Homework 6

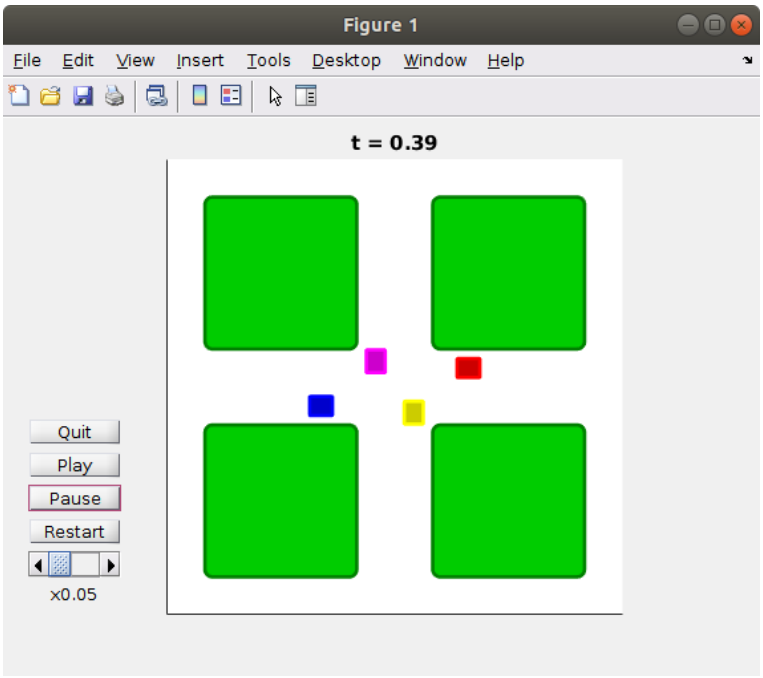
Erivelton Gualter dos Santos

Model Predictive Control

1. Serial distributed MPC for a traffic intersection with autonomous vehicles

This problem exemplify the use of serial distributed MPC for a traffic intersection with autonomous vehicles. The car model used in this approach was a double integrator. In order to compare the advantages of use serial distributed MPC versus centralized MPC, the simulation was timed for both case. An animation was also built in order to visualize the traffic intersection as depicted in figure 1.

Figura 1. GUI Interface



The following plot shows the position of the cars along the time.

Additionally, the following figure shows the time consuming for both MPC approaches. Note that the serial MPC is much faster than the centralized approach.

Figura 2. Car Position along the time

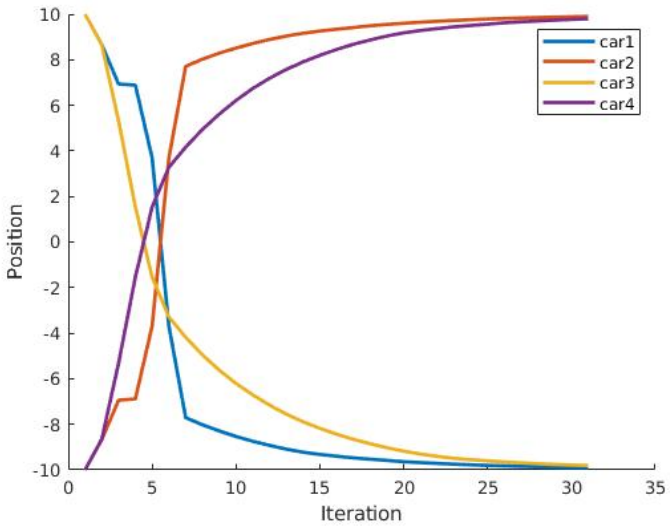
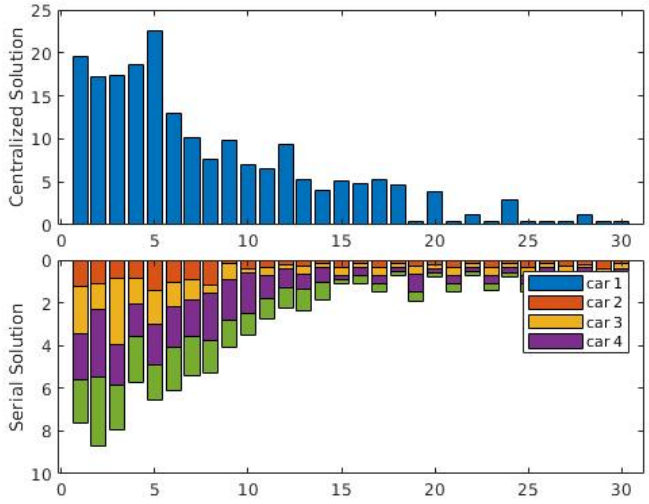


