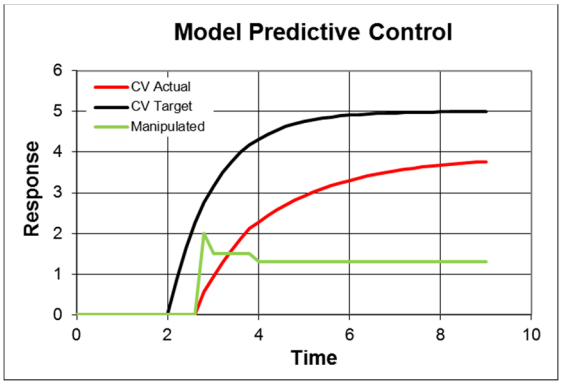
Special Problem 11 - ChE 436 – Process Control

Model Predictive Control, or MPC, is an advanced method of process control that has been in use in the process industries such as chemical plants and oil refineries since the 1980s. Model predictive controllers rely on dynamic models of the process, most often linear empirical models obtained by system identification.



These models are typically in the finite impulse response form or linear state space form. Nonlinear elements can be added to avoid multiple model switching, gain scheduling, or other ad hoc measures commonly employed because of linear MPC restrictions.

For this homework assignment, you are requested to manually determine the set of inputs (MVs) that will achieve the desired target tracking. Use the associated Excel spreadsheet to complete this assignment. For the following 3 scenarios, complete parts a and b.

Scenario 1: Faster than the natural process time constant

Target Trajectory Parameters	
Final Target	5
Time Constant (tau)	1
Delay (theta)	2

Scenario 2: Equal to the natural process time constant

Target Trajectory Parameters	
Final Target	5
Time Constant (tau)	3
Delay (theta)	2

Scenario 3: Slower than the natural process time constant.

Target Trajectory Parameters	
Final Target	5
Time Constant (tau)	4
Delay (theta)	2

Part a) Use Excel solver to adjust the Delta MV moves to match the CV Actual with the CV Target. Minimize a sum of squared errors *OR* sum of absolute errors. Comment on the results and the ability of the solver to achieve the desired trajectory.

Part b) Manually adjust the solution that Excel solver provided to further improve the solution, if possible. Note that there are better solvers for this problem than the Nonlinear GRG solver that Excel provides. Manual adjustment of the solution is not required for commercial Model Predictive Control (MPC).

Problem Configuration				Change	u	y	Target		
y0	0		**time**	**Delta MV**	**manipulated**	**model**	**desired**	**abs(error)**	**error^2**
time step	0.2		0		0	0	0	0	0
			0.2	0	0	0	0	0	0
Model Parameters			0.4	0	0	0	0	0	0
gain	3		0.6	0	0	0	0	0	0
tau	3		0.8	0	0	0	0	0	0
theta	0		1	0	0	0	0	0	0
			1.2	0	0				
Target Trajectory Parameters			1.4	0	0				
Final Target	5		1.6	0	0				
Time Constant (tau)	4		1.8	0	0				
Delay (theta)	2		2	0	0				
			2.2	0	0				
			2.4	0	0				
Minimize Either of These			2.6	0	0				
Sum of Squared Errors	90.31725		2.8	0.2	0.2				
Sum of Absolute Errors	54.05464		3	0	0.2				

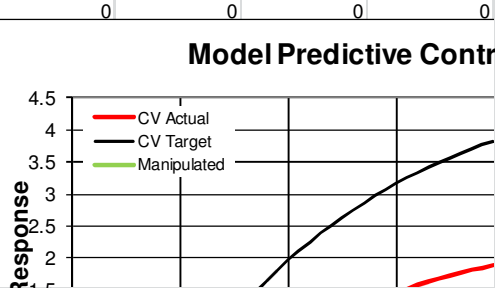


Fig 1. Screenshot of the Excel Spreadsheet for this exercise.