TEMPERATURE CONTROL

In this project controllers are designed for controlling the temperature of the system. Two approaches are followed

1. LQOC
2. MPC

Firstly, the model Identification of the system is done from data. A second order ARMX model is identified.

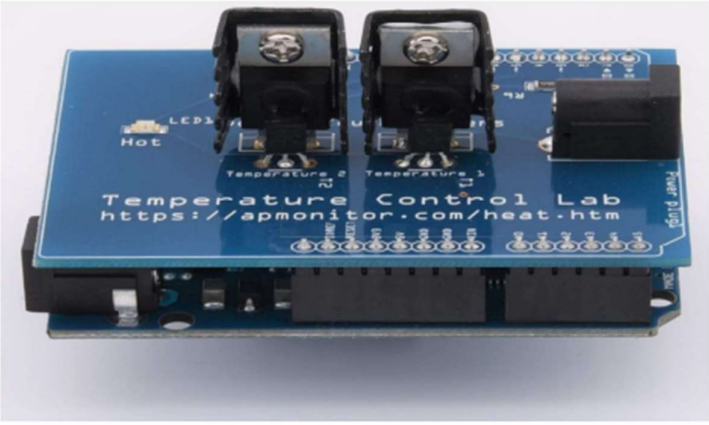


Figure 1 Temperature Control Lab (TCL) setup

We have a Multi -Input Multi-output (MIMO) system, schematic is shown below:

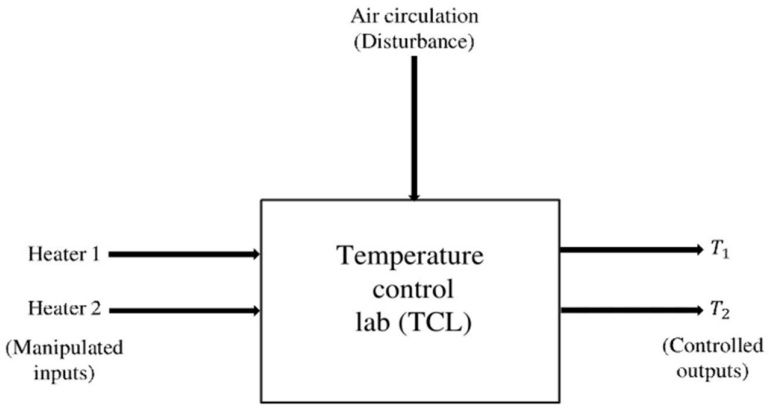


Figure 2 TCL: Schematic representation of the control system

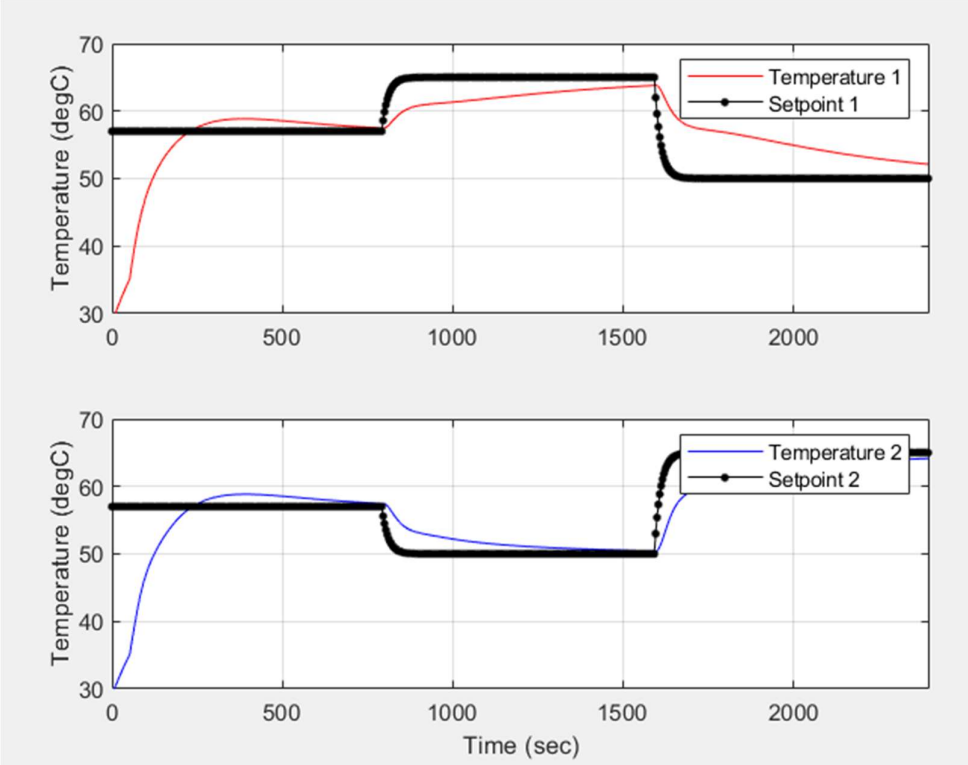
RESULTS:

