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Special Issue on Agentic Intelligence for Materials Handling, Warehousing, and Logistics 5.0

Materials handling, warehousing, and intralogistics systems are rapidly evolving into automation-intensive cyber-physical environments in which robotics, sensing, software-defined execution systems, digital twins, and human supervision interact in tightly coupled operational loops. Materials handling spans a wide set of physical and decision processes - storage and retrieval, internal transport, conveying and sortation, order picking, palletising and depalletising, dock and yard operations, cross-docking, packaging, and reverse flows - that together govern how goods move and are synchronised across facilities. Driven by e-commerce growth, demand volatility, labour shortages, sustainability pressures, and the need for resilience, modern materials handling operations have become complex real-time systems that require integrated coordination across storage, fulfilment, internal transport, and material-flow execution.

This Special Issue introduces agentic intelligence as an emerging automation-science layer for materials handling, warehousing, and logistics. Specifically, the issue is focused on LLM-agent-enhanced and foundation-model-based agentic systems that act as the real-time decision-and-control layer of materials-handling cyber-physical systems. When integrated with digital twins, these capabilities support sense-simulate-decide-act-learn loops for planning, coordination, exception handling, and resilience management on real materials-handling hardware. The Special Issue targets T-ASE-level automation-engineering contributions validated on materials-handling cyber-physical testbeds, digital-twin-in-the-loop setups, or industrial deployments.

Submissions of original, significant, and visionary automation contributions from experts in academia and industry worldwide are strongly encouraged. Topics to be covered include, but are not limited to:

- *LLM-Agent and Foundation-Model Architectures for Materials-Handling Automation*: LLM-agent designs (planner-executor-reflector, ReAct-style, tool-using agents); vision-language and multimodal foundation models for warehouse perception, exception detection, and reasoning; retrieval-augmented and procedure-grounded agents against WMS/WES/WCS data; agent memory, experience replay, and continual learning; natural-language interfaces between operators and materials-handling agents.
- *Real-Time, Resource-Constrained, and Cost-Effective Deployment of Agentic Systems*: low-cost LLM-agent architectures deployable in real warehouses; on-edge and on-device inference for agentic decision-making; model compression, distillation, quantisation, and small-language-model strategies; hybrid cloud-edge orchestration with bounded latency and bandwidth; latency-, energy-, and cost-aware planning and tool-use; reliability and graceful-degradation strategies; real-time benchmarks for LLM-agent stacks on representative materials-handling workloads.
- *Multi-Agent Coordination and Distributed Agentic Control of Materials-Handling Systems*: coordination of AMR/AGV/forklift/shuttle/conveyor and robotic-picker fleets; negotiation-, market-, and contract-net-based task and resource allocation; decentralised, edge-based, and federated agentic control architectures;

cooperative and game-theoretic decision-making; real-time exception detection, diagnosis, and recovery; communication-efficient coordination under industrial network constraints.

- *Digital-Twin-Integrated Agentic Control and Human-in-the-Loop Operation*: architectures coupling agentic AI with materials-handling and intralogistics digital twins; closed-loop sense–simulate–decide–act–learn systems; verification, validation, and calibration of agentic policies via simulation and hardware-in-the-loop; disruption- and resilience-oriented agentic recovery; human–robot collaboration and human-on-the-loop supervision; safety assurance and runtime monitoring of LLM-agent-driven control on physical equipment.

Important Dates

- Paper submission deadline: 15 February 2027
- Completion of the first-round review: 30 April 2027
- Completion of the second-round review: 30 September 2027
- Final submission due: 30 November 2027
- Tentative publication date: Early 2028

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Paper Submission

All papers are to be submitted through the IEEE’s Manuscript Central for Transactions on Automation Science and Engineering <http://mc.manuscriptcentral.com/t-ase>. Please select the Manuscript Category “**Topic**-Based Special Issue” under “Type” in Step 1 and this specific Special Issue in Step 6 of your article’s submission process. **All manuscripts must be prepared according to the IEEE Transactions on Automation Science and Engineering publication guidelines** (<http://www.ieee-ras.org/publications/t-ase>). Please address inquiries to banu.yetkinekren@cranfield.ac.uk.