervision and Safety for Technical Processes

5 – 7 June 2024

SAFEPROCESS 2024 Program

Editor: L. Travé-Massuyès

Department of Engineering, University of Ferrara
Via Saragat, 1E - 44122 Ferrara (FE)
ITALY

Welcome to SAFEPROCESS 2024

The National Organizing and International Program Committees have the pleasure of inviting you to participate in the 12th IFAC Symposium on Fault Detection, Supervision and Safety for Technical Processes, to take place in Ferrara, Italy, 4 - 7 June 2024, under the auspices of IFAC, the International Federation of Automatic Control.

Ferrara is a city in Italy's Emilia-Romagna region, Northern Italy. It is known for the buildings erected by its Renaissance rulers, the Este family. The city's cultural treasures were designated a UNESCO World Heritage site in 1995. Ferrara is also known as the city of bicycles, due to bicycle usage by city residents being considered amongst the highest in Europe.

The SAFEPROCESS Symposium is organized every three years, and for the first time since its first edition in 1991, it takes place in Italy. SAFEPROCESS 2024 is continuing the successful series of IFAC symposia held in Baden Baden (Germany, 1991), Espoo (Finland, 1994), Hull (United Kingdom, 1997), Budapest (Hungary, 2000), Washington (United States, 2003), Beijing (China, 2006), Barcelona (Spain, 2009), Mexico City (Mexico, 2012), Paris (France, 2015), Warsaw (Poland, 2018), and Pafos (Cyprus, 2022).

The SAFEPROCESS Symposium is a major international gathering of leading experts in academia and industry from all over the world. Prominent speakers will discuss the comprehensive range of topics in fault diagnosis, process supervision, and safety monitoring, covering both state-of-the-art applications and emerging research directions. The symposium aims to boost collaboration between academia and industry, fostering new connections and reinforcing established ones. It also serves as a global forum for young scientists to present their research projects and works to an international audience of experts, fellow researchers, academics, and students.

Fault diagnosis, Fault Detection and Isolation (FDI) and Fault-Tolerant Control (FTC) build a major area of research at the intersection of systems and control engineering, artificial intelligence, applied mathematics and statistics, and application fields like chemical, electrical, mechanical, aerospace engineering and transportation systems.

IFAC has recognized the significance of this area by launching a triennial symposium series dedicated to these subjects. The IFAC SAFEPROCESS 2024 edition will be focused on major topics related to energy, cybersecurity, water systems, and autonomous vehicles. Invited sessions, plenary lectures, tutorials, benchmarks, and roundtables will highlight industrial-academic projects, challenges, and applications.

During the symposium, three awards will be recognised. The Paul M. Frank Award was established in memory of Prof. Paul M. Frank, who was one of the pioneers and great contributors to the fault diagnosis area. It will be given to the best theoretical contribution by considering paper and oral presentation. The Best Student and Best Application Paper Awards will also be offered by the Symposium. An appointed Award Committee will evaluate all candidates, and the winners will be announced during the Symposium.

On behalf of the National Organizing and International Program Committees, we wish you a pleasant stay in Ferrara and a fruitful participation in SAFEPROCESS 2024.

<div align="right">
Cristina Verde Rodarte (IPC Chair)
Silvio Simani (General Chair)
L. Travé-Massuyès (Editor)
</div>

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Co-sponsoring Organisations

Department of Engineering, University of Ferrara (DE-UNIFE), Consorzio Futuro in Ricerca (CFR) University of Ferrara, Ferrara City Council, Italian Association of MAiNtenance-AIMAN, Italian Society of Researchers and Academics of Automation - SIDRA, Nationa Association of Automation APplication - ANIPLA, and MathWorks.

Keynote Speaker Talk Titles & Abstracts

Prof. Ron J. Patton (r.j.patton@hull.ac.uk)

Title Offshore wind turbine rotor imbalance, a Fault Tolerant Control problem.

Abstract

Offshore wind turbines are subjected to asymmetrical loads caused by blade flapping and turbulent wind flow, leading to increased fatigue of blade rotor hub and tower structures and limiting power conversion. This motivates the development of unbalanced load mitigation strategies using improved pitch control, considering tolerance of pitch actuator faults. A Fault-Tolerant Control (FTC) approach (modelled using FAST) is used to address the problem of rotor actuator faults. The traditional Individual Pitch Control (IPC) system is an FTC system in which the faults are the unbalanced rotor loads. Through this system the unbalanced loads are compensated by balancing the rotor using a special form of actuator redundancy, thereby restoring power efficiency. Actuator fault effects are compensated through fault estimation (unknown input observer) when an actuator FTC scheme is combined with the IPC system to (a) balance the rotor loading and (b) compensate the actuator faults. Robustness is evaluated over 100 Monte Carlo Region 3 operating points. Two interesting issues arise:

(i)   How can rotor load sensor faults be handled?

(ii)   Can the system be extended to work in a floating wind turbine configuration?

Key Takeaways

- Rotor load imbalance can be handled using an "FTC Principle."
- The handling of load balancing and component (actuator) faults leads to reduced rotor fatigue, especially in Region 3 operation, thereby enhancing wind turbine life and efficiency.

## Dr. Christophe Combastel (christophe.combastel@u-bordeaux.fr)

Title Reachability and Filtering for Safe Processes: from Zonotopes to Functional Sets with Typed Symbols.

Abstract

Ensuring safety involves uncertainty management. How to evaluate uncertainty propagation through system dynamics? How imperfect predictions can improve multi-sensor data fusion? How to check consistency to further make sound diagnosis decisions and/or verify the satisfaction of requirements with full coverage? The answer is far from unique! In this talk, starting from set-based zonotopic reachability and linear Kalman-like filtering/observation, several extensions will be presented: parameter-varying, jointly stochastic, distributed, nonlinear/polynomial, hybrid, logical (Boolean, signed), and shown to be unified through functional sets with typed symbols.

Key takeaways

- Functions can be used to implicitly define sets as the image of their definition domain.
- Functional sets with typed symbols extend zonotopes to non-convex, non-centrally symmetric, non-connected mixed/hybrid sets.
- An explicit distinction between syntax and semantics, combined with eager and lazy evaluations (of symbolic expressions and bounds) are keys to overcoming the dependency problem.
- Uniquely identified symbols preserve the traceability of global dependencies (e.g. variable multi-occurrences), even through local/distributed compositional operations.
- Generic hybrid nonlinear filtering algorithms can directly result from basic operator overloading.
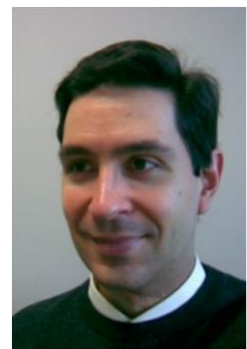
Prof. Roger Dixon (r.dixon@bham.ac.uk)

Title Fault Tolerance in Railways: the evolution of a radical next generation track switch

Abstract

Railway track switches are crucial for the flexibility and efficiency of railway networks, as they enable trains to switch between different tracks. However, they are also a major source of vulnerability and risk, as they are prone to malfunction and failure. When this happens, trains may be forced to stop, re-route, or even derail, causing delays, disruptions, and accidents. Despite their importance, the design and operation of track switches have not changed significantly for many decades. The plenary will introduce a groundbreaking alternative to the conventional track switch technology. REPOINT is an innovative, patented, railway track switch system that has been developed by applying a mechatronic systems design approach to create a novel fault-tolerant switch. The presentation will introduce the problem and will then outline the research and development process of the new switch system: starting with the generation of the initial concept, passing through simulation and laboratory testing and validation, and covering the path to full-scale implementation and evaluation in a real-world setting. During the presentation, some of the commercial challenges and opportunities will also be discussed. Including the team's (current) journey toward the launch of a spinout company with a product that they believe will offer safe, reliable and cost-effective track switching for railways.

Dr. Steinert Olof (olof.steinert@scania.com)

Title Harnessing Data for Predictive Maintenance and Collaboration, Boost Innovation.

Abstract

Explore how Scania is unlocking the future of transports through the strategic use of connected data. Discover how predictive maintenance and remote issue diagnosis are key components in preventing unexpected downtimes in connected, electrified and autonomous transport solutions. The talk underscores the significance of data sharing for fostering faster collaboration and innovation within the research community.

Key takeaways

- Practical strategies for leveraging connected data to implement predictive maintenance and data-driven diagnostics effectively.

- Understanding the strategic use of connected data not only enhances current transport operations but also future-proofs them against emerging challenges.