Firstly, the controllers are simulated and the results are presented below. The performance achieved is very good and finally the controllers are implemented on the TCL setup.

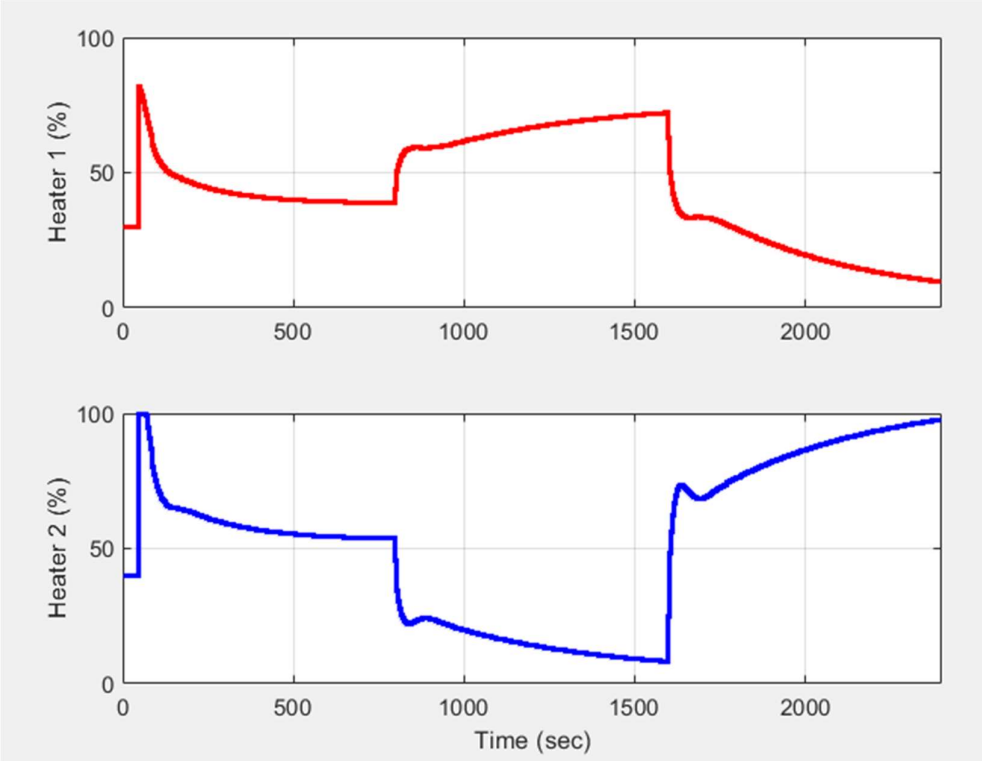
Simulation Results:

LQOC:

