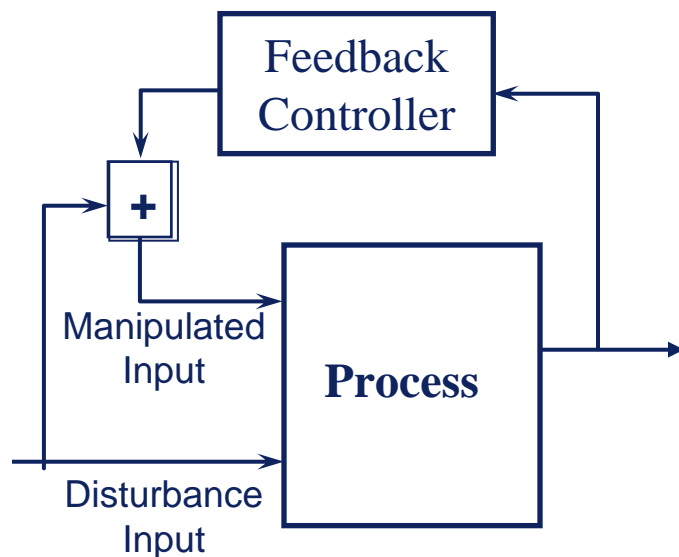


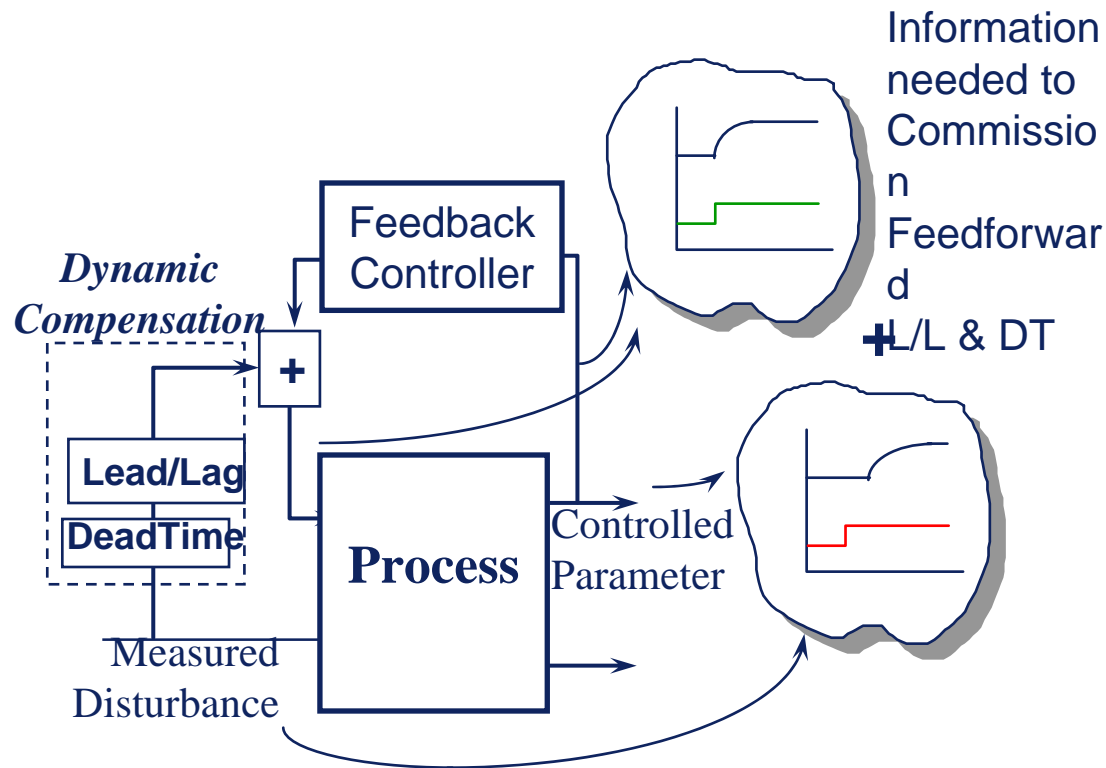
Feedforward Control

Basis of Feedforward Control



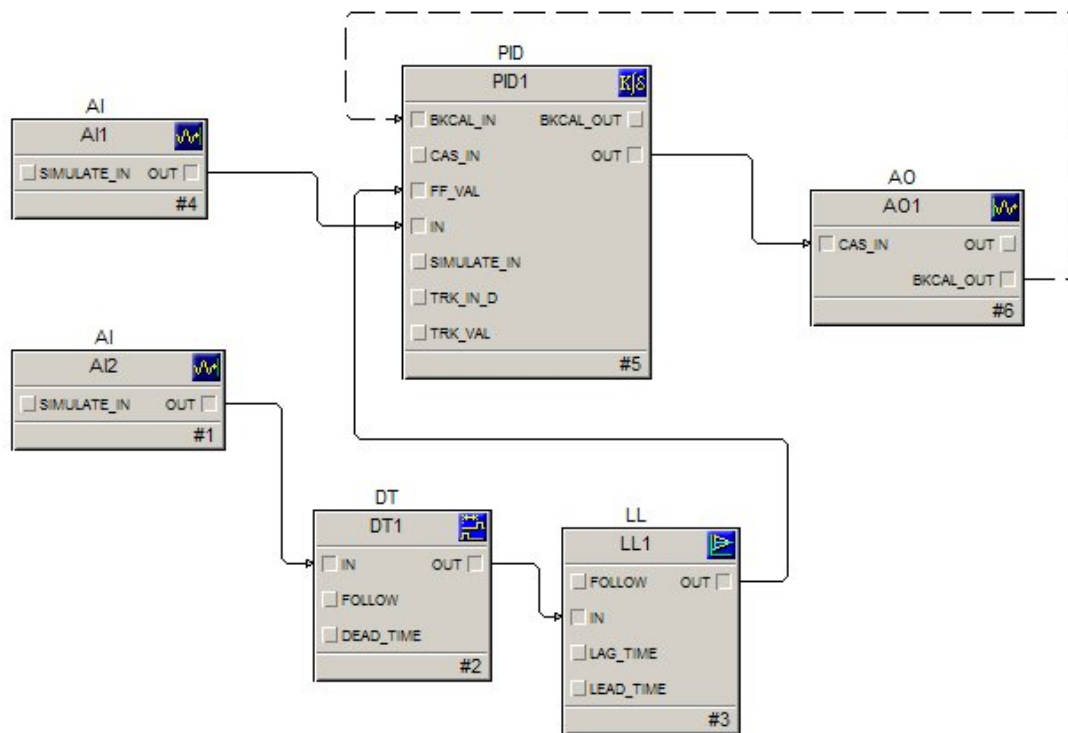
- In some cases the major load disturbance to a process may be measured and utilized to provide feedforward control.
- The advantage feedforward control is that corrective action is taken for a change in a disturbance input **before** it affects the control parameter.
- Feedforward control is used in conjunction with feedback control to provide multiple-input single output (MISO) control

Feedforward Dynamic Compensation



- When the dynamic response of the controlled parameter to a change in the disturbance input differs significantly from that for the manipulated parameter, then **dynamic compensation** should be included in the feedforward implementation.
- It can be shown that a pure deadtime and lead/lag unit provide correct compensation for first order plus deadtime processes.

