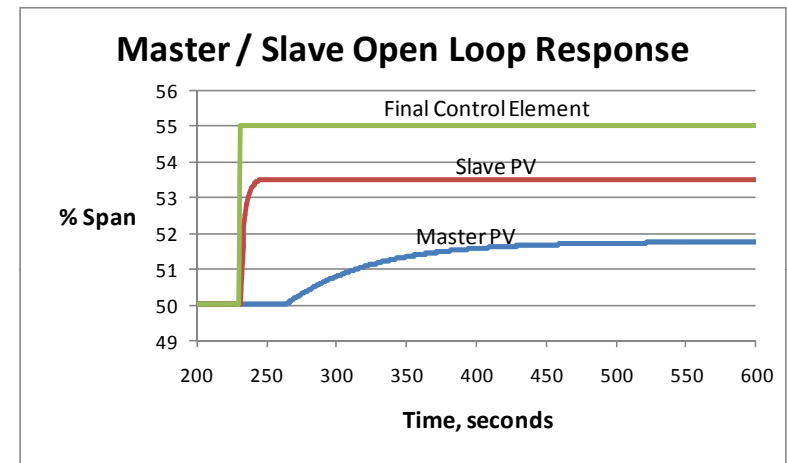
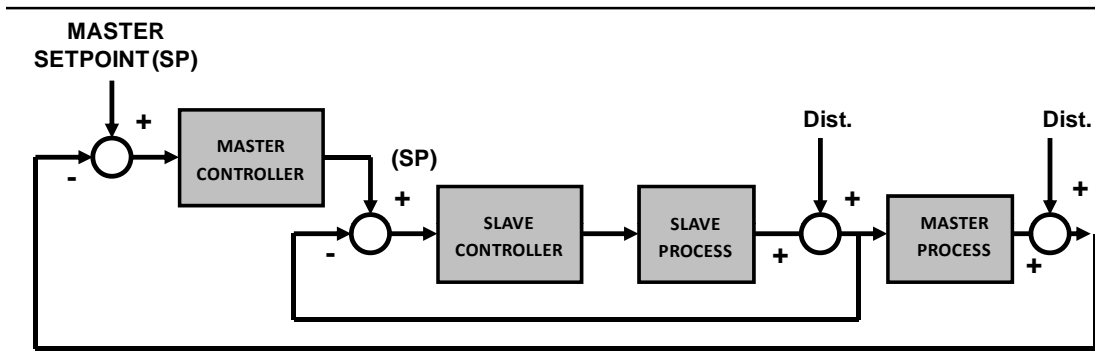


Opportunities for Cascade Control