- Gain insights into why daring to share data is crucial for fostering innovation and collaboration.

Prof. Biao Huang (biao.huang@ualberta.ca)

Title Advancing Causal Analysis for Fault Detection and Root Cause Analysis in Process Systems Engineering

Abstract

Causality analysis, a well-established data-driven technique for root cause identification, has garnered extensive attention across multiple disciplines. Utilizing causal analysis tools, engineers can construct causal maps crucial for fault prediction and diagnostic applications. However, relying solely on conventional data analytics for reconstructing causal maps raises challenges associated with data quality. High-quality data are imperative to ensure the reliability of results. In causality analysis, issues stemming from data quality manifest as spurious causations and the failure to identify the existence of causations. While causal maps can be constructed based on expert knowledge and process flow diagrams, this approach may prove inadequate for complex and tightly integrated processes. The emerging field of physics-informed modelling offers a promising avenue, having been successfully applied in various domains. However, combining physics information with observed data for reconstructing causal maps remains a relatively unexplored challenge. Motivated by these considerations, we introduce a novel framework to reconstruct causal maps for linear time-invariant dynamical systems. This innovative approach integrates observed data with physics information, enhancing the reliability of identifying the sources of process faults. We will demonstrate the application of this physics-informed causal analytic tool through case studies involving two industrial process units: plantwide oscillation source identification and flooding prediction for a de-propane column. This framework represents a significant step towards bridging the gap between observed data and physics information, ensuring more robust causal analysis in complex industrial processes.

Prof. Ping Zhang (pzhang@eit.uni-kl.de)

Title Detection and Avoidance of Cyber Attacks on Industrial Control Systems

Abstract

In modern production plants, different system components like sensors, actuators and controllers are becoming more and more connected through communication networks. While the flexibility and the reconfigurability of the plants have been improved significantly, the vulnerability of industrial control systems to cyber-attacks has increased as well. How to effectively cope with cyber-attacks and significantly enhance the resilience of industrial plants to cyber-attacks has attracted much attention not only in academia but also in the industry and the regulatory authority in recent years. As an interdisciplinary research field, addressing these questions requires insights from control, communication, and computer engineering. In this talk, we shall at first analyse the risk of cyber-attacks and clarify some of the myths. Then the focus is put on how to detect challenging cyber-attacks early and reliably with the help of the control theory and fault diagnosis. After that, preventive measures such as encrypted control and monitoring will be explored. Benchmark studies on cyber-attack detection in critical infrastructure such as water treatment plants and water distribution networks underline the important contribution that can be made by the fault diagnosis technique to improving the cyber security of industrial control systems.

Key takeaways

- Gain insights into cyber risks in industrial control systems.
- Advanced strategies to detect challenging cyber-attacks in control systems early and reliably.
- Efficient defence-in-depth measures for better protection of industrial plants
- Practical examples of the application of fault diagnosis to cyber-attack detection in critical infrastructure.

Roundtable

Topic Gnosis for Maintenance: From Diagnosis to Prognosis and Health-Aware Control

Organisers

- *Vasso Reppa*. Maritime and Transport Technology Department, Delft University of Technology, Mekelweg 2, 2628CD, Delft, The Netherlands. Email: v.reppa@tudelft.nl.
- *Mayank S JHA*. CRAN, CNRS University of Lorraine. B.P. 70239 54506. VANDOEUVRE-LES-NANCY, FRANCE. Email: mayank-shekhar.jha@univ-lorraine.fr
- *Didier Theilliol*. CRAN, CNRS. University of Lorraine, B.P. 70239 54506. VANDOEUVRE-LES-NANCY, FRANCE. Email: didier.theilliol@univ-lorraine.fr

Abstract

Maintenance has always been essential for many engineering systems and processes. In several domains like transport (automotive, rail, maritime), the vision is to render maintenance automated using numerous sensors for monitoring and providing data and sophisticated algorithms to decide among others: (i) when to perform maintenance, (ii) which components need maintenance, (iii) whether we can prolong maintenance, (iv) how to optimize maintenance. To address these questions in real-time, a fault diagnosis procedure is important to detect the malfunctioning of a system, isolate the cause of malfunctioning, and if possible, identify the severity. The next step is to define the remaining useful life until the fault becomes a failure through a prognosis procedure. A great impact on the evolution of system malfunctioning can have the closed-loop operation of the system; it may delay or accelerate the evolution according to control decisions. How can we perform health management and maintenance of the system in an automatic control context, or how can we control a system in a health management and maintenance context (e.g. what if design)?

List of Panelists

1. *Vicenç Puig*, Professor at Technical University of Catalunya (UPC), Spain. URL: futur.upc.edu/VicencPuigCayuela
2. *Jin Jiang*, Professor at the University of Western Ontario, Canada. URL: cies-western-eng.ca/jjiang/home.htm
3. Alfredo Núñez, Professor at Delft University of Technology, the Netherlands. URL: www.tudelft.nl/staff/a.a.nunezvicencio

Roundtable Outcomes

- State-of-the-art (academia) and state-of-practice (industry) methods for maintenance, prognosis, and health-aware control
- Health aware control and its development in industry/academia, and its relationship with fault tolerant control
- Relationship between (i) predictive maintenance and prognosis, (ii) predictive maintenance and diagnosis/monitoring, (iii) prognosis and closed loop control
- Challenges (of implementation) of predictive maintenance, prognosis, and health-aware control
- Presentation of most popular industrial use cases of health-aware control.

IFAC Safeprocess 2024 Benchmark Competition

LiU-ICE Industrial Fault Diagnosis Benchmark — Anomaly Detection and Fault Isolation with Incomplete Data

Organizers: Daniel Jung, Eric Frisk

Benchmark Description

A common challenge in designing diagnosis systems in industrial applications is limited data availability from relevant fault scenarios and a lack of knowledge of model uncertainty. The development of fault diagnosis design techniques in this situation is the theme of the competition. The case study is the airflow of an internal combustion engine. The complexity of modelling the engine combined with noisy measurements makes it a challenging system to diagnose because of its non-linear dynamic behaviour and wide operating range.
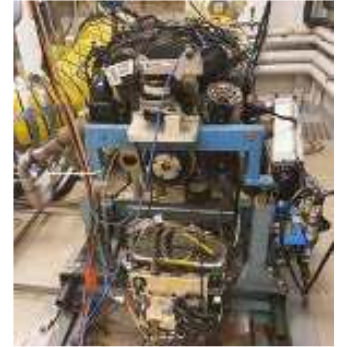
Competition Objectives

- Design a diagnosis system that can detect faults and identify the cause of the abnormal behaviour.

- Handle that the availability of representative data from all fault scenarios and fault sizes is limited.

- The solution should handle unknown faults.

Problem Statement

- Data is collected from both nominal and faulty behaviour during the transient operation of the process. The set of available actuator and sensor signals corresponds to the standard signals that are available in a commercial vehicle.

- Considered faults include leakage and sensor faults. Each dataset in training data represents one fault scenario with almost 30 minutes of operational data sampled in 20Hz.

- A system description in the form of a state-of-the-art analytical model where model parameters are unknown.
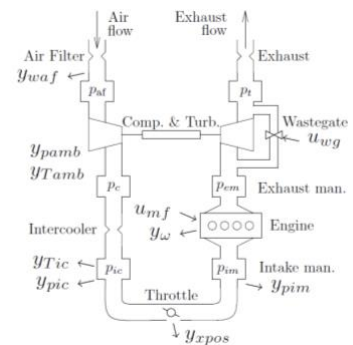
Evaluation Criteria

- False alarm rate/Missed detection rate/Mean detection delay

- Fault isolation accuracy

- Computation time

Benchmark Competition Award

Further information for competition participants is found on the benchmark homepage: https://vehsys.gitlab-pages.liu.se/diagnostic_competition/. The main outcomes of the competition and the best solutions provided by the participants will be summarised in the Invited Session FrD1 - LiU-ICE Benchmark Competition and awarded on Friday 7th June during the closing ceremony of the SAFEPROCESS 2024 symposium.

Useful Information

Registration Desk

The desk located on the ground floor of the Civic Theatre (Teatro Comunale di Ferrara, www.teatrocomunaleferrara.it/en/) will be open from 5th to 7th June 2024 during the working hours of the symposium. All attendees must be registered and will receive a badge together with the registration package.

Internet Access

All participants have access to the free wireless Internet connection of the Civic Theatre, by using the access codes provided at the registration desk.