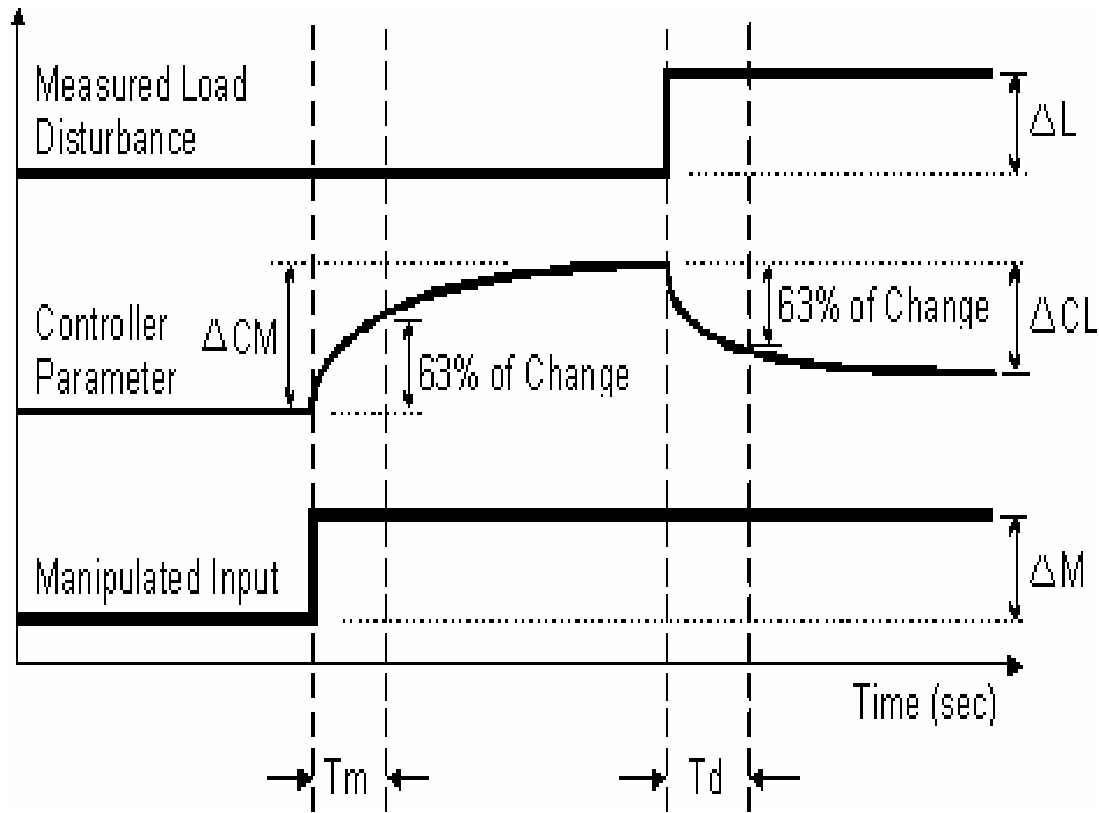
Feedforward Control in DeltaV



Addition of feedforward input and scaling of feedforward input by **FFW_GAIN** is included as part of the DeltaV PID.

