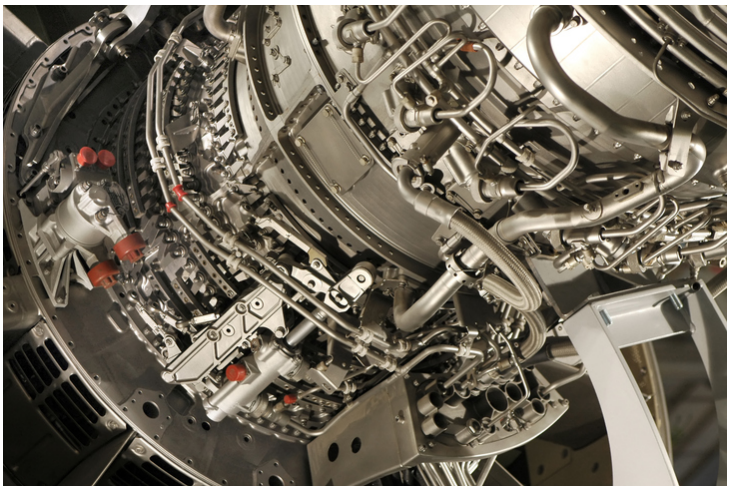
INNOVATION PARTNERSHIPS
UNIVERSITY OF MICHIGAN

Retrospective Cost Adaptive with Concurrent Model Identification

TECHNOLOGY NUMBER: 6930



Technology ID

6930

Category

Software

Engineering & Physical Sciences

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OVERVIEW

Adaptive control system optimizing performance without prior NMP zero knowledge.

- Enables adaptive control without pre-defined nonminimum-phase zero knowledge.
- Robust automated systems, aerospace control, real-time industrial processes.

BACKGROUND

Adaptive control systems aim to optimize performance in environments with model uncertainties and variable conditions. Historically, such systems required extensive prior knowledge about system characteristics, including nonminimum-phase (NMP) zeros and other modeling details. These zeros can present significant challenges, as improper control can lead to instability or poor performance. Classical adaptive control methods typically assume minimum-phase conditions or rely on robust control approaches, which may compromise performance. The need to efficiently manage NMP systems, therefore, requires new adaptive methodologies that reduce the dependency on pre-determined system models and can adapt dynamically in real-time. This necessity drives the development of retrospective cost adaptive control (RCAC) to incorporate target models that dynamically identify these crucial system characteristics, thus providing a more adaptable and efficient control solution.

INNOVATION

Researchers at the University of Michigan have developed an enhancement to Retrospective Cost Adaptive Control (RCAC) enabling concurrent optimization without a priori knowledge of nonminimum-phase (NMP) zeros. By applying an alternating convex search (ACS) algorithm, this innovative approach dynamically refines the controller and target model coefficients concurrently. Such an advancement allows the adaptive control system to accurately identify and utilize NMP zeros in real-time without predefined models, offering a significant breakthrough in adapting to uncertain or complex dynamics. This innovation improves the system's robustness and reliability, especially when controlling single-input, single-output (SISO) plants that may present asymptotic stability, instability, or NMP challenges. Real-world applications encompass aerospace systems' precision control, industrial automation with flexible processes, and adaptable control solutions in robotics where system dynamics frequently change or are initially unknown.

ADDITIONAL INFORMATION

REFERENCES

F. M. Sobolic, A. Goel and D. S. Bernstein, "Retrospective cost adaptive control using concurrent controller optimization and target-model identification," 2016 American Control Conference (ACC), Boston, MA, USA, 2016, pp. 3416-3421, doi: 10.1109/ACC.2016.7525442