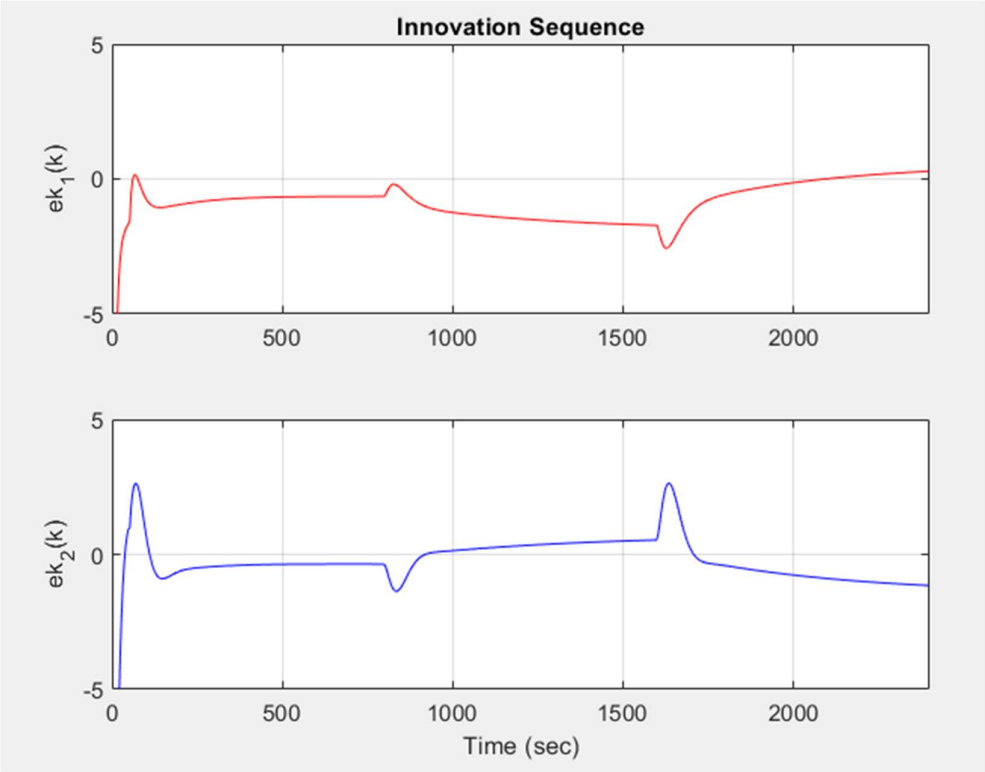
TEMPERATURE OUTPUT:



MANIPULATED INPUTS:



ERROR:



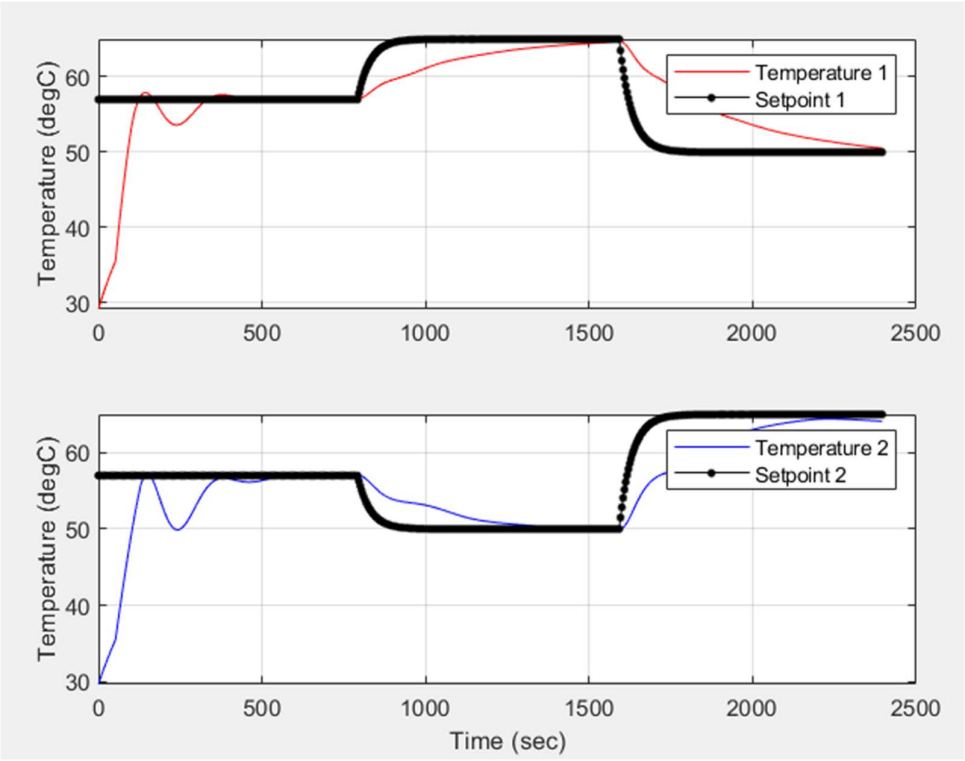
MPC:

The MPC problem is solved by re-formulating it as a QP. MATLAB's Optimization toolbox function **quadprog** is used to solve the QP.