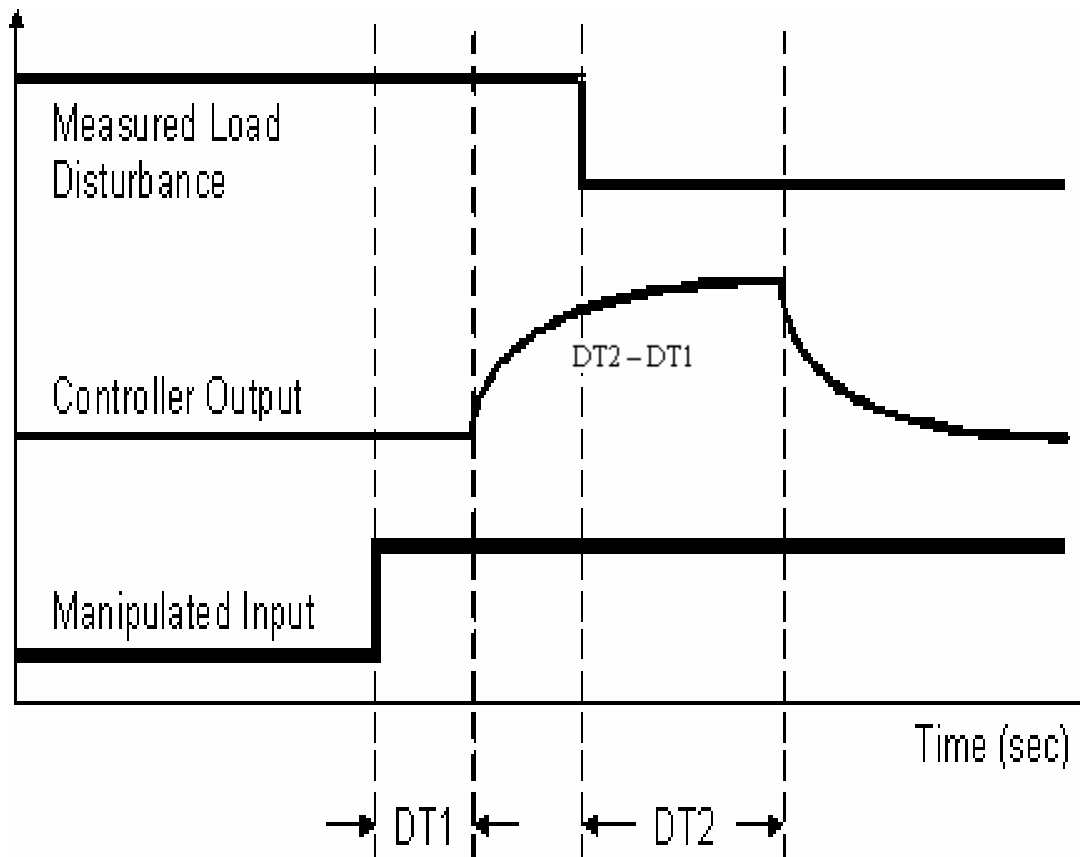
DT and LL blocks are used to implement the lead-lag and deadtime components of dynamic compensation

Setup of Lead-Lag Block



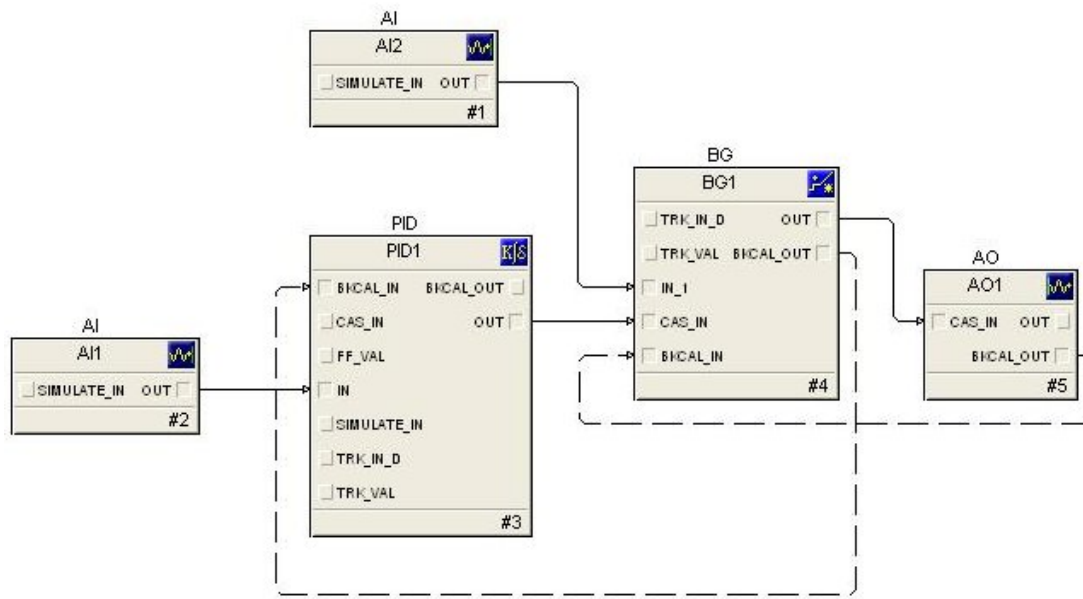
- Set the **LEAD_TIME** to T_m
- Set the **LAG_TIME** to T_d .
- The gain of the L/L should be set to :
- - (Load Dist Gain/Manip Gain).

