The 22nd World Congress of the International Federation of Automatic Control
July 9 – 14, 2023, Yokohama, Japan

Human in the Loop of Artificial Intelligence in Smart Maintenance and Manufacturing Systems

Invited Track Code: Code 24qtf

This proposal is endorsed by TC5.1 Manufacturing Plant Control and the WG A-MEST

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Keywords: Human in the Loop of AI in Maintenance and Manufacturing Systems; Human – AI Teaming; Linked Data and Knowledge; Mixed Human – AI Agent-Based Systems; Shared Human – AI Context Spaces in Manufacturing Plants and Maintenance Activities

Abstract

AI-driven human augmentation or industrial automation have seen many applications in maintenance and manufacturing. High expectations are set regarding AI-driven solutions and automated outcomes, but the role of the Human in the Loop in producing these outcomes is less well explored. This is surprising given that Human integration in Sociotechnical Systems has long been studied. Much is expected to be achieved in automated manner from Machine Learning in industrial systems, leaving the possibility for properly integrating human knowledge and human capabilities insufficiently exploited. Yet, the application practice of Machine Learning and broader AI in Maintenance and Manufacturing provides ample evidence of brittleness of derived solutions in the face of limited or new data, changing contexts, or evolving situations. AI communities seek to address such challenges with approaches such as Transfer Learning. More recently Active Learning has been explored to better focus on the integration of Human Interaction, and therefore the Human Physical and Cognitive Capabilities in the AI Loop. The interest in addressing Human – Centricity in Industry 5.0 often targets high conceptual, abstraction, and design levels, and does not sufficiently target the interactive and operational engagement of the Human in the AI Loop. This pattern is changing, especially in domains with high performance, safety or ethics requirements, with research targeting mixed or sliding autonomy and decision making, shared contexts and collaboration workspaces. Such approaches deserve further research in maintenance, as well as manufacturing shop floor contexts. The simplest cases are human – annotated data to drive machine learning. Modelling and integration of domain knowledge with data via knowledge graphs and ontologies is also pursued. Employing human operators, workers, or engineering staff as a source of observation, knowledge, decision, or action is another example. The collaboration of human and non-human (AI-driven) cooperating agents in industrial systems is a further step. Considering the above, the effective integration of humans in the Machine Learning and Broader AI Loop for Maintenance and Manufacturing is the focus of this track.

The session invites contributions in the form of original research, survey papers, case studies, and demonstration reporting, including architectures, methods, modelling approaches and frameworks, which target Human – AI integration in Maintenance and Manufacturing, addressing (indicatively) the following topics:

- Human in the loop of Machine Learning and industrial AI systems: human roles, methods, architectures, and applications in maintenance and manufacturing
- Human augmentation via Machine Learning and AI systems in maintenance and manufacturing settings
- Human-centric AI oriented Machine Learning (e.g. explainable / interpretable AI, Active Learning, Fair and Ethical AI)
- Mixed autonomy and decision – making models, architectures, and systems
- Agent-based approaches, models, architectures and systems of Human-AI symbiosis
- Knowledge and data integration in AI-driven industrial maintenance and manufacturing (for example, via knowledge graphs, ontologies, and reasoning methods)
- Enabling technologies for Human in the AI Loop: smart sensing; Industrial IoT, smart and natural interfaces and environments (e.g. speech, chatbots, AR/VR/XR, Digital Twins)
- Model-Based Human-System integration for Human in the AI Loop
- Fusion of Domain-specific knowledge and models into Machine Learning and AI (e.g. FMEA/FMECA)
- Human in the AI Loop at Design, Implementation and Deployment, as well as Operation and Maintenance phases of industrial systems
- Human in the Loop of Data Management and Data Quality Management in AI-driven industrial systems
- Application cases and results showcasing the needs and / or benefits of Human in the AI loop in industrial maintenance and manufacturing (for example in maintenance or manufacturing operations planning, optimisation and scheduling, as well as in monitoring, diagnostics, prognostics, safety management etc.)

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Tentative schedule

- October 31, 2022 Deadline for paper submission
- February 01, 2023 Notification of acceptance/rejection
- March 31, 2023 Final paper submission
- 09-14 July 2023 22nd IFAC World Congress: Yokohama, Japan

Manuscript preparation

Papers for the open invited track will follow the guidelines of the conference, available at:
https://www.ifac2023.org/submission/submit-contribution
and specifically:
http://www.ifac.papercept.net/conferences/support/support.php
Upon preparing the manuscript, please follow the submission guidelines:
https://ifac.papercept.net/conferences/scripts/start.pl
When submitting your paper, **make sure to select Open invited track code: 24qtf**

For any queries, please do not hesitate to contact the organisers
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