

Special Session Proposal

2nd CBM conference (11-13 September '24, Paris)

Exploring Explainable AI, Predictive Models, and Federated Learning for CBM in Aerospace

SUMMARY

Condition-Based Maintenance (CBM) plays a vital role in proactively identifying potential failures in complex engineering systems, enabling timely interventions to minimize risks and maximize operational efficiency. Accurately predicting Remaining Useful Life (RUL) is essential for effective maintenance scheduling and resource allocation, ensuring critical assets operate optimally without unexpected downtime or costly disruptions. These systems operate in intricate environments influenced by various factors, such as environmental conditions and operational loads. Neglecting these dynamics can lead to suboptimal predictive models. To address this, future CBM research should adopt a holistic approach beyond RUL prediction and PHM.

In aerospace, where safety and reliability are paramount, critical systems employ advanced techniques like federated learning and Explainable AI. These methods enable collaborative learning and offer transparent insights into AI decision-making, meeting regulatory standards and fostering trust among stakeholders.

The purpose of this special session is threefold: firstly, to gather papers discussing recent advancements in predictive maintenance techniques, fault detection, and methodologies for monitoring system health. Secondly, the session will examine the growing field of Federated Learning, investigating its potential applications in Condition-Based Maintenance (CBM) and its capacity to support collaborative model training across distributed systems while safeguarding data privacy and security. Furthermore, the session will explore the incorporation of optimization models and algorithms into AI systems to enhance explainability, examining how optimization techniques can improve the interpretability and efficacy of predictive maintenance algorithms.

MAIN TOPICS

- Holistic approaches to CBM
- Prognostics and health management (PHM)
- Federated learning approaches
- Dimensionality reduction and space projection
- Prior estimation and latent representation
- Explainable intelligent systems in PHM
- Integrating explainability into existing CBM systems
- The human in the loop in CBM
- Ethics and privacy challenges in CBM

BIOGRAPHIES

Prof. Alberto Cardoso is Associate Professor with Tenure at the Department of Informatics Engineering of the University of Coimbra, Coordinator of the Adaptive Computation Group of the Centre for Informatics and Systems of the University of Coimbra (CISUC), and senior member of the International Society of Engineering Pedagogy (IGIP), the Portuguese Association of Automatic Control (APCA) and the Portuguese Society for Engineering Education (SPEE). He received the title of “International Engineering Educator Honoris Causa” and the “Adolf-Melezinek-Meritorious-Service-Award” from IGIP.

He coordinates the Industrial Informatics and Systems Lab and the Wearable Systems Lab of CISUC and supervises(d) several PhD and MSc students. He has several scientific publications in books (20), journals (47) and conferences (180), and his research interests include data analysis, data and information fusion, predictive maintenance, supervision and fault diagnosis, cyber-physical systems, and intelligent systems, in various application areas.

He coordinates(d) and participates(d) in several European (FP7, H2020, SUDOE, ...) and national (FCT, PRR, ...) projects, such as ReMAP (H2020), KYKLOS 4.0 (H2020), HealthyW8 (H2020), SenForFire (SUDOE), NEXUS (PRR), and NextGenAI (PRR).

<https://www.cisuc.uc.pt/en/people/alberto-cardoso>

Prof. Catarina Silva is Associate Professor at the Department of Informatics Engineering of the University of Coimbra. She has a PhD degree in Computer Engineering, with 20 years experience teaching Computer Engineering BSc and MSc, while also supervising MSc and PhD students. She is a senior researcher at the Adaptive Computation Group of CISUC with machine learning and pattern recognition as main areas of research. More specific recent research projects on Transparency in AI in Finance (COST); Industry 4.0 Circular and Agile Manufacturing and individualized consumer preferences (H2020); Real-time Condition-based Maintenance for Adaptive Aircraft Maintenance Planning (H2020); Real-time monitoring of ambient air quality with low-cost nano-sensors (Sudoe).

Skilled at managing different sized projects and scientific entrepreneurships, involving people with different backgrounds, namely faculty, students, alumni, and companies. Author and co-author of 4 books, circa 20 journal articles and 100 conference papers. Scientific committee and paper reviewer of several conferences and journals. Board member of the Portuguese Association of Pattern Recognition, IEEE senior member of the Computational Intelligence Society, IEEE past chair of the Portuguese Section.

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Prof. Bernardete Ribeiro is Full Professor at the University of Coimbra. She is Former Director of the Center of Informatics and Systems of the University of Coimbra (CISUC).

Bernardete Ribeiro is the Past President of the Portuguese Association of Pattern Recognition (APRP). She is a senior member of the Adaptive Computation Group of CISUC and is the Founder and Director of the Laboratory of Artificial Neural Networks (LARN) for more than 30 years. Her research interests are in the areas of Machine Learning, Pattern Recognition, Signal Processing, Bioinformatics and Industry Applications. Bernardete Ribeiro has served as both Principal Investigator (PI) and participant in numerous international and national projects spanning academia and industry. She has also contributed as a European Union Expert Reviewer and Leader Panel Reviewer at both national and international levels.

Bernardete Ribeiro serves as an Associate Editor for the IEEE Transactions on Cybernetics and holds memberships in various prestigious organizations, including IEEE, IARP, INNS, APCA, APPIA, AAAS.

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