Model-assisted optimal control framework for industrial system coupling problems

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Stellingen

Behorende bij het proefschrift

Model-Assisted Optimal Control Framework for Industrial System Coupling Problems

1. Industrial coupling problems fall into three types—system-environment, inter-components, and system-working medium—because each fundamentally alters the optimal control structure (Chapter 2)
2. In system-environment coupling, optimal control under partial observability can be achieved by inferring unobservable states from historical observation sequences (Chapter 3).
3. For coupling among system components, inverse surrogate modeling transforms iterative search into one-shot optimization (Chapter 4).
4. For system-working medium coupling, overshoot caused by hysteresis can be suppressed through trajectory planning and optimized PID control. (Chapter 5).
5. Hierarchical partially observable Markov decision process reduces error propagation by parallelizing belief inference and decision-making.
6. In hybrid surrogates, Transformer fuses global constraints while CNN decodes local patterns—this mirrors the causal structure of manufacturing.
7. CMA-ES offers a practical pathway for online PID optimization where decoupling or model predictive control fails.
8. Real-world validation is necessary to confirm simulation-trained model generalizability.
9. Digital twins and surrogate models reduce material waste and labor cost by replacing physical trial-and-error.
10. Cross-disciplinary dual-degree programs effectively bridge the gap between academic algorithms and industrial deployment.

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