



Retrospective Cost Adaptive Control with Online Retrospective Cost Identification

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Category

Software

Engineering & Physical Sciences

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OVERVIEW

Hybrid adaptive control using cumulative retrospective cost optimization and online model refinement

- Enhances transient response with no prior model information required
- Applications in robotics, industrial process control, and aerospace systems

BACKGROUND

Adaptive control is essential for systems that encounter varying dynamics and uncertainties. Historically, direct adaptive control relies on pre-existing model information, while indirect adaptive control updates controller gains based on real-time learned models. Hybrid adaptive control incorporates online learning to support adaptation, addressing how much information is necessary for acceptable performance during learning. Model-free control is theoretically feasible but impractical due to noise and transient response issues. Traditional methods often depend on indicative parameters or known system poles and disturbance signals, limiting adaptability. There is a need for a robust adaptive control method that can handle system variations and disturbances without extensive prior modeling, particularly for non minimum-phase systems.

INNOVATION

This hybrid adaptive control algorithm combines direct adaptive control with retrospective cost optimization and online model refinement. Utilizing a cumulative retrospective cost approach, the controller updates gains based on an evolving model, while a recursive-least-squares algorithm refines the model using real-time data. This technique improves transient response and adaptability, even without prior model information. Covariance resetting ensures stability during abrupt system changes. The innovation was tested on various disturbance rejection and command following scenarios for both minimum-phase and non minimum-phase systems, demonstrating its versatility and robustness. Potential applications include robotics, industrial automation, aerospace systems, and other dynamic environments requiring adaptive control without extensive pre-configuration, enhancing system reliability and performance.

ADDITIONAL INFORMATION

REFERENCES:

A. M. D'Amato, J. B. Hoagg and D. S. Bernstein, "Hybrid retrospective-cost-based adaptive control using concurrent parameter estimation," Proceedings of the 2010 American Control Conference, Baltimore, MD, USA, 2010, pp. 4812-4817, doi: 10.1109/ACC.2010.5531119