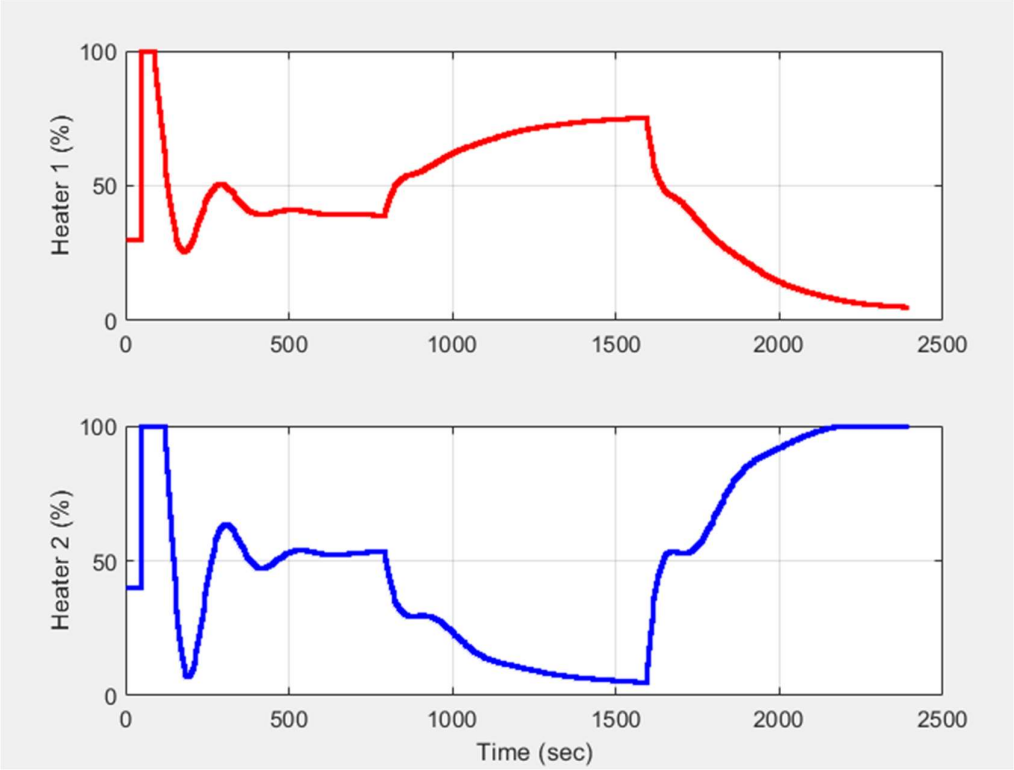
Tuning parameters:

$$\begin{aligned} \mathbf{w}_x &= \mathbf{C}^T\mathbf{C} \;;\; \mathbf{w}_u = \mathbf{I}_{2\times 2} \;;\; p = 75 \;; q = 5 \;; \alpha = 0.9 \\ \mathbf{U}_L &= [0 \quad 0]^T; \quad \mathbf{U}_H = [100 \quad 100]^T; \\ \mathbf{u}_L &= \mathbf{U}_L - \mathcal{U}_s \quad ; \quad \mathbf{u}_H = \mathbf{U}_H - \mathcal{U}_s \end{aligned}$$

