Risk-aware Sparse Predictive Control

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Motivation: Model Pred. Control

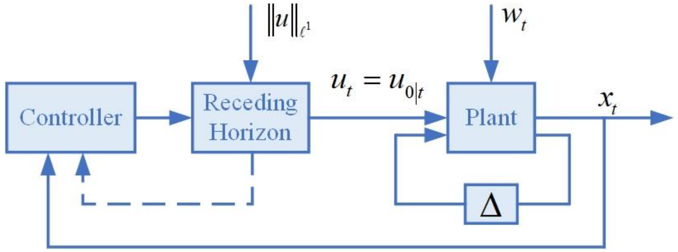
- From chess game to control theory
- Receding horizon strategy (first action)
- Minimum pieces in chess checkmate

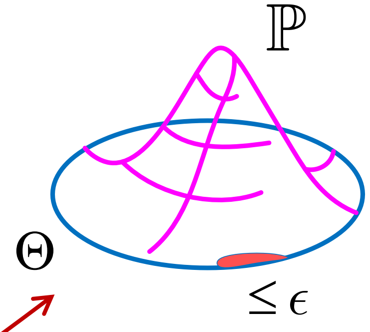
Sparsity promoting

Objective: Sparse Pred. Control

- Seek a control sequences with "risk-aware" and "input sparsity" to arrive at target set

Minimum control effort in control systems



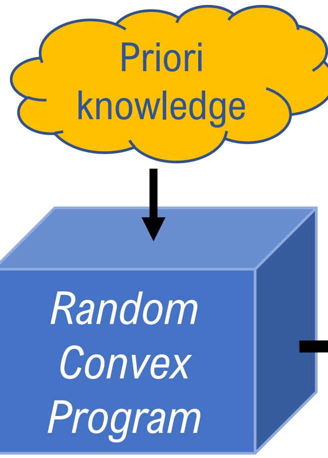


"Soft State + Hard Input" Constrs.

$$\mathbb{P}\left\{\theta \in \Theta : h(\bar{u}, \theta) \leq 0\right\} \geq 1 - \epsilon$$

$$Du_{j|t} \leq d, \; j \in \mathcal{N}$$

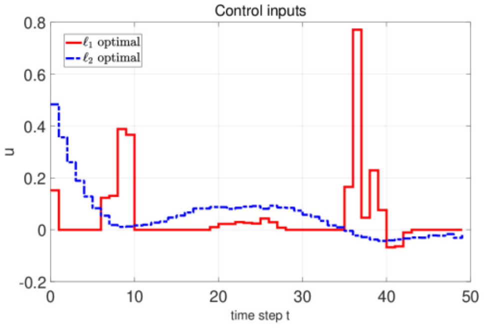
$$\left\{\theta^{(1)}, \theta^{(2)}, \cdots, \theta^{(K)}\right\} \overset{i.i.d.}{\sim} \mathbb{P}$$

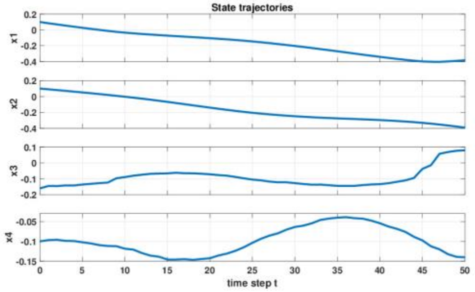


$$\min_{\bar{u}, \bar{x}} \|\bar{u}\|_1$$

$$\text{s.t.} \quad h(\bar{u}, \theta^{(i)}) \leq 0, \; i \in \mathcal{K}$$

$$\bar{u}_K^*$$





- **Fact:** risk-aware solution $\bar{u}_\epsilon^*$ is hard to calculate !!!

Oracle: Data-Driven Sampling

Result: Prob. Robust. Guarantee

- data-driven $\bar{u}_K^*$ approximates risk-aware $\bar{u}_\epsilon^*$ with a high probability, i.e.,

$$\mathbb{P}^K\left(\mathbb{P}\left(h(\bar{u}_K^*, \theta) > 0\right) \leq \epsilon\right) \geq 1 - \beta$$

- SPC enjoys good sparsity and robustness

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Looking forward to meeting you at my interactive talk !