Setup of Deadtime Block for Dynamic Compensation



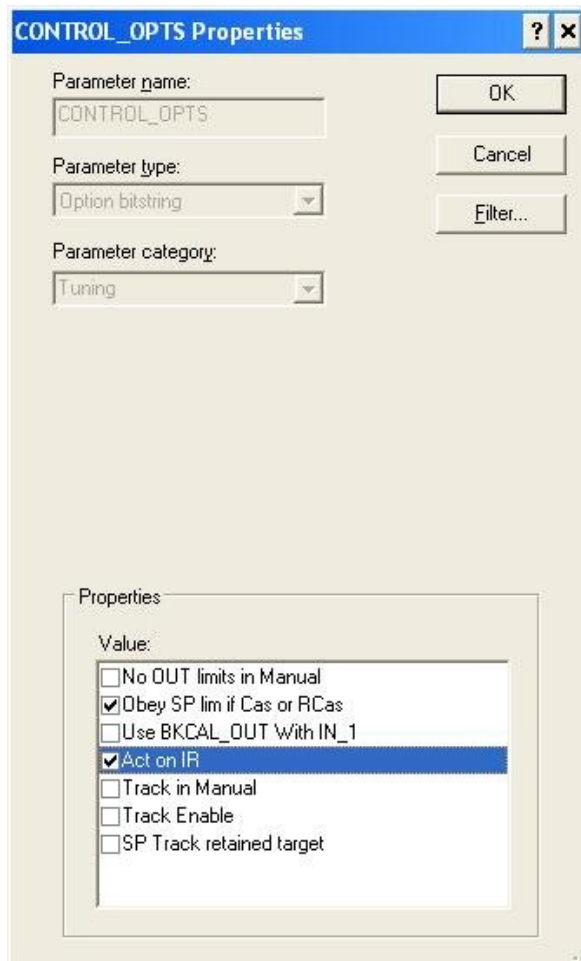
- The DEAD_TIME parameter should be set to a value of $DT2 - DT1$.
- If $DT1$ is greater than $DT2$, then compensation for deadtime is not required.

Alternate Implementation - External Feedforward – Using Bias-Gain Block



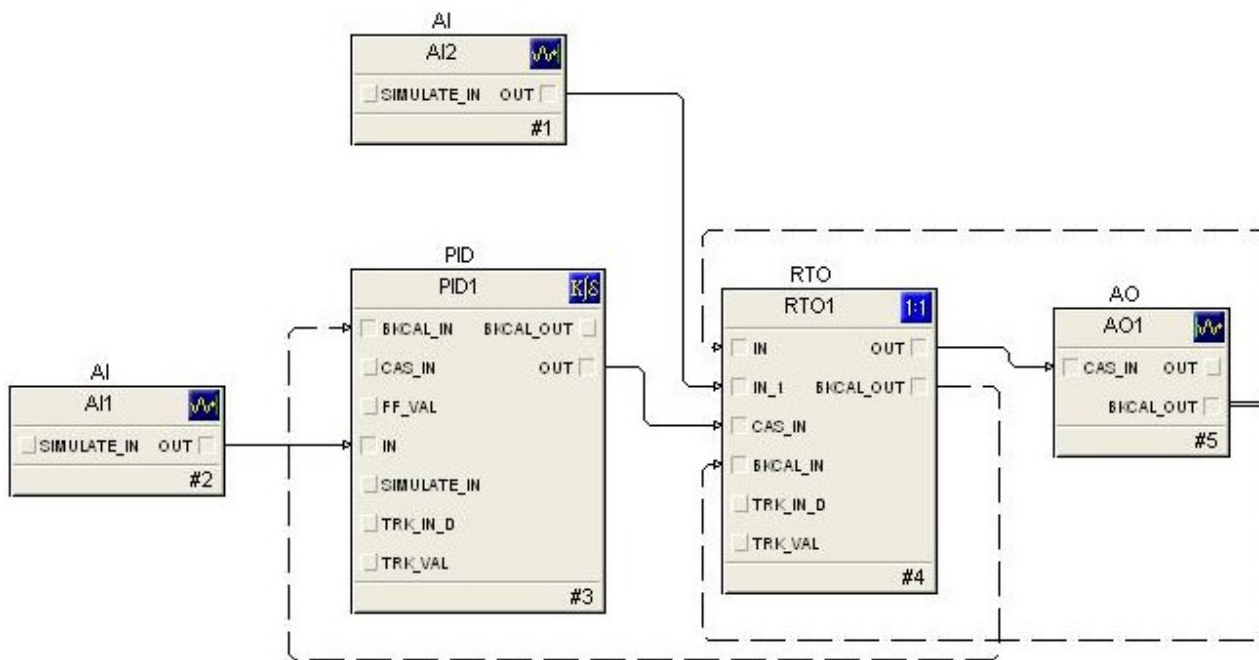
- The feedforward input is added to the PID output using the Bias-Gain Block.
- Advantage is that the feedforward action continues even if PID is in Man mode
- Feedback correction is limited by the PID output limits

