Department of Mechanical Engineering Seminar
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Zoom link:
https://us02web.zoom.us/j/89135443578?pwd=a1RnTU1vSzM3Qy9vK2tFVEYybG13QT09

Estimation and Control of Hidden Mode Markov Jump Linear Systems with Application to Fault-tolerant Satellite Attitude Control

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The seminar is based on PhD thesis supervised by
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Abstract:

In this work a novel jump-linear quadratic controller is suggested for discrete-time dynamical systems under the assumptions of full state information and corrupted detection of the hidden mode. The controller is linear in the state and the gains are functions of the mode observations. They stem from a Riccati-like backward propagation involving approximate computations of conditional expectations of the problem parameters. Discarding the state information, closed-form recursive expressions for the mode estimator are developed with increasing and limited memory of the mode observations. For the sake of practicality, the mode estimator with memory limited to the current mode observation is proposed. This results in a controller that maintains a computation burden similar to the full information jump-linear quadratic controller. Comparative results of an extensive Monte-Carlo simulation for a simple system illustrate the efficacy of the proposed algorithm that mitigates the destabilizing effect of corrupted mode observations. The proposed algorithm lends itself to a fault-tolerant spacecraft attitude controller. The proposed approach shows flexibility from the modeling standpoint and proves to be promising for the development of efficient fault-tolerant attitude controllers. This work also presents stability and stabilizability criteria for a class of Markov jump linear (MJL) periodic systems under the assumptions of perfect and imperfect mode information. We consider MJL systems with mode-frozen periodic parameters and extend known stability results from MJL systems via a mode augmentation approach. The novel approach is first applied to the case of instantaneous and correct mode information. It is then applied to the case where the mode is hidden yet detected with known probabilities of correct and missed detection. The validity of the suggested criteria is illustrated via simple numerical examples.

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