Refreshments and lunches

Two refreshments and coffee breaks and one lunch per day will take place in the Small Theatre Hall on the first floor of the Civic Theatre (symposium venue) in Ferrara.

Gala Dinner

The dinner, together with the planned social activities, will be held at one of the former Civic Theatres ('ex Teatro Verdi', https://laboratorioapertoferrara.it/), which will be easily reached by walking from the Civic Theatre (symposium venue) after the end of the technical sessions at 6:30 pm on June 6th, 2024. The 'ex Teatro Verdi' is located in the oldest city centre of Ferrara at the address: Via Castelnuovo, 10, 44121 Ferrara FE.

Symposium Awards

- *Paul M. Frank Award*: The University of Duisburg-Essen has established an award in memory of Professor Paul M. Frank who was one of the pioneers and great contributors to the fault diagnosis area. It will be given to the best theoretical contribution by considering paper and oral presentation.

- *Best Student/Application Paper Awards*: The Symposium also offers two awards for the best student and application /case study papers. A selected committee will evaluate all candidates, and the winners will be announced during the Symposium.

The three recognitions are funded by the Consorzio Futuro in Ricerca (CFR) and the Department of Engineering of the University of Ferrara.

Members of the Award Committee

Cristina Verde Rodarte (MX, Chair), Christopher Berenguer (FR), Vicent Cocquempot (FR), Vicent Compostel (FR), Steven X. Ding (DE), Erik Frisk (SE), Phillippe Goupil (FR), Josef Korbicz (PL).

Symposium Venue

The symposium will be held from 5th to 7th June at the Civic Theatre of Ferrara, Teatro Comunale di Ferrara (address: Corso Martiri della Libertà, 5, 44121 Ferrara FE, Italy). It has a capacity of about 700 people. Three rooms host the technical sessions, keynote speeches and the roundtable: the main stage (capacity 250 persons), the small theatre (capacity 150 persons), and the rehearsal room (capacity 50 persons). The maps and plans of the symposium venue are depicted below.
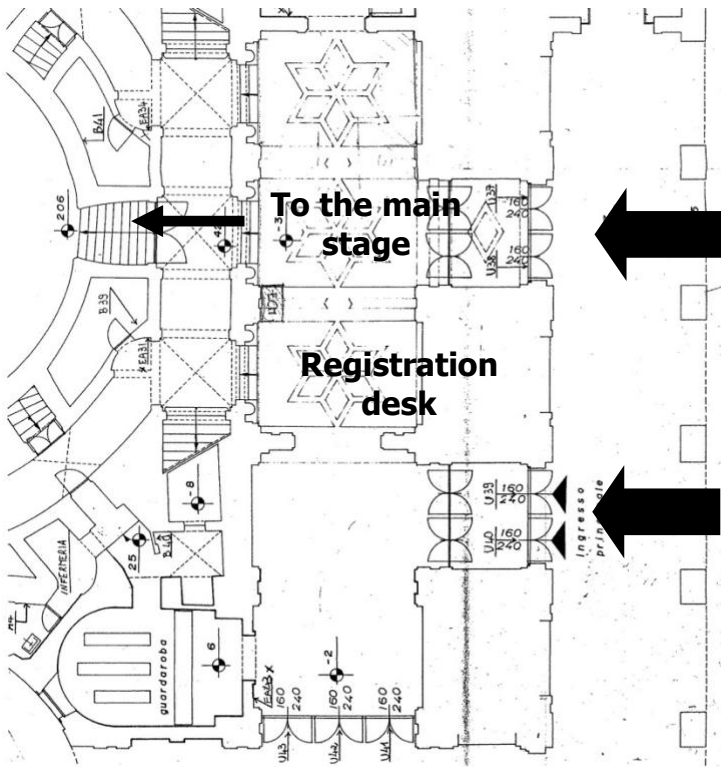
Theatre main entrance from Corso Martiri della Libertà
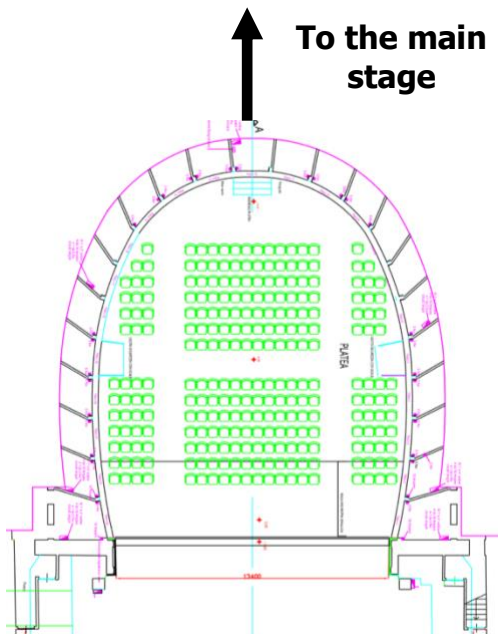
From the Theatre entrance to the Main Stage inner view.

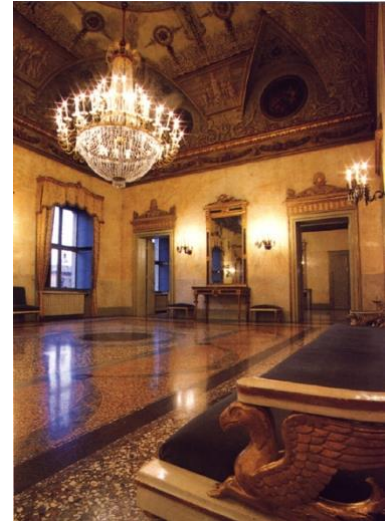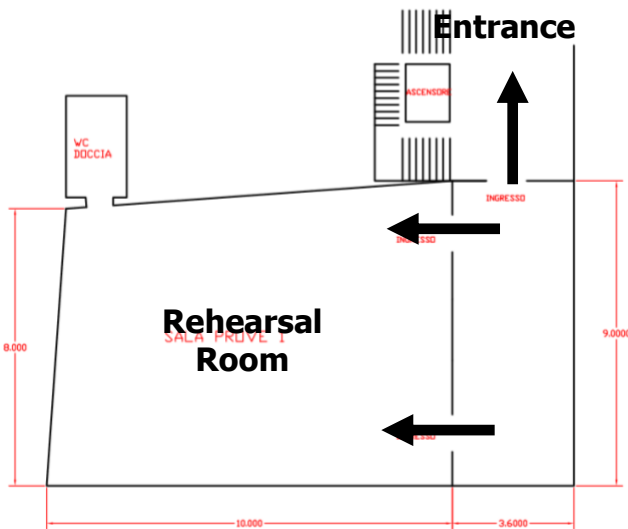First floor: Small Sheatre and a detail of its inner view.

First floor: Rehearsal Room and a detail of its inner view.

Symposium Program at a Glance, 5 – 7 June 2024

Wednesday 5th June 2024

08:30-09:00 **Main Stage** *Opening Ceremony*		
09:00-10:00 **Main Stage** **Plenary Session We1P** *Ron J. Patton: Offshore Wind Turbine Rotor Imbalance, a Fault Tolerant Control Problem*		
10:00-10:15 **Small Theatre** *Coffee Break*		
10:15-12:15 **Main Stage** **Invited Session WeB1** *AI Enhanced Fault Detection, Supervision and Safety of Technical Processes I*	10:15-12:15 **Small Theatre** **Invited Session WeB2** *Fault Diagnosis and Fault Tolerant Control for Safety of Marine Systems*	10:15-12:15 **Rehearsal Room** **Invited Session WeB3** *Hydraulic Systems: Advanced Detection and Security*
12:15-13:30 **Small Theatre** *Lunch*		
13:30-14:30 **Main Stage** **Plenary Session We2P** *Christophe Combastel: Reachability and Filtering for Safe Processes: From Zonotopes to Functional Sets with Typed Symbols*		
14:30-16:10 **Main Stage** **Regular Session WeD1** *Fault Diagnosis for Aerospace Systems*	14:30-16:10 **Small Theatre** **Regular Session WeD2** *FDI for Vehicles and Traction Systems*	14:30-16:10 **Rehearsal Room** **Regular Session WeD3** *Prognostic Methods and Predictive Maintenance*
16:10-16:25 **Small Theatre** *Coffee Break*		
16:25-18:25 **Main Stage** **Invited Session WeE1** *AI Enhanced Fault Detection, Supervision and Safety of Technical Processes II*	16:25-18:25 **Small Theatre** **Regular Session WeE2** *Advanced Vehicle Fault Diagnosis*	16:25-18:25 **Rehearsal Room** **Regular Session WeE3** *System Monitoring and Maintenance*

