
Algorithm 1: Unconstrained MPC with Kalman Filter

Data: $x(0)$, Q , R , Ts , N

Result: $u^*(k)$

- 1 Compute prediction matrices F , G , and H , L , M ;
 - 2 Compute P using the mode-2 gain K to guarantee stability;
 - 3 Compute K_N ;
 - 4 Compute the Kalman Filter gain L_{KF} ;
 - 5 Initialize $x(0) \leftarrow x_0$;
 - 6 **for** $k = 0 : nk$ **do**
 - 7 Measure the current noisy output: $y(k) \leftarrow C x(k) + v(k)$;
 - 8 Apply the first control input to the current state: $u^*(k) \leftarrow K_N x(k)$;
 - 9 Estimate the state $\hat{x}(k)$, and close the loop:
 $x(k) \leftarrow A x(k) + B u^*(k) + L_{KF}(y(k) - C x(k)) + w(k)$;
 - 10 Set the noisy state $x(k+1)$ for the next iteration;
 - 11 Wait one time step;
 - 12 Increment k ;
 - 13 **end**
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