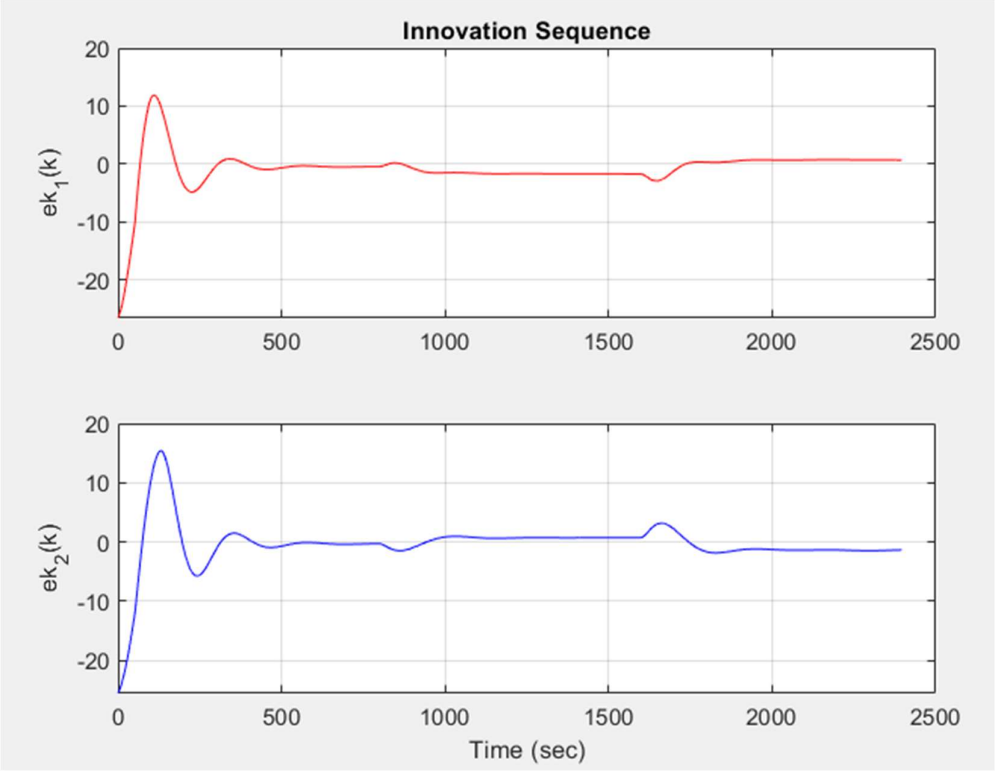
TEMPERATURE OUTPUT:



MANIPULATED INPUTS:



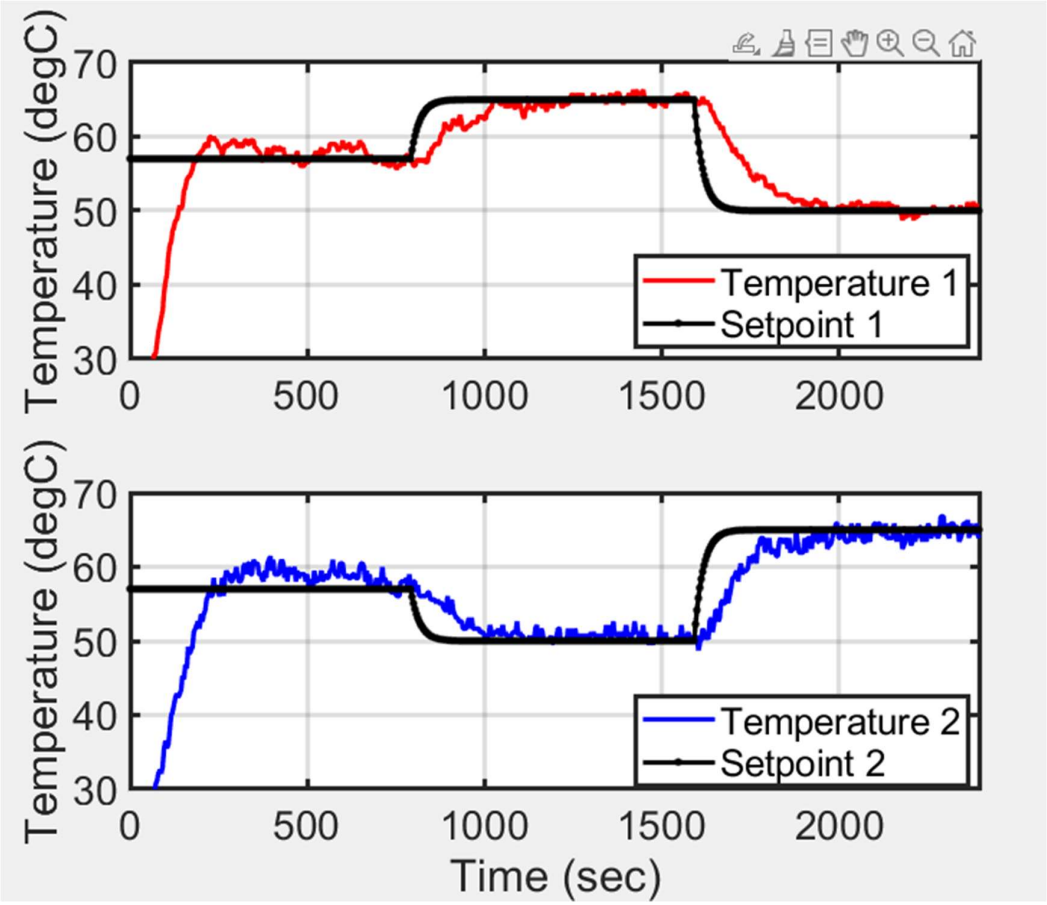
ERROR:



