Incorporating Control Performance Tuning into Economic Model Predictive Control

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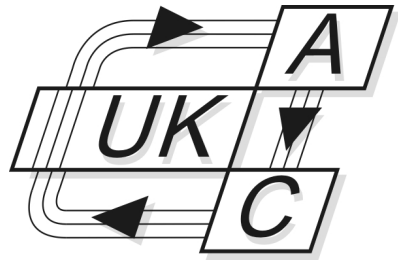
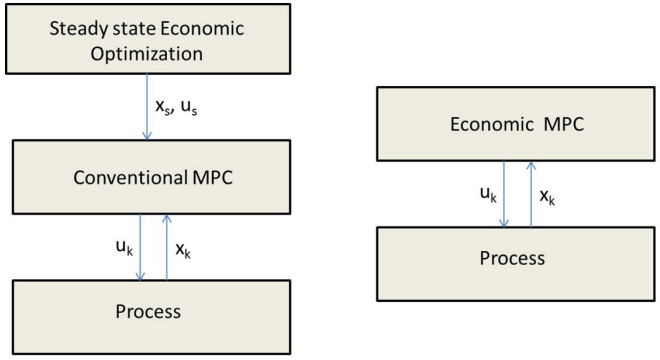


Introduction



Conventional MPC vs Economic MPC setup

$$l(x_k, u_k) = x_k^T Q x_k + u_k^T R u_k + x_k^T S u_k + u_k^T S^T x_k$$

$$\begin{bmatrix} Q & S \\ S^T & R \end{bmatrix} \geq 0 \text{ in conventional MPC}$$

$$\begin{bmatrix} Q & S \\ S^T & R \end{bmatrix} \text{ indefinite in economic MPC}$$

- **Conventional MPC**
  - *Stage cost designed to track the optimal equilibrium.*
  - *Asymptotic stability based on positive-definiteness of stage cost.*
- **Economic MPC**
  - *Use economic cost directly to generate inputs.*
  - *Asymptotically stable if system is strictly-dissipative with respect to stage cost.*

Focus

➢ Focus

- *Can a dissipative system be made strictly-dissipative without 'regularizing'?*
- *Any means of tuning control performance such as system's speed of response?*

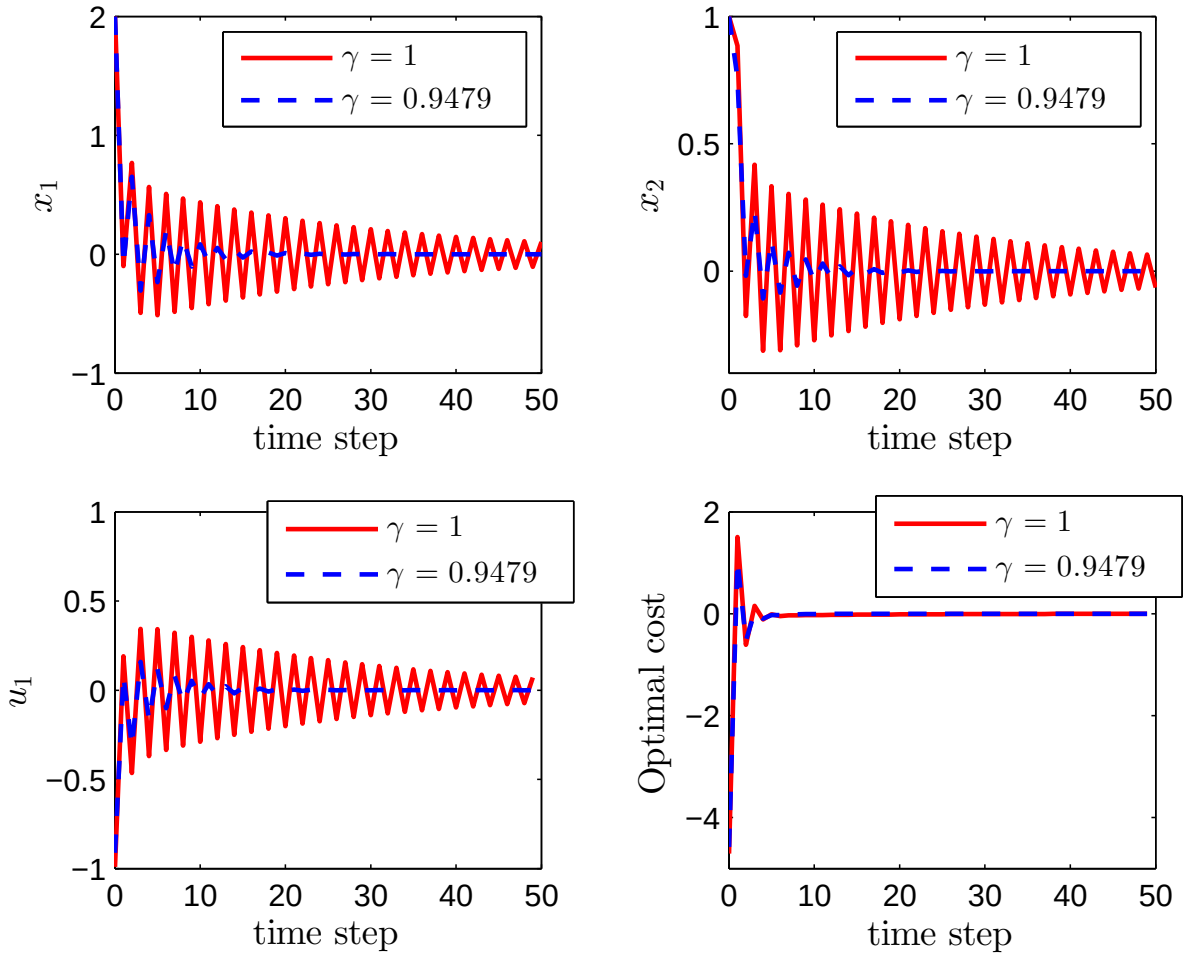
➢ Solution

- *Modify the cost using a discount factor i.e*

$$\tilde{l}_e(x_k, u_k) = \gamma^k l_e(x_k, u_k)$$

- *We have algorithm for finding values of γ for which the system is strictly-dissipative with respect to the modified cost.*

LTI Example



Conclusions

- **Research Status**
  - *By incorporating a discount factor into the economic cost, it is possible to transform a dissipative system into a strictly-dissipative system with respect to the stage cost*
  - *Also gives a level of control performance tuning.*
- **Future Directions**
  - *Non-dissipative systems.*
  - *Equivalence between 2-layer optimization and Economic MPC*