# ECE1635: LMIs for Joint State Estimation and Model Predictive Control

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## 1 Project Proposal

Deploying autonomous robotic systems in the real world requires high performance for efficient and effective operation, and safety guarantees to avoid collisions. Existing approaches typically consider estimation and control separately, and often do not explicitly account for state estimation errors when designing the controller, which can be unsafe for real-world robotics applications. While there are robust approaches that account for state estimation uncertainties, these approaches often lead to conservative controller designs. Towards the goal of deploying robotic systems in the real world, we investigate the joint optimization of state estimators and controllers using output feedback proposed by [3]. In [3] the author formulates a joint state estimation and robust min-max model predictive controller (MPC) for uncertain linear time-invariant systems using linear matrix inequalities (LMIs). We will provide a detailed technical review of [3] by writing out any omitted proofs, which will involve Schur complements and other techniques to linearize constraints. The presented approach conservatively approximates the state estimation LMI and assumes that each state estimate lies in a ellipsoidal set. We will explore more recent LMI-based state estimation, that could potentially circumvent these restrictions and conservatism [5, 1, 2]. Finally, we will present a comparison of the certainty equivalence approach, the uncertainty-aware approach [4], and the joint optimization problem in simulation.

## References


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