Figura 3. Centralized solution vs. the serial distributed



2. Parallel distributed MPC

A dual decomposition MPC was used to control a given plant in terms of state space system. As in the serial approach, the dual decomposition is also based on the creation of subsystem. Therefore, take in consideration the following matrix, the system were divided in two subsystem. The first subsytem consist in the first and second state, while the second system consist on the last state.

$$A = \begin{bmatrix} 1 & 2 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 2 \end{bmatrix} \text{ and } \begin{bmatrix} 1 & 0 \\ -1 & 0 \\ 0 & 1 \end{bmatrix}$$

The global Lagrange multiplier were initialized with a zero value. However, the code presented also good performance for random numbers. The following plots show the state response, control inputs and computation time. Note, that parallel distributed MPC also presented faster computation time then the centralized MPC.

Figura 4. Centralized solution vs. the serial distributed

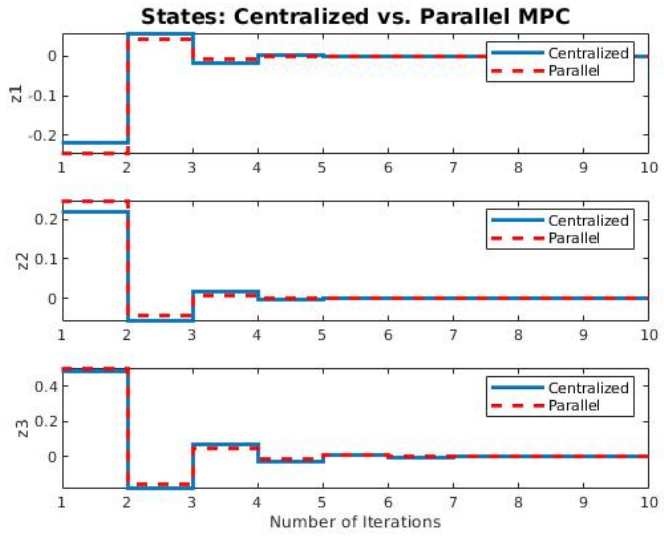


Figura 5. Centralized solution vs. the serial distributed

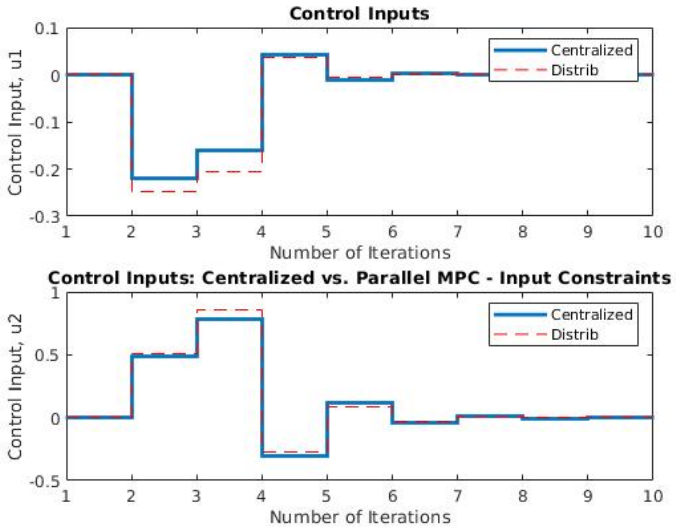


Figura 6. Centralized solution vs. the parallel distributed