Thursday 6th June 2024

08:30-09:30 **Main Stage** **Plenary Session Th1P** *Roger Dixon: Fault Tolerance in Railways: The Evolution of a Radical Next Generation Track Switch*		
09:30-09:45 **Small Theatre** *Coffee Break*		
09:45-11:45 **Main Stage** **Invited Session ThB1** *Advance of Fault-Tolerant Estimation and Control*	09:45-11:45 **Small Theatre** **Regular Session ThB2** *Estimation and Filtering Methods for Fault Diagnosis*	09:45-11:45 **Rehearsal Room** **Regular Session ThB3** *Structural Methods for Fault Diagnosis*
11:45-13:00 **Small Theatre** *Lunch*		
13:00-14:00 **Main Stage** **Plenary Session Th2P** *Olof Steinert: Harnessing Data for Predictive Maintenance and Collaboration, to Boost Innovation*		
14:00-16:00 **Main Stage** **Regular Session ThD1** *Artificial Neural Networks for Fault Diagnosis*	14:00-16:00 **Small Theatre** **Regular Session ThD2** *Health Monitoring and Fault Diagnosis Applications*	14:00-16:00 **Rehearsal Room** **Regular Session ThD3** *Fault Diagnosis for Nonlinear Systems*
16:00-16:15 **Small Theatre** *Coffee Break*		
16:15-18:15 **Main Stage** **Regular Session ThE1** *Estimation and Filtering Methods for FDI Applications*	16:15-18:15 **Small Theatre** **Regular Session ThE2** *Cybersecurity & Cyber Attack Solutions*	16:15-18:15 **Rehearsal Room** **Round Table Discussion ThE3** *Round Table: Gnosis for Maintenance: From Diagnosis to Prognosis and Health Aware Control*
18:30-23:00 *Gala Dinner* **Ex Teatro Verdi** Via Castelnuovo, 10, 44121 Ferrara (FE), Italy		

Friday 7th June 2024

08:45-09:45 **Main Stage** **Plenary Session Fr1P** *Biao Huang: Advancing Causal Analysis for Fault Detection and Root Cause Analysis in Process Systems Engineering*		
09:45-10:00 **Small Theatre** *Coffee Break*		
10:00-12:00 **Main Stage** **Regular Session FrB1** *Model Predictive and Reconfigurable Control*	10:00-12:00 **Small Theatre** **Regular Session FrB2** *Process Safety*	10:00-12:00 **Rehearsal Room** **Regular Session FrB3** *Wind and Wave Energy System*
12:00-13:15 **Small Theatre** *Lunch*		
13:15-14:15 **Main Stage** **Plenary Session Fr2P** *Ping Zhang: Detection and Avoidance of Cyber Attacks on Industrial Control Systems*		
14:15-16:15 **Main Stage** **FrD1** *LiU-ICE Benchmark Competition*	14:15-16:15 **Small Theatre** **Regular Session FrD2** *FDI for Discrete Event and Hybrid Systems*	14:15-16:15 **Rehearsal Room** **Regular Session FrD3** *Fault Detection and Isolation for Linear Systems*
16:15-16:30 **Small Theatre** *Coffee Break*		
16:30-18:10 **Main Stage** **FrE1** *No Session*	16:30-18:10 **Small Theatre** **Regular Session FrE2** *Fault-Tolerant and Reconfigurable Control*	16:30-18:10 **Rehearsal Room** **Regular Session FrE3** *Fault Diagnosis in Electromechanical Systems*
18:10 – 18:30 **Main Stage** *Closing Ceremony*		

Symposium Technical Program

Wednesday 5th June 2024

9:00 – 10:00 We1P	**Plenary Session, Main Stage** Chair: Simani, Silvio Co-Chair: Dallabona, Alessio
	Ron J. Patton *Offshore Wind Turbine Rotor Imbalance, a Fault Tolerant Control Problem*

10:15 – 12:15 WeB1	**Invited Session, Main Stage** *AI Enhanced Fault Detection, Supervision and Safety of Technical Processes I* Chair: Biswas, Gautam Co-Chair: Blesa, Joaquim Organizers: Chanthery Elodie, Travé-Massuyès Louise
10:15-10:35, WeB1.1	*Tree Based Diagnosis Enhanced with Meta Knowledge Applied to Dynamic Systems** by Goupil, Louis, Travé-Massuyès Louise, Chanthery Elodie, Kohler Thibault, Delautier Sébastien
10:35-10:55, WeB1.2	*Making Systems Fail-Aware: A Semi-Supervised Machine Learning Approach for Identifying Failures by Learning the Correct Behavior of a System** by Mühlburger Herbert, Wotawa Franz
10:55-11:15, WeB1.3	*Diagnosis Driven Anomaly Detection for Cyber-Physical Systems* by Steude Henrik Sebastian, Moddemann Lukas, Diedrich Alexander, Ehrhardt Jonas, Niggemann Oliver
11:15-11:35, WeB1.4	*Data Preprocessing for Utilizing Simulation Models for ML-Based Diagnosis** by Kaufmann David, Wotawa Franz
11:35-11:55, WeB1.5	*Leakage Detection and Estimation Using a Genetic Algorithm-High Order Sliding Modes Observer Hybrid Approach** by Pumaricra David, Pérez Zuñiga Gustavo, Sotomayor Moriano Javier
11:55-12:15, WeB1.6	*Fault Diagnosis Using Interval Data-Driven LPV Observers and Structural Analysis** by Fang Xin, Blesa Joaquim, Puig Vicenç

10:15 – 12:15 WeB2	**Invited Session, Small Theatre** *Fault Diagnosis and Fault Tolerant Control for Safety of Marine Systems* Chair: Berenguer, Christophe Co-Chair: Shahnazi, Reza Organizers: Reppa Vasso, Blanke Mogens, Monteriù Andrea
10:15-10:35, WeB2.1	*A Multiple Sensor Fault Diagnosis Scheme for Autonomous Surface Vessels** by Dhyani Abhishek, Negenborn Rudy, Reppa Vasso
10:35-10:55, WeB2.2	*ESO-Based Fault-Tolerant Funnel Heading Control of Surface Vessels** by Shahnazi Reza, Kurowski Martin, Eisenblätter Nick, Jeinsch Torsten

10:55-11:15, WeB2.3	*Active Thruster Fault Diagnosis for an Overactuated Autonomous Surface Vessel** by Tsolakis Anastasios, Ferranti Laura, Reppa Vasso
11:15-11:35, WeB2.4	*Sensor Set Decomposition for Enhanced Distributed Sensor Fault Isolability of Marine Propulsion Systems** by Kougiatsos Nikos, Reppa Vasso
11:35-11:55, WeB2.5	*A Survey on Data-Driven Fault Diagnostic Techniques for Marine Diesel Engines* by Youssef Ayah, Noura Hassan, El Amrani Abderrahim, El Adel El Mostafa, Ouladsine Mustapha
11:55-12:15, WeB2.6	*Actuator Fault Tolerant Control for a Remotely Operated Vehicle Based on Adaptive Extended Kalman Filter** by Baldini Alessandro, Felicetti Riccardo, Freddi Alessandro, Monteriù Andrea

10:15 – 12:15 WeB3	**Invited Session, Rehearsal Room** *Hydraulic Systems: Advanced Detection and Security* Chair: Kallesøe, Carsten Skovmose Co-Chair: Verde, Cristina Organizers: Torres Lizeth, Duviella Eric, Blesa Joaquim
10:15-10:35, WeB3.1	*Nodal Hydraulic Head Estimation through Unscented Kalman Filter for Data-Driven Leak Localization in Water Networks** by Romero Ben Luis, Irofti Paul, Stoican Florin, Puig Vicenç
10:35-10:55, WeB3.2	*Identification Algorithm for Simultaneous Leaks in a Pipeline** by Peralta Jesús, Verde Cristina
10:55-11:15, WeB3.3	*Leak Localization in an Urban Water Distribution Network Using a LSTM Deep Neural Network** by Gómez Coronel Leonardo, De Los Santos Ruiz Ildeberto, Blesa Joaquim, Puig Vicenç, López Estrada Francisco Ronay
11:15-11:35, WeB3.4	*EKF-Based Algorithm for Two-Simultaneous-Leak Diagnosis in Pipelines** by Delgado Aguiñaga Jorge Alejandro, Besancon Gildas, Begovich Ofelia
11:35-11:55, WeB3.5	*Topological Data Analysis-Based Replay Attack Detection for Water Networks** by Kuskonmaz Bulut, Wisniewski Rafal, Kallesøe Carsten Skovmose
11:55-12:15, WeB3.6	*Cyber-Attack and Fault Detection Using a Digital Twin of the Controller Software** by Kallesøe Carsten Skovmose, Wisniewski Rafal