TCL – Setup Results:

LQOC:

TEMPERATURE OUTPUT:



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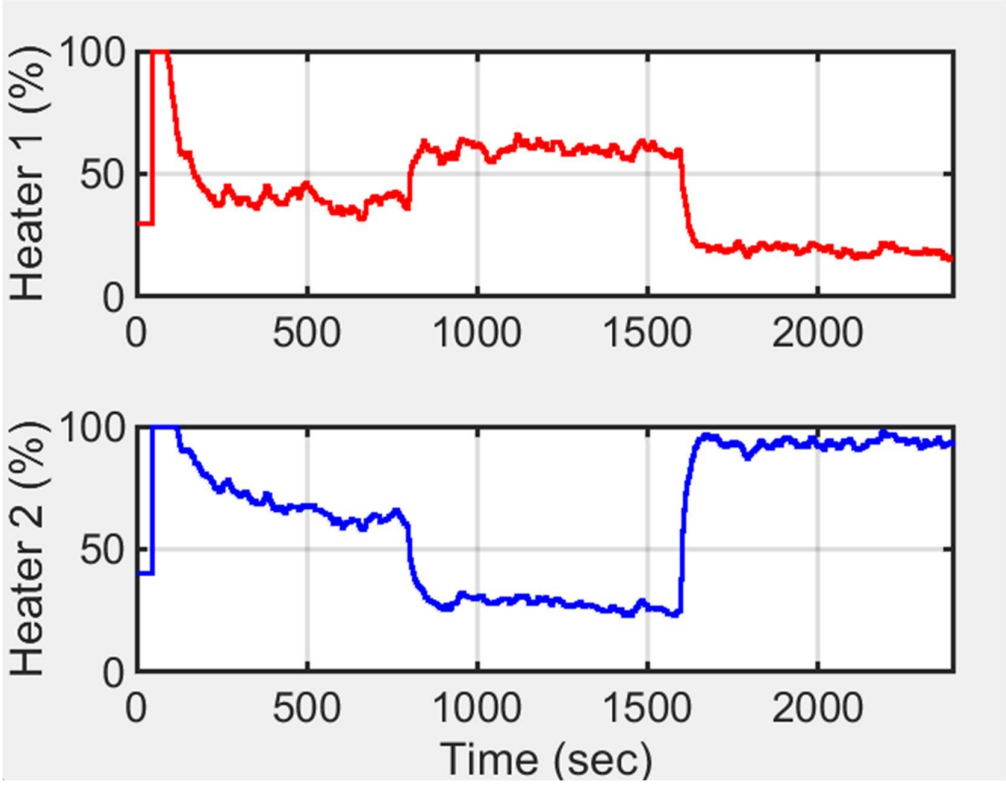

