Model Predictive Control
Checkpoints 1 & 2
Date: 27 September 2020

1 Checkpoint 1

1.1 Question 1

Four main advantages of MPC Design methodology are:

- Control of multi-variable coupled dynamical systems
- Handling of constraints on the state and on the control input
- Expression of optimality concerns
- Conceptually easy handling of nonlinearities in the system model

1.2 Question 2

MPC software can be sold as a product because it is generic and useful with many applications in the petrochemical/food/aerospace/car industry.

1.3 Question 3

Three big companies that advertise for MPC on their official website are:

- ABB
- Siemens
- Honeywell

1.4 Question 4

An international conference dedicated to nonlinear MPC is the 6th IFAC Conference on Nonlinear Model Predictive Control, which took place August 2018 in Madison, Wisconsin (USA).

2 Checkpoint 2

2.1 Question 1

The principle of MPC strategy:

- At each decision instant, evaluate the situation
- Compute the best strategy based on this
- Apply the beginning of the strategy until the next decision instant
- Keep repeating the above

2.2 Question 2

In the standard notation of a dynamic system $x_{k+1} = f(x_k, u_k)$ in discrete-time setting,

- x stands for the state vector, $\in \mathcal{R}^n$.
- u stands for the input vector (vector of manipulated variables), $\in \mathcal{R}^m$.
- k is the current instant, the short form of $k\tau$ where τ is some sampling period.
- x_k and u_k stand for the state and the applied constant control input during $[k\tau, (k+1)\tau]$.

2.3 Question 3

Using the same notation as in the previous question and assuming that the system has three actuators and that we consider a prediction horizon N of 50 sampling periods,

- $\mathbf{u}_k$ stands for the sequence of future control inputs on $[k, k + N\tau]$.
- $\mathbf{u}_k$ has a dimension of 50×3 where 50 rows with one for each instant and three columns for three actuators.

2.4 Question 4

The three ingredients of an optimization problem:

- A cost function to be minimized $V(\mathbf{u})$
- A vector of decision variable $\mathbf{u}$ (degrees of freedom)
- A set of admissible values of $\mathbf{u}$, say $\mathcal{U}$