13:30 – 14:30 We2P	**Plenary Session, Main Stage** Chair: Travé-Massuyès Louise Co-Chair: Bauer Peter
	Christophe Combastel *Reachability and Filtering for Safe Processes: From Zonotopes to Functional Sets with Typed Symbols*

14:30 – 16:10 WeD1	Regular Session, Main Stage *Fault Diagnosis for Aerospace Systems* Chair: Goupil, Philippe Co-Chair: Verhaegen, Michel

14:30-14:50, WeD1.1	*Optical Flow-Based Vertical Angular Rate Fault Detection on UAVs* by Jevuczo Gabor, Bauer Peter
14:50-15:10, WeD1.2	*Simultaneously Identifying the System Dynamics and Fault Isolation for Air Data Sensor Failures: A Convex Approach* by Noom Jacques, de Visser Cornelis. C., Ramesh Nirupama Sai, Verhaegen Michel
15:10-15:30, WeD1.3	*An Integrated Method for Early and Robust Detection of Oscillatory Failure Cases in Flight Control Systems* by Yu Jingfei, Chang Jing, Chen Weisheng, Cieslak Jérôme, Ossmann Daniel
15:30-15:50, WeD1.4	*Aeroengine Actuator Fault Detection and Estimation Via Combined Model Observers* by Alseiari Sara Khalifa, Cen Zhaohui, Youssef Heba, Tsoutsanis Elias
15:50-16:10, WeD1.5	*Mono Camera-Based GPS Spoofing Detection for Aerial Vehicles* by Petró Péter, Bauer Peter

14:30 – 16:10 WeD2	Regular Session, Small Theatre *FDI for Vehicles and Traction Systems* Chair: Fényes, Dániel Co-Chair: Blanke, Mogens

14:30-14:50, WeD2.1	*Set-Based Estimation of Battery End of Discharge for Electric Vehicles* by Zhang Shuang, Puig Vicenç, Ifqir Sara
14:50-15:10, WeD2.2	*Fault Estimation Observers for the Vehicle Suspension with a Varying Chassis Mass* by Tran Gia Quoc Bao, Pham Thanh-Phong, Sename Olivier
15:10-15:30, WeD2.3	*On the Problem of On-Board Risk Assessment for Railway Hunting: An Exploratory Study* by Kritikakos Kyriakos, Fassois Spilios D., Sakellariou John S.
15:30-15:50, WeD2.4	*Safe and Fault Tolerant Control of Industrial Differential Drive Vehicles* by Racanelli Vito Andrea, Mascolo Saverio
15:50-16:10, WeD2.5	*Toward Enhancing Security in Intelligent Transportation: A Simulation-Based Approach* by A. Ali Wasim, Mangini Agostino Marcello, Julvez, Jorge, Mahulea Cristian, Fanti Maria Pia

14:30 – 16:10 WeD3	**Regular Session, Rehearsal Room** *Prognostic Methods and Predictive Maintenance* Chair: Quinones-Grueiro, Marcos Co-Chair: Verde, Cristina
14:30-14:50, WeD3.1	*Physics-Defined HMM Model for Reusable LPRE Bearing Remaining Useful Life Estimation* by Galli Federica, Sircoulomb Vincent, Weber Philippe, Hoblos Ghale, Fiore Giuseppe
14:50-15:10, WeD3.2	*An Integrated Monitoring System Based on Deep Learning Tools for Industrial Process* by Rodríguez-Ramos Adrián, Verde Cristina, Llanes-Santiago Orestes
15:10-15:30, WeD3.3	*Sustainability in Semiconductor Production Via Interpretable and Reliable Predictions* by Fathi Kiavash, Stramaglia Maria Elena, Ristin Marko, Sadurski Marcin, Kleinert Tobias, Schönfelder Robert, van de Venn Hans Wernher
15:30-15:50, WeD3.4	*Comparison of Transfer Learning Techniques for Building Energy Forecasting* by Das Sharma Shansita, Coursey Austin, Quinones-Grueiro Marcos, Biswas Gautam
15:50-16:10, WeD3.5	*System Identification for Battery State Prediction and Lifespan Estimation* by Li Chenyi, Zhang Long

16:25 – 18:25 WeE1	**Invited Session, Main Stage** *AI Enhanced Fault Detection, Supervision and Safety of Technical Processes II* Chair: Liu, Qiang Co-Chair: Frisk, Erik Organizers: Chanthery Elodie, Travé-Massuyès Louise
16:25-16:45, WeE1.1	*Anticipation, Earliness, Alarm Cardinality: A New Metric for Industrial Time-Series Anomaly Detection** by Dion Raphaël, Alamir Mazen, Le Magueresse Thibaut
16:45-17:05, WeE1.2	*Dynamic Reconstruction Feature-Based Graph Attention Networks for Semi-Supervised Process Fault Diagnosis* by Yan Peng, Liu, Qiang
17:05-17:25, WeE1.3	*Self-Supervised Graph Structure Learning for Cyber-Physical Systems* by Augustin Jan Lukas, Niggemann Oliver
17:25-17:45, WeE1.4	*Fault Diagnosability Analysis of Multi-Mode Systems* by Hashemniya Fatemeh, Caillaud Benoît, Frisk Erik, Krysander Mattias, Malandain Mathias
17:45-18:05, WeE1.5	*End of Life Detection of Li-Ion Primary Cell Battery Based on Closed-Loop Voltage and Ambient Temperature** by Aboulfadl Rania, Roman Christophe, Graton Guillaume, Ouladsine Mustapha
18:05-18:25, WeE1.6	*A Flexible Data-Driven Prognostics Model Using System Performance Metrics** by Diaz-Gonzalez Abel, Coursey Austin, Quinones-Grueiro, Marcos, Biswas Gautam

16:25 – 18:05 WeE2	Regular Session, Small Theatre *Advanced Vehicle Fault Diagnosis* Chair: Fassois, Spilios D. Co-Chair: Karimi, Hamid Reza
16:25-16:45, WeE2.1	*Safe Vehicle Motion Design with Learning for Moving in Environment with Uncertainties* by Tompos Denes, Nemeth Balazs, Hegedűs Tamás, Vu Van Tan, Gaspar Peter
16:45-17:05, WeE2.2	*Fault Tolerant Control of a Bio-Inspired UAV Using Sliding Mode* by Ma Tianle, Alwi Halim, Edwards Christopher
17:05-17:25, WeE2.3	*Modeling of Autonomous Vehicle Based on Multiscale Reduced Kernel Principal Component Analysis* by Jamii Jannet, Nasri Romdhane, Mansouri Majdi, Mimouni Mohamed Fouzi, Nounou Hazem, Puig Vicenç
17:25-17:45, WeE2.4	*Scalable Data-Based Diagnostic Concept - Introduction and Application in Automotive Field* by Schmitz Andreas, Decker Marco, Guehmann Clemens, Serway Roland
17:45-18:05, WeE2.5	*Fault Diagnosis and Identification in AGVs System* by Bertoli Annalisa, Battilani Nicola, Fantuzzi Cesare

16:25 – 18:25 WeE3	Regular Session, Rehearsal Room *System Monitoring and Maintenance* Chair: Lan, Jianglin Co-Chair: Casavola, Alessandro
16:25-16:45, WeE3.1	*An Approach to Secret Sharing Based Secure Remote Monitoring* by Sun Jie, Zhang Ping, Shen Bo
16:45-17:05, WeE3.2	*Runtime Monitoring and Fault Detection for Neural Network-Controlled Systems* by Lan Jianglin, Zhan Siyuan, Patton Ron J., Zhao Xianxian
17:05-17:25, WeE3.3	*A Shape-Based Monitoring Method for Variable Trajectories of Finishing Mill Processes* by Wang Yilin, Zhang Tongshuai, Ye Hao, Xiong Zhihua, He Xiao
17:25-17:45, WeE3.4	*Synthetic Generation of Streamed and Snapshot Data for Predictive Maintenance* by Safdari Arezou, Frisk Erik, Holmer Olov, Krysander Mattias
17:45-18:05, WeE3.5	*RAPM-Based Selective Preventive Maintenance to Improve Availability for Series-Parallel Systems* by Liao Jing, Peng Tao, Xu Yansong, Chen Zhiwen, Gui Weihua