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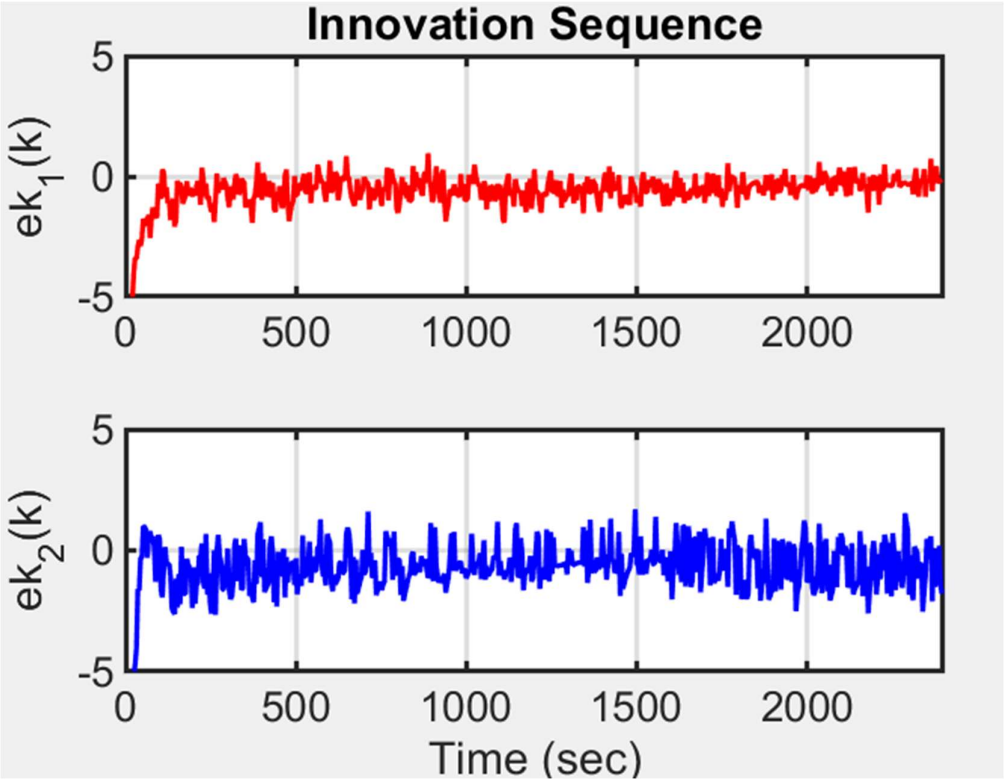
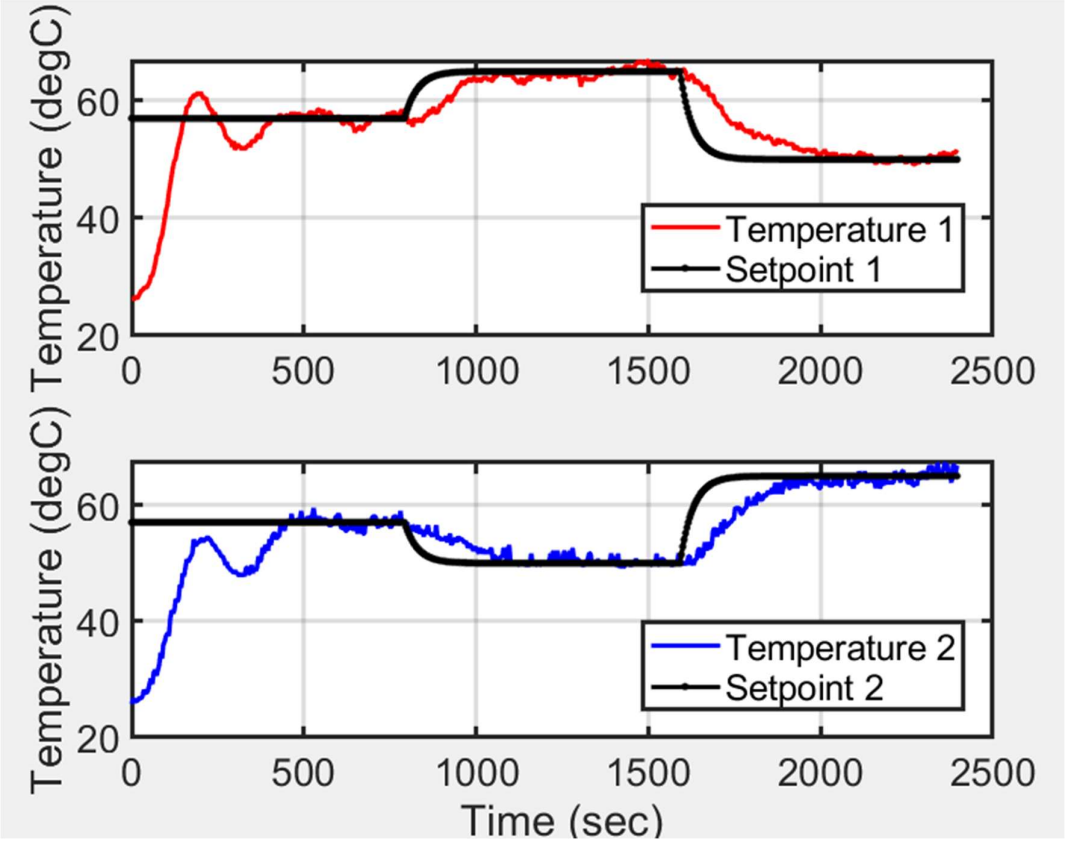