External Feedforward - Bias(Cont)



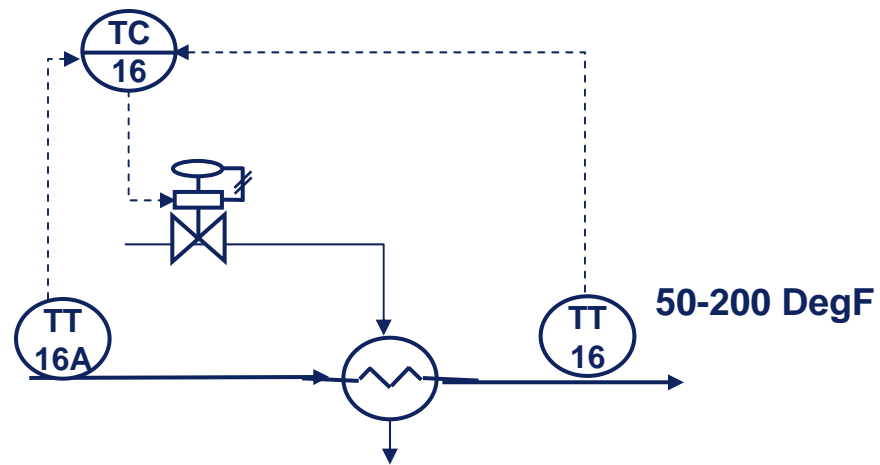
→ Act on IR should be selected to allow the bias (SP) to be initialized on transition from IMAN to CAS actual mode.

Alternate Implementation - External Feedforward - Ratio



- Ratio block is used to multiply the PID output with the feedforward input.
- Feedforward continued even if PID is in Man mode
- Ratio correction is limited by the PID output limits

PID Feedforward Workshop



Feedforward Control Workshop

- Step 1. Using the EXAMPLE_D_FF module, make a change in the process disturbance value with the PID in automatic (with Feedforward disabled). What impact does the disturbance have on the process and the value of the PID output value needed to maintain Setpoint?
- Step 2. Change the mode of the PID to manual. Identify the process gain, lag and deadtime for a step change in the PID output.
- Step 3. With the PID in manual and the process at steady state, change the value of the process disturbance by a step and identify the process gain, lag and deadtime for a change in the disturbance input.
- Step 4. Calculate the feedforward gain (See L/L setup for guidance) based on the process responses. Enter this gain in the FF_GAIN parameter and enable feedforward action through the FF_ENABLE parameter.
- Step 5. Change the mode of the PID to AUTO and let the loop settle at a target SP value. Make a change in the disturbance input and observe the controller and process output. Did the feedforward action minimize the impact of the disturbance?

EXAMPLE_D_FF