Thursday 6th June 2024

8:30 – 9:30 Th1P	Plenary Session, Main Stage Chair: Puig, Vicenç Co-Chair: Reppa, Vasso
	Roger Dixon *Fault Tolerance in Railways: The Evolution of a Radical Next Generation Track Switch*

9:45 – 11:45 ThB1	Invited Session, Main Stage *Advance of Fault-Tolerant Estimation and Control* Chair: Combastel, Christophe Co-Chair: Chadli, Mohammed Organizers: Jiang Bin, Polycarpou Marios M., Meng Qingkai
09:45-10:05, ThB1	*A Virtual Actuator and Sensor Approach for Event-Triggered Fault-Tolerant Control of Multi-Agent Systems** by Wang Zeyuan, Chadli Mohammed
10:05-10:25, ThB1	*A Stackelberg Differential Game-Based Optimal Fault-Tolerant Control Method for Over-Actuated Systems** by Ni Yuan, Yang Hao, Xu Yuhang, Jiang Bin, Lu Ningyun
10:25-10:45, ThB1.3	*Fault-Tolerant Safe Control for Water Networks: An Interconnected Switched System Approach** by Meng Qingkai, Vrachimis Stelios, Polycarpou Marios M.
10:45-11:05, ThB1.4	*Inverse PageRank-Based Fault Propagation Analysis of Production Lines under Multiple Uncertain Performance Indicators* by Huang Shoujin, Huang Binda, Jiang Bin, Lu Ningyun, Ma Yajie, Li Ronghua, Du Wei, Cao Jie
11:05-11:25, ThB1.5	*Data-Driven Adaptive Fault--Tolerant Control for Floating Offshore Wind Turbines** by Simani Silvio, Ping Lam Yat
11:25-11:45, ThB1.6	*Synergetic Decomposition of Input-Output Dependency for Control System Intelligent Monitoring: A Perspective from Information Theory** by Chen Xu, Ren Jiayi, Zhao Chunhui

9:45 – 11:45 ThB2	Regular Session, Small Theatre *Estimation and Filtering Methods for Fault Diagnosis* Chair: Lopez-Estrada, Francisco-Ronay Co-Chair: Hajiyev, Chingiz
09:45-10:05, ThB2.1	*A Kernel-Based Approach to Data-Driven Actuator Fault Estimation* by Sheikhi Mohammad Amin, Mohajerin Esfahani Peyman, Keviczky Tamas
10:05-10:25, ThB2.2	*A Distributionally Robust Approach to Active Fault Detection for Linear Stochastic Dynamic Systems* by Xue Ting, Zhao Dong, Li Linlin, Li Yueyang, Zhong Maiying
10:25-10:45, ThB.2.3	*Constrained Multi-Output Gaussian Process Regression for Data Reconciliation* by Horak Wessel, Louw Tobi, Bradshaw Steven

10:45-11:05, ThB2.4	*Spectral Conditioning within the Energy Graph-Based Visualisation Fault Detection Method* by Wolmarans Wikus, van Schoor George, Uren Kenneth Richard
11:05-11:25, ThB2.5	*Adaptive Filtering against Sensor/Actuator Faults* by Hajiyev Chingiz
11:25-11:45, ThB2.6	*Fault Detection Statistics in the Presence of Additive Measurement Errors* by Hajiyev, Chingiz

9:45 – 11:45 ThB3	**Regular Session, Rehearsal Room** *Structural Methods for Fault Diagnosis* Chair: Cocquempot, Vincent Co-Chair: Krysander, Mattias
09:45-10:05, ThB3.1	*Structural Analysis of a Rocket's Multi-Engine Propulsion Cluster for Fault Detection and Isolation* by Murata Renato, Gibart Jules, Marzat Julien, Piet-Lahanier Helene, Boujnah Sandra, Farago François
10:05-10:25, ThB3.2	*Improving Residual Robustness to Noise for Fault Localization in a Y-Shaped Network* by Abdel Karim, Cocquempot Vincent, Atoui M. Amine Laly Pierre, Degardin Virginie
10:25-10:45, ThB3.3	*Fuel Injection Fault Diagnosis Using Structural Analysis and Data-Driven Residuals* by Allansson Niklas, Mohammadi Arman, Jung Daniel, Krysander Mattias
10:45-11:05, ThB3.4	*Model-Based Sensor Fault Detection and Diagnosis in Closed-Loop Power Converters for Electric Vehicles* by Ajra Youssef, Hoblos Ghaleb, Al Sheikh Hiba, Moubayed Nazih
11:05-11:25, ThB3.5	*Data-Driven Soft Sensor Based on Sparse Relational Graph Attention Network for Hot Strip Mill Process* by Li Kang, Gao Xiaoyong, Xue Jianye, Ye Hao, Zhang Laibin
11:25-11:45, ThB3.6	*A Deductive Fault Analysis Method Based on Hypergraphs* by Vitucci Carlo, Westerbäck Thomas, Sundmark Daniel, Forsberg Håkan, Nolte Thomas, Jägemar, Marcus

13:00 – 14:00 Th2P	**Plenary Session, Main Stage** Chair: Frisk, Erik Co-Chair: Ossmann, Daniel
	Olof Steinert *Harnessing Data for Predictive Maintenance and Collaboration, to Boost Innovation*

14:00 – 16:00 ThD1	**Regular Session, Main Stage** Artificial Neural Networks for Fault Diagnosis Chair: Mazzoleni, Mirko Co-Chair: Djeziri, Mohand Arab
14:00-14:20, ThD1.1	*Novel Stack Autoencoder and Its Application to Industrial Fault Diagnosis* by Lu Zi-Yang, He Yan-Lin, Zhu Qun-Xiong

14:20-14:40, ThD1.2	*Stacked AutoEncoder Based Diagnosis Applied on a Solar Photovoltaic System* by Bougoffa Mouaad, Benmoussa Samir, Djeziri Mohand Arab, Thierry Contaret
14:40-15:00, ThD1.3	*Enhancing Fault Detection in Nonlinear Industrial Processes: A Reduced Kernel Principal Component Analysis-Based Spectral Clustering Approach* by Attouri Khadija, Mansouri Majdi, Hajji Mansour, Abdelmalek Kouadri, Bouzrara Kais, Nounou Hazem
15:00-15:20, ThD1.4	*A Novel Kernel Based Domain Adaption Neural Network for Fault Diagnosis of Aero Gas Turbine* by Li Bing, Zhao Yuxiang, Wu Lan, Yao Yuan, Fu Yuhui
15:20-15:40, ThD1.5	*Genetic Algorithm-Based Hyperparmeter Optimization of Deep Learning for Fault Diagnosis* by Hichri Amal, Hajji Mansour, Mansouri Majdi, Abdelmalek Kouadri, Bouzrara, Kais, Nounou Hazem
15:40-16:00, ThD1.6	*Kernel Principal Component Analysis Improvement Based on Data-Reduction Via Class Interval* by Kaib Mohammed, Abdelmalek Kouadri, Harkat Mohamed-Faouzi, Bensmail Abderazak, Mansouri Majdi, Nounou Mohamed

14:00 – 16:00 ThD2	**Regular Session, Small Theatre** *Health Monitoring and Fault Diagnosis Applications* Chair: Puncochar, Ivo Co-Chair: Biswas, Gautam
14:00-14:20, ThD2.1	*A Step Towards Implementation of State Observers in Industrial Aluminium Smelters* by Mattioni Andrea, da Silva Moreira Lucas José, Roustan Herve Yves Guy Bernard Louis, Besancon Gildas, Fiacchini Mirko
14:20-14:40, ThD2.2	*A Two-Stage Machine Learning-Aided Approach for Quench Identification at the European XFEL* by Boukela Lynda, Eichler Annika, Branlard Julien, Jomhari Nur Zulaiha
14:40-15:00, ThD2.3	*Leak Detection for Household Pipelines Based on a Smart Valve with Single Pressure and Flow Sensors* by Cesani Davide, Mazzoleni Mirko, Previdi Fabio
15:00-15:20, ThD2.4	*Intelligent Monitoring and Optimal Control of HVAC System and Its Cloud-Edge Implementation* by Deng Qiao, Chen Zhiwen, Zhu Wanting, Li Zefan, Yuan Yifeng, Li Xinhong, Jiang Zhaohui, Yin Shen, Chunhua Yang, Gui Weihua
15:20-15:40, ThD2.5	*CNN-Based Temperature Dynamics Approximation for Burning Rooms* by Liebert Artur, Palani Arulnambi, Rensmeyer Tim, Breuer Michael, Niggemann Oliver
15:40-16:00, ThD2.6	*Time-Series Few Shot Anomaly Detection for HVAC Systems* by Huang Yuxin, Coursey Austin, Quinones-Grueiro Marcos, Biswas Gautam