MPC:

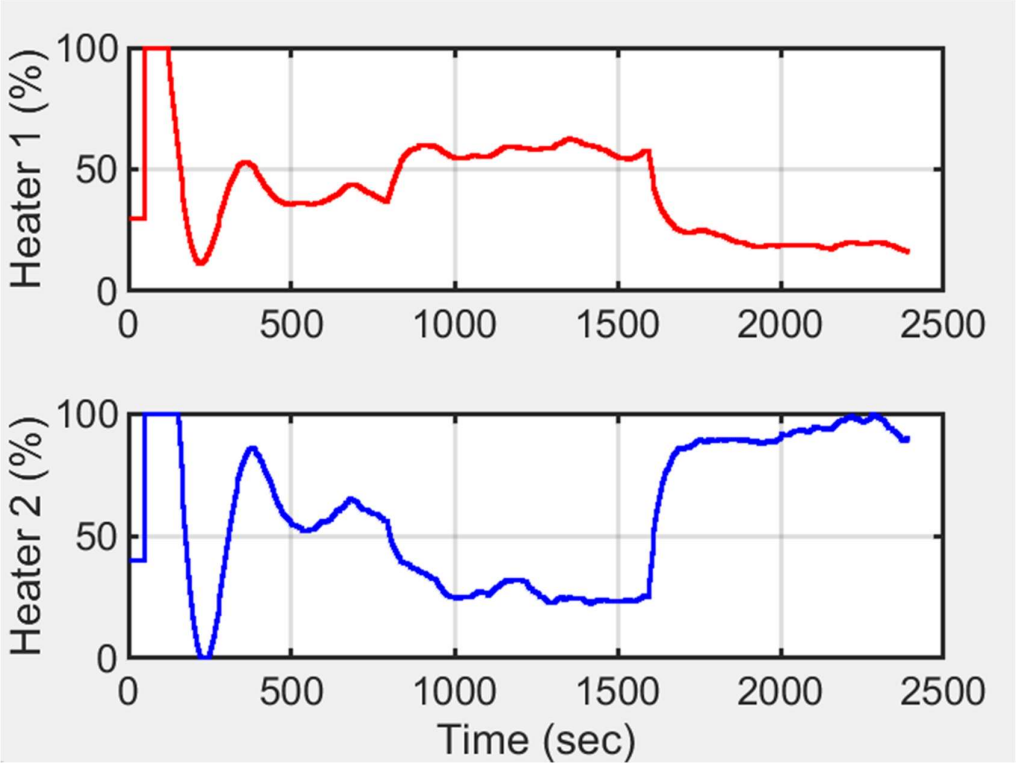
Tuning Parameters:

$$
\begin{aligned}
\mathbf{w}_x &= \mathbf{C}^T\mathbf{C} \;;\; \mathbf{w}_u = \mathbf{I}_{2\times 2} \;;\; p = 75 \;;q = 5 \;;\alpha = 0.9 \\
\mathbf{U}_L &= [0 \quad 0]^T; \quad \mathbf{U}_H = [100 \quad 100]^T; \\
\mathbf{u}_L &= \mathbf{U}_L - \mathcal{U}_s \quad ; \quad \mathbf{u}_H = \mathbf{U}_H - \mathcal{U}_s
\end{aligned}
$$

TEMPERATURE OUTPUT:



MANIPULATED INPUTS:



ERROR: