Special Session VII

Special Session Basic Information:

专栏题目 **Session Title**	中文：大模型赋能的工业系统智能运维 英文：Large Model-Empowered Intelligent Operations and Maintenance for Industrial Systems

专栏介绍和征稿主题
Introduction and topics

中文：

在工业 4.0 与数字化转型的浪潮下，现代工业系统正朝着高度自动化、网络化和智能化的方向发展。系统的复杂性与日俱增，物理设备与数字孪生深度融合，产生了海量的运行日志、传感器时序、机器视觉、工艺参数等多模态数据。传统的工业运维方法在处理如此庞大、异构的数据时面临巨大挑战，尤其在跨域故障的根本原因分析、系统健康状态的精准预测和复杂工况下的自适应决策方面，已显得力不从心。

以大语言模型为代表的大规模基础模型的崛起，为工业系统智能运维带来了革命性的新范式。这些模型凭借其强大的自然语言理解、多模态数据融合、复杂逻辑推理和内容生成能力，能够有效解析非结构化的工业知识，并关联理解来自不同监控源的数据，从而显著提升运维任务的效率和智能化水平。将大模型与工业运维场景深度融合，不仅有望打通信息空间与物理空间的壁垒，解决传统方法在泛化能力和语义理解上的瓶颈，更能推动工业运维体系从“被动响应”向“主动预测”和“自主优化”的更高阶段演进。

本专栏旨在汇集“大模型赋能的工业系统智能运维”领域的最新研究成果与前沿探索，聚焦于大模型在提升工业系统可靠性、安全性、可用性和生产效率方面的核心作用，促进前沿 AI 技术与工业工程实践的深度融合。我们诚挚欢迎高质量的理论、算法、应用及综述类稿件，尤其鼓励以下主题（包括但不限于）的投稿：

- 面向工业运维的大模型基础理论与架构
- 工业多模态运维数据的融合与分析
- 基于大模型驱动的故障诊断与根因分析
- 大小模型交互增强的工业智能
- 大模型赋能的预测性维护与健康管理
- 基于大模型驱动的运维决策与自动化
- 工业智能运维中的人机交互与可信 AI

英文：Amidst the wave of Industry 4.0 and digital transformation, modern industrial systems are evolving towards being increasingly automated, networked, and intelligent. The complexity of these systems is ever-increasing, and the deep integration of physical assets and digital twins generates massive volumes of multi-modal data, including operational logs, sensor time-series, machine vision, and process parameters. Traditional industrial Operations and Maintenance (O&M) methods face immense challenges in processing such vast and heterogeneous data, proving inadequate, particularly in cross-domain root cause analysis, precise prediction of system health status, and adaptive decision-making under complex operating conditions.

The rise of large-scale foundation models, represented by Large Language Models (LLMs), has introduced a revolutionary new paradigm for the intelligent O&M of industrial systems. Leveraging their powerful capabilities in natural language understanding, multi-modal data fusion, complex logical reasoning, and content generation, these models can effectively interpret unstructured industrial knowledge and correlate data from diverse monitoring sources, thereby significantly enhancing the efficiency and intelligence of O&M tasks. The deep integration of large models into industrial O&M scenarios not only promises to bridge the gap between the information and physical spaces and overcome the bottlenecks of traditional methods in generalization and semantic understanding, but also propels the evolution of the industrial O&M framework from "reactive response" to the higher stages of "proactive prediction" and "autonomous optimization."

This Special Issue aims to gather the latest research findings and cutting-edge explorations in the field of "Intelligent O&M for Industrial Systems Empowered by Large Models." It focuses on the pivotal role of large models in enhancing the reliability, safety, availability, and production efficiency of industrial systems, promoting the deep integration of advanced AI technologies with industrial engineering practices. We cordially invite high-quality submissions in the form of theoretical works, algorithms, applications, and review articles. Topics of interest include, but are not limited to:

- Foundation Models and Architectures for Industrial O&M
- Fusion and Analysis of Industrial Multi-Modal O&M Data
- Large Model-Driven Fault Diagnosis and Root Cause Analysis
- Large-Small Model Interaction for Enhanced Industrial Intelligence
- Large Model-Empowered Predictive Maintenance and Health Management
- Large Model-Driven O&M Decision-Making and Automation
- Human-Computer Interaction and Trustworthy AI in Industrial Intelligent O&M

Special Session Chair(s):

姓名 Name	王锴 (Kai Wang)
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Organizer's Brief Biography

中文：王锴，博士，研究员，中国科学院特聘骨干，博士生副导师，硕士生导师，美国马里兰大学访问学者。中国自动化学会技术过程的故障诊断与安全性专业委员会委员，沈阳市高层次人才、沈阳市标准化专家。获国防科技进步一等奖、辽宁省自然科学成果奖、IEEE 会议最佳论文奖、中科院沈阳自动化所冠名奖（技术创新奖）等，在 IEEE Transactions 等国内外知名期刊和会议上发表论文近百篇，申请/授权发明专利近 20 项，参与制定装备智能运维领域多项国家标准，培养的研究生多次获得国家奖学金。主要研究方向是工业装备故障预测与健康管理，主持多项国家自然科学基金（青年、面上）项目、国家重点研发计划课题、辽宁省科技项目（包括“揭榜挂帅”重点项目、自然基金面上项目）、企业委托课题，为中核、中广核、中船重工、新松机器人等企业提供可靠性咨询服务。

英文：Dr. Kai Wang is a Professor and a recipient of the "Distinguished Core Talent" honor from the Chinese Academy of Sciences (CAS). He serves as an Associate Doctoral Supervisor and a Master's Supervisor at the Shenyang Institute of Automation (SIA), and was formerly a Visiting Scholar at the University of Maryland, USA.

His research is primarily focused on Prognostics and Health Management (PHM) for industrial equipment. As a recognized expert in this domain, he serves as a committee member of the Technical Committee on Fault Diagnosis and Safety of Technical Processes, under the Chinese Association of Automation. He is also honored as a High-Level Talent and a Standardization Expert by Shenyang City.

As a leading researcher, Dr. Wang's work has earned significant recognition, including the First Prize of the National Defense Science and Technology Progress Award, the Liaoning Provincial Natural Science Achievement Award, a Best Paper Award from an IEEE conference, and the SIA Named Award for Technical Innovation. He has authored nearly 100 papers in renowned international journals and conferences, such as various IEEE Transactions, and holds nearly 20 invention patents (granted or applied for). Furthermore, he has actively participated in the development of multiple national standards in the field of intelligent equipment O&M. His commitment to mentorship is evidenced by his graduate students, who have frequently been awarded the National Scholarship.

Dr. Wang has a proven track record of leading significant research initiatives. He has served as the Principal Investigator (PI) for multiple projects funded by the National Natural Science Foundation of China (NSFC), including

both Youth Fund and General Programs, as well as tasks within the National Key R&D Program of China. His leadership extends to provincial-level initiatives, including key "Jiebang Guashuai" (Challenge-based) projects, and numerous enterprise-commissioned projects. He provides expert reliability consulting services to leading enterprises such as China National Nuclear Corporation (CNNC), China General Nuclear Power Group (CGN), China Shipbuilding Industry Corporation (CSIC), and SIASUN Robot & Automation.

姓名 Name	王思瀚 (Sihan Wang)
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Organizer's Brief Biography

中文：王思瀚，博士，中国科学院沈阳自动化研究所工业控制网络与系统研究室助理研究员。2014、2017、2024 年分别获得东北大学生物医学工程学士及电气工程硕士、博士学位。2018 年任职于华为技术有限公司北京研究所。近年来主持省自然基金 1 项，核心参与多项国家重点研发计划、国家自然科学基金面上项目、全国重点实验室自主课题及省科技创新重大专项项目等。研究成果发表在 IEEE 汇刊、Measurement、IET CTA 等国际权威期刊会议 20 余篇，授权/受理发明专利 6 项。担任 ISA Transactions 等多个 SCI 期刊审稿人。主要研究方向包括工业装备建模与健康管理、大语言模型及人工智能驱动的科学研究。

英文： Dr. Sihan Wang is an Assistant Researcher at the Department of Industrial Control Networks and Systems, Shenyang Institute of Automation (SIA), Chinese Academy of Sciences. He received his Ph.D. in Electrical Engineering from Northeastern University and previously held an engineering position at the Beijing Research Institute of Huawei Technologies, bringing a valuable blend of rigorous academic training and direct industrial experience to his work.

His research is centered on the convergence of advanced artificial intelligence and industrial engineering, with a specific focus on the modelling and health management of industrial equipment, the application of Large Language Models , and AI for Science. His work seeks to address the increasing complexity of modern industrial systems by developing next-generation intelligent maintenance and diagnostic solutions.

As an active researcher in intelligent industrial systems, Dr. Wang has made significant contributions to the field. He serves as the Principal Investigator for a provincial-level Natural Science Foundation project and has been a core member of numerous high-profile research initiatives, including National Key R&D Programs of China, General Programs of the National Natural Science Foundation (NSFC), and independent projects of State Key Laboratories. His research findings are documented in over 20 articles published in prestigious international journals and conferences, such as various IEEE Transactions, Measurement, and IET Control Theory & Applications, and are further evidenced by 6 invention patents (granted or pending).

Dr. Wang's work is dedicated to bridging the gap between theoretical AI advancements and practical industrial applications. His research aims to leverage the power of Large Language Models and data-driven methods to enhance the reliability, autonomy, and efficiency of critical industrial equipment and systems. He also contributes to the academic community by serving as a reviewer for several SCI-indexed journals, including ISA Transactions.