

ANSWER KEY - LABORATORY EXERCISE  
FAMILIARITY WITH MODEL PREDICTIVE CONTROL

## 4. MPC OPERATION

- Does the actual behavior follow the predicted behavior? Yes
- Does the predicted behavior approach the SP? Yes
- Does the PV (actual) behavior remain approximately on SP? Yes
- Does the MV (output) change to compensate for this load change? Yes
- .... which should be approximately compensated for by feedforward action. Is it? Yes

## 5. DETAILED ANALYSIS

## 6. ANOTHER CALCULATION CYCLE, FOLLOWING A LOAD CHANGE

The following pages give an example of the worksheets which are requested by the exercise. Your data will probably be different, because no two persons will start collecting data for the worksheet with the process in the same state. Nevertheless, the example should be helpful.

Note that your predicted profile (for example, column 4) should agree with the computer-generated data (for example, column 5) except for possible round-off error in the second place to the right of the decimal.

## 7. OTHER EXPLORATION (Optional)

## 7.2 Multiple-Input, Multiple-Output

- One at a time, change the set points for PV-1 and PV-2. Do both outputs change? Yes
- Does the other PV stay approximately on SP? Yes
- .... You should be seeing a random load change of both disturbance variables. Do both PV's stay approximately on SP? Yes

## 7.3 Insufficient Degrees of Freedom

- With a higher priority given to PV-1, it will control closer to its set point, but at the expense of more deviation at PV-2. Is this what you observe? Yes
- ... priority for PV-2 of 0.95. Do the PVs move in a way that you would expect. Yes. PV-2 is closer to SP. There is more deviation of PV-1.

## 7.4 Output Limiting.

- What is the largest move (change) that the controller output makes in any one calculation cycle? 6.7%. First step only
- The controller output should now show the effects of limiting the size of the move. Do you observe that? Yes. First 3 steps are 3%.

PV-1 RESPONSE  
TO UNIT STEP CHANGE OF:

Worksheet No. 1

STEP	OUT-1	LOAD-1
0	0.000	0.000
1	0.009	0.000
2	0.067	0.000
3	0.201	0.000
4	0.405	- 0.012
5	0.664	- 0.038

MODEL PREDICTIVE CONTROL WORKSHEET

using  
MPC-ControlLAB  
from  
Wade Associates, Inc.  
Houston, TX

Step No	1	2	3	4	5	6	7	8	9	10	11	12	Step No
	End of Last Cycle	Start of New Cycle	Fdbk Corr +0.006	Feedback Correction		Load Change 0.000	Feedforward Correction		Control Move -1.432	Control Correction		End of Cycle	
				Your Predicted Profile	MPC Predicted Profile		Your Predicted Profile	MPC Predicted Profile		Your Predicted Profile	MPC Predicted Profile		
0	305.250	313.664	313.670	313.670	313.670	0.000	313.670	313.670	0.000	313.670	313.670	313.670	0
1	313.664	321.833	Read Actual PV from VIEW   DATA MONITOR	321.839	321.840	0.000	321.840	321.840	- 0.013	321.827	321.827	321.827	1
2	321.833	329.579		329.585	329.585	0.000	329.585	329.585	- 0.096	329.489	329.489	329.489	2
3	329.579	336.845		336.851	336.852	0.000	336.852	336.852	- 0.288	336.564	336.564	336.564	3
4	336.845	343.631	343.637	343.638	0.000	343.638	343.638	- 0.580	343.058	343.058	343.058	343.058	4
5	343.631	349.946	349.952	349.953	0.000	349.953	349.953	- 0.950	349.003	349.002	349.002	349.002	5

PV-1 RESPONSE  
TO UNIT STEP CHANGE OF:

Worksheet No. 2

STEP	OUT-1	LOAD-1
0	0.000	0.000
1	0.009	0.000
2	0.067	0.000
3	0.201	0.000
4	0.405	- 0.012
5	0.664	- 0.038

MODEL PREDICTIVE CONTROL WORKSHEET  
using  
MPC-ControlLAB  
from  
Wade Associates, Inc.  
Houston, TX

Step No.	1	2	3	4	5	6	7	8	9	Control Correction		12	Step No.
										Your Predicted Profile	MPC Predicted Profile		
0	End of Last Cycle	Start of New Cycle	Fdbk Corr Actual PV	Your Predicted Profile	MPC Predicted Profile	Load Change 5.0 (%) Load Change Effect	Your Predicted Profile	MPC Predicted Profile	Control Move Control Move Effect	Your Predicted Profile	MPC Predicted Profile	End of Cycle	0
1			Read Actual PV from VIEW   DATA MONITOR		329.506	0.000	329.506	329.506					1
2					336.583	0.000	336.583	336.583					2
3					343.079	0.000	343.079	343.079					3
4					348.085	- 0.060	348.025	348.021					4
5					354.461	- 0.190	354.271	354.225					5