14:00 – 16:00 ThD3	**Regular Session, Rehearsal Room** *Fault Diagnosis for Nonlinear Systems* Chair: Puig, Vicenç Co-Chair: Previdi, Fabio
14:00-14:20, ThD3.1	*Discrete-Time Sliding Mode Control Based on Improved Decoupled Disturbance Compensator* by Bai Jianjun, Guan Yacun, Jiang Bin, Lin Yihao
14:20-14:40, ThD3.2	*Estimation of Cornering Stiffness Using Ultra-Local Model and LPV-Based Observer* by Fényes Dániel, Hegedűs Tamás, Gaspar Peter
14:40-15:00, ThD3.3	*A Zonotopic FDI Approach with LPV-Based EKF in Autonomous Vehicles* by Conejo Carlos, Puig Vicenç, Morcego Bernardo, Navas Francisco, Milanés Vicente
15:00-15:20, ThD3.4	*Enhancing Fault Diagnosis of Uncertain Grid-Connected Photovoltaic Systems Using Deep GRU-Based Bayesian Optimization* by Yahyaoui Zahra, Hajji Mansour, Mansouri Majdi, Abdelmalek Kouadri, Bouzrara Kais, Nounou Hazem
15:20-15:40, ThD3.5	*Adaptive Fault-Tolerant Tracking Control for MIMO Nonlinear Systems with Time-Varying Full State Constraints* by Chao Daikun, Qi Ruiyun, Soh Yeng Chai
15:40-16:00, ThD3.6	*The Scenario Approach for Data-Driven Prognostics* by Cesani Davide, Mazzoleni Mirko, Previdi Fabio

16:15 – 18:15 ThE1	**Regular Session, Main Stage** *Estimation and Filtering Methods for FDI Applications* Chair: Zhang, Ping Co-Chair: Shang, Chao
16:15-16:35, ThE1.1	*Identification of Relevant Symptoms of Performance Degradation in Industrial Machines* by Boni Pietro, Sala Roberto, Mazzoleni Mirko, Pirola Fabiana, Previdi Fabio
16:35-16:55, ThE1.2	*Fault Diagnosis of PEM Fuel Cells: An Assessment of Two Bayes' Filters* by Allam Abdulrahman, Mangold, Michael, Zhang Ping
16:55-17:15, ThE1.3	*Hydrogen Rate Prediction in Natural-Gas Pipes Supplying Industrial Machines in the Frame of Power-To-Gas Technology* by Djeziri Mohand Arab, Benmoussa Samir, Occelli Clément, Fiorido Tomas, Bendahan Marc, Seguin Jean-Luc
17:15-17:35, ThE1.4	*Research on Wireless Physical Layer Covert Channel Detection in MIMO Scenario* by Huang Shuhua, Bo Cuimei, Li Jun
17:35-17:55, ThE1.5	*Fast Trend Extraction of Industrial Process Data Based on Deep Bidirectional LSTM* by Liu Ju, Wang Yibo, Zhou Yifan, Shang Chao, Huang Dexian
17:55-18:15, ThE1.6	*Model-Based Head Losses Estimation for Hydropower Plants* by Alonso Augustin, Robert Gerard, Besancon Gildas

16:15 – 18:15 ThE2	**Regular Session, Small Theatre** *Cybersecurity & Cyber Attack Solutions* Chair: Bonfe, Marcello Co-Chair: Bartyś, Michał
16:15-16:35, ThE2.1	*Attack Isolation in a Water Treatment Plant* by Jia Mengsen, Zhang Ping
16:35-16:55, ThE2.2	*Modbus Vulnerability: Hard-To-Detect Sabotage Scenario* by Bartyś Michał, Włodarczyk Olgierd
16:55-17:15, ThE2.3	*Kullback–Leibler Divergence-Based Tuning of Kalman Filter for Bias Injection Attacks in an Artificial Pancreas System* by Tosun Fatih Emre, Teixeira André M.H., Ahlen Anders, Dey Subhrakanti
17:15-17:35, ThE2.4	*Adaptive Resilient Control for a Class of Strict-Feedback Nonlinear Systems under Replay Attacks* by He Wenjing, Shi Yukun, Wang Youqing
17:35-17:55, ThE2.5	*An Observer-Based Approach to Mitigation of Integrity Cyberattacks* by Zhou Liutao, Salah Abd A., Ding Steven X., Liu Tianyu
17:55-18:15, ThE2.6	*Attack Detection in Cyber-Physical Systems Via Nullspace-Based Filter Designs* by Ossmann Daniel

16:15 – 18:15 ThE3	**Round Table Discussion, Rehearsal Room** *Gnosis for Maintenance: From Diagnosis to Prognosis and Health Aware Control* Chair: Reppa, Vasso Co-Chair: Kougiatsos, Nikos
List of Panellists	• Vicenç Puig, Technical University of Catalunya (UPC), Spain • Jin Jiang, University of Western Ontario, Canada • Alfredo Núñez, Delft University of Technology, the Netherlands
Main Topics	- State-of-the-art (academia) and state-of-practice (industry) methods for maintenance, prognosis, and health-aware control - Results (expectations) of a maintenance method - Health-aware control and its development in industry/academia, and its relationship with fault-tolerant control - Relationship among (i) predictive maintenance and prognosis, (ii) predictive maintenance and diagnosis/monitoring, (iii) prognosis and closed loop control - Predictive maintenance and prognostics tasks as part of a controlled system considering nonlinear dynamics, uncertainties, and different time scales - Challenges (of implementation) of predictive maintenance, prognosis, and health-aware control - Presentation of most popular industrial use cases of health-aware control

Friday 7th June 2024

8:45 – 9:45 Fr1P	**Plenary Session, Main Stage** Chair: Verde, Cristina Co-Chair: Quinones-Grueiro, Marcos
	Biao Huang *Advancing Causal Analysis for Fault Detection and Root Cause Analysis in Process Systems Engineering*

10:00 – 12:00 FrB1	**Regular Session, Main Stage** *Model Predictive and Reconfigurable Control* Chair: Verde, Cristina Co-Chair: Boem, Francesca
10:00-10:20, FrB1.1	*Hierarchical Fault-Tolerant Coverage Control for an Autonomous Aerial Agent* by Papaioannou Savvas, Vitale Christian, Kolios Panayiotis, Panayiotou Christos, Polycarpou Marios M.
10:20-10:40, FrB1.2	*Enhancing Fault Diagnosis in Process Industries with Internal Variables of Model Predictive Control* by Diallo Abdoul Rahime, Homri Lazhar, Dantan Jean-yves, Bonnet Frédéric, Boeuf Thomas
10:40-11:00, FrB1.3	*Resilience Countermeasures for Networked Control Systems under Denial-Of-Service Scenarios* by Franze Giuseppe, Lucia Walter, Tedesco Francesco
11:00-11:20, FrB1.4	*Privacy Preserving Approximated Optimal Control of Pasteurization Unit Using Homomorphic Encryption* by Dzurková Diana, Mészáros Olivér, Kaluz Martin
11:20-11:40, FrB1.5	*Model Predictive Control for Tumor Growth: Detection of Deviations and Therapeutic Implications* by Hernández-Rivera Andrés, Velarde Rueda Pablo, Zafra-Cabeza Ascension, Maestre Torreblanca, José María
11:40-12:00, FrB1.6	*Learning-Based MPC with Uncertainty Estimation for Resilient Microgrid Energy Management* by Casagrande Vittorio, Ferianc Martin, Rodrigues Miguel, Boem Francesca

10:00 – 12:00 FrB2	**Regular Session, Small Theatre** *Process Safety* Chair: Carpitella, Silvia Co-Chair: Jiang, Jin
10:00-10:20, FrB2.1	*Sustainable Supply Chain Control Strategies for the Natural Stone Market* by Azevedo Elen, Carpitella Silvia
10:20-10:40, FrB2.2	*Ageing in Process Industry: Identification of Material Degradation from past Accidents Analysis* by Vitale Morena, Shi Huxiao, Castro Rodriguez David Javier, Barresi Antonello, Demichela Micaela
10:40-11:00, FrB2.3	*Adding Smart Functions to an Industry-Grade Transducer for Process Fault Detection without Modifying Footprint* by Jiang Jin
11:00-11:20, FrB2.4	*A Modeling Approach of EFT Faults on In-Vehicle Communication Protocols Supported by FTA Analysis* by Pohren Daniel, Dos Santos Roque Alexandre, Pignaton de Freitas Edison, Pereira Carlos Eduardo

11:20-11:40, FrB2.5	*Short-Term Photovoltaic Power Forecasting Based Kernel Ridge Regression* by Marweni Manel, Hajji Mansour, Mansouri Majdi, Mimouni Mohamed Fouzi, Nounou, Mohamed
11:40-12:00, FrB2.6	*Sensor Fault Detection and Diagnosis: Methods and Challenges* by Jombo Gbanaibolou, Zhang Yu, Lu Ningyun

10:00 – 12:00 FrB3	**Regular Session, Rehearsal Room** *Wind and Wave Energy System* Chair: Martinez Molina, John J. Co-Chair: Simani, Silvio
10:00-10:20, FrB3.1	*Accommodating Sensor Faults in Wave Energy Optimal Control* by Papini Guglielmo, Faedo Nicolás, Matiazzo Giuliana
10:20-10:40, FrB3.2	*Neural Networks for Offshore Wind Turbine Converter Failure Prognosis* by Moros Demitri, Berrabah Nassif, Ashton Ian
10:40-11:00, FrB3.3	*Friction Estimation for Condition Monitoring of Wind Turbine Hydraulic Pitch System* by Dallabona Alessio, Blanke Mogens, Papageorgiou Dimitrios
11:00-11:20, FrB3.4	*Wind Turbine Blade Monitoring Via Deep Learning and Acoustic Aerodynamic Signals* by Ping Lam Yat, Simani Silvio
11:20-11:40, FrB3.5	*Current Sensor Fault Diagnosis of DFIG Wind Turbines Using an Extended Kalman Filter Observer: Experimental Validation* by Abbas Mohammed, Chafouk Houcine, Ardjoun Sid Ahmed El Mehdi
11:40-12:00, FrB3.6	*Evaluating the Effect of Control Gains on Wind Turbine Drive-Train Deterioration: An Experimental Study* by Romero Elena, Martinez Molina John J., Dumon Jonathan, Berenguer Christophe

13:15 – 15:15 Fr2P	**Plenary Session, Main Stage** Chair: Simani, Silvio Co-Chair: Quinones-Grueiro, Marcos
	Ping Zhang *Detection and Avoidance of Cyber Attacks on Industrial Control Systems*

14:15 – 16:15 FrD1	**Invited Session, Main Stage** *LiU-ICE Benchmark Competition* Chair: Jung, Daniel Co-Chair: Frisk, Erik
	LiU-ICE Industrial Fault Diagnosis Benchmark - Anomaly Detection and Fault Isolation with Incomplete Data

14:15 – 16:15 FrD2	**Regular Session, Small Theatre** *FDI for Discrete Event and Hybrid Systems* Chair: Chadli, Mohammed Co-Chair: Frey, Christian W.
14:15-14:35, FrD2.1	*The Effect of Graph Complexity in an Energy-Based FDI Approach* by Smith Jan-Hendrik, van Schoor George, Uren Kenneth Richard, Schäfer Thomas

14:35-14:55, FrD2.2	*Learning System Descriptions for Cyber-Physical Systems* by Diedrich Alexander, Moddemann Lukas, Niggemann Oliver
14:55-15:15, FrD2.3	*Hybrid Unsupervised Learning Strategy for Monitoring Industrial Batch Processes* by Frey Christian W.
15:15-15:35, FrD2.4	*Discret2Di - Deep Learning Based Discretization for Model-Based Diagnosis* by Moddemann Lukas, Steude Henrik Sebastian, Diedrich Alexander, Niggemann Oliver
15:35-15:55, FrD2.5	*Transforming Time Petri Nets into Heterogeneous Petri Nets for Hybrid System Monitoring* by Hatte Léonie, Ribot Pauline, Chanthery Elodie
15:55-16:15, FrD2.6	*V-Nets* by Vasquez John William, Pérez Zuñiga Gustavo, Rodriguez Leonardo

14:15 – 16:15 FrD3	**Regular Session, Rehearsal Room** *Fault Detection and Isolation for Linear Systems* Chair: Niemann, Henrik Co-Chair: Orchard, Marcos
14:15-14:35, FrD3.1	*A Novel Dynamical Model for Diagnosis, Prognosis and Health-Aware Control of Lithium-Ion Batteries* by Martinez Molina John J., Spinola Félix Mônica, Kulkarni Chetan, Orchard Marcos, Berenguer Christophe
14:35-14:55, FrD3.2	*Vector Based Fault Isolation in Closed-Loop Systems* by Niemann Henrik, Poulsen Niels Kjølstad
14:55-15:15, FrD3.3	*Distributed Data-Driven Fault Detection for Industrial Interconnected Systems with Unknown Topology Structure* by Gao Jingjing, Yang Xu, Zhou Xian, Li Qing, Huang Jian, Cui Jiarui
15:15-15:35, FrD3.4	*Active Fault Detection Based on Tensor Train Decomposition* by Puncochar Ivo, Straka Ondrej, Tichavsky Petr
15:35-15:55, FrD3.5	*A Unified Modelling of Dead-Zone, Dead-Band, Hysteresis, and Other Faulty Local Behaviors of Actuators and Sensors* by Bainier Gustave, Marx Benoit, Ponsart Jean-Christophe
15:55-16:15, FrD3.6	*Interval Observer Design for Fault Diagnosis* by Zhirabok Alexey N., Zuev Alexander, Shumsky Alexey

16:30 – 18:10 FrE2	**Regular Session, Small Theatre** *Fault-Tolerant and Reconfigurable Control* Chair: Jiang, Jin Co-Chair: Witczak, Marcin
16:30-16:50, FrE2.1	*Finite-Frequency Fuzzy Fault-Tolerant Static Output Feedback $H\infty$ Control for Diesel Engine Air-Path System* by El-Amrani Abderrahim, Noura Hassan, El Adel El Mostafa, Ouladsine Mustapha
16:50-17:10, FrE2.2	*Evaluating Resilience Metrics in the Context of Safety Concepts* by Ghanbari Mohammad, Jiang Jin
17:10-17:30, FrE2.3	*Consensus Control for T-S Fuzzy Multi-Agent Systems with Parametric Uncertainties* by Cherigui Aioub, Nachidi Meriem, Chadli Mohammed

17:30-17:50, FrE2.4	*Switching LPV Approach for Analysis and Control of TCP-Based Cyber-Physical Systems under DoS Attack* by Barchinezhad Soheila, Puig Vicenç, Witczak Marcin
17:50-18:10, FrE2.5	*Optimal Fault Tolerant Control Strategy of a Continuous Fermentative Bioprocess for Biogas Production* by Gurubel Tun Kelly Joel, Rodríguez Reyes Juan José, León Becerril Elizabeth, Moya Sanchez Eduardo Ulises

16:30–18:10 FrE3	**Regular Session, Rehearsal Room** *Fault Diagnosis in Electromechanical Systems* Chair: Zhang, Ping Co-Chair: Karimi, Hamid Reza
16:30-16:50, FrE3.1	*Application of Digital Signature to Attack Detection in a DC Motor Control System* by Barbosa Costales Jose Efren, Gomez Munoz Daniel, Yadgar Obaidullah, Fauser Moritz, Zhang Ping
16:50-17:10, FrE3.2	*Weighted Feature Fusion of Convolutional Neural Network and Graph Convolutional Network for Mechanical Fault Diagnosis under Time-Varying Speeds* by Yu Yue, Karimi Hamid Reza, Liu Caiyi
17:10-17:30, FrE3.3	*Harmonic Signature Extraction in Motor Fault Detection Via a Weighted Sparsity-Driven and Graph-Based Model* by Tsuruta Shinya, Liu Dehong
17:30-17:50, FrE3.4	*A Blind Denoising Method for Noise Rotating Machinery Vibration Signals* by Yang Daoguang, Karimi Hamid Reza, Ma Dayou
17:50-18:10, FrE3.5	*Multi-Modal Self-Supervised Learning for Cross-Domain One-Shot Bearing Fault Diagnosis* by Chen Xiaohan, Xue Yihao, Huang Mengjie, Yang Rui