Algorithm 1: Unconstrained MPC with Kalman Filter

Data: $x(0)$, Q, R, Ts, N
Result: $u^*(k)$

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