CPS: Medium: Collaborative Research: Multi-Objective Mitigation Strategies for Viability and Performance of Cyber-Physical Systems

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CHALLENGE

- Run-time mitigation when complex CPSs operating in uncertain environments confront unanticipated viability-compromising situations.

SOLUTION

- Set-theoretic and stochastic failure detection, isolation and reconfiguration multi-mode control strategies that integrate reference governors and enforce safety constraints.
- Computing resource allocation strategies for optimization-based controllers executing in a shared processor.
- Robust to Early Termination algorithms for optimization-based control.
- Computationally efficient viability maximizing Model Predictive Control formulations.

SCIENTIFIC IMPACT

- Strategies for continuing operation in the face of a variety of contingencies.
- Addressing emergent problems arising from interactions of resource-allocation and optimization-based control strategies.

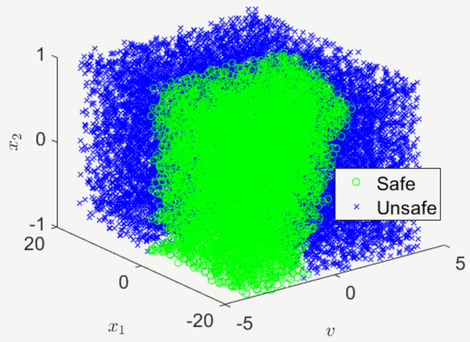
BROADER IMPACT

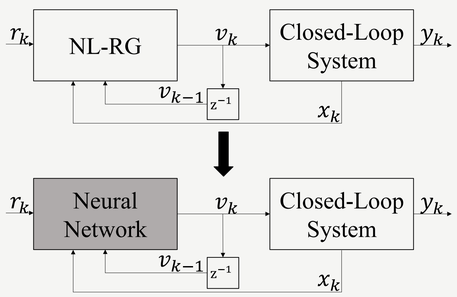
- Outcomes support industry in developing safer advanced and autonomous vehicles.
- Traffic control solutions to facilitate emergency vehicle routing.
- Students and postdocs develop cross-disciplinary expertise.

RECENT HIGHLIGHTS:

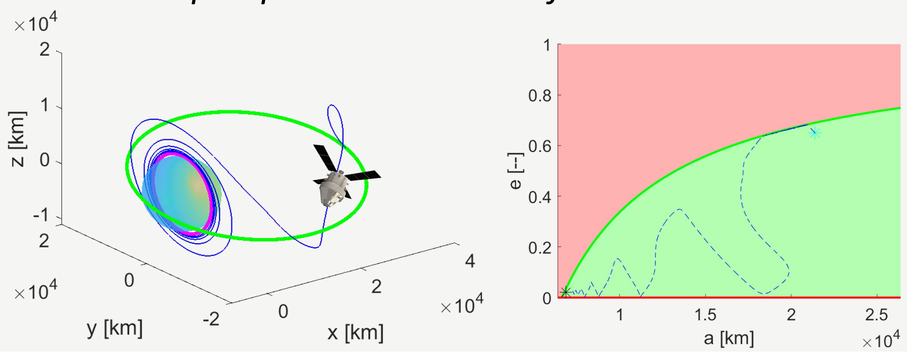
- Analytic and machine learning approaches to construct safe sets and reference governors.
- MPC and constrained control formulations to improve reliability of space missions

Safe set and reference governor construction via ML

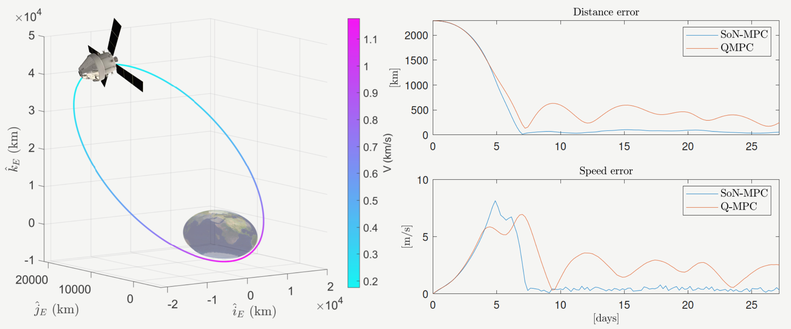




Feedback laws ensuring orbital transfer safety despite potential thruster failures



MPC formulations for Earth-Moon Halo orbit tracking with low fuel consumption



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