MPC Python

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Abstract

1 MPC Problem

The MPC problem to be solved is:

$$\begin{aligned}
&\arg \min_{\{u\}_0^{N_p-1},\{x\}_0^{N_p}} \big(x_N - x_{ref}\big)^\top Q_{x_N} \big(x_N - x_{ref}\big) + \\
&\sum_{k=0}^{N_p-1} \big(x_k - x_{ref}\big)^\top Q_x \big(x_k - x_{ref}\big) + \big(u_k - u_{ref}\big)^\top Q_u \big(u_k - u_{ref}\big) + \Delta u_k^\top Q_{\Delta u} \Delta u_k && \text{(1a)} \\
&\text{subject to} \\
&x_{k+1} = Ax_k + Bu_k && \text{(1b)} \\
&u_{min} \leq u_k \leq u_{max} && \text{(1c)} \\
&x_{min} \leq x_k \leq x_{max} && \text{(1d)} \\
&\Delta u_{min} \leq \Delta u_k \leq \Delta u_{min} && \text{(1e)} \\
&x_0 = \bar{x} && \text{(1f)}
\end{aligned}$$

The QP solver expets a problem with form:

$$\begin{aligned}
&\min \frac{1}{2} x^\top P x + q^\top x && \text{(2a)} \\
&\text{subject to} \\
&l \leq Ax \leq u && \text{(2b)}
\end{aligned}$$

The difficulty is to write the MPC optimization problem (1) in form (2) to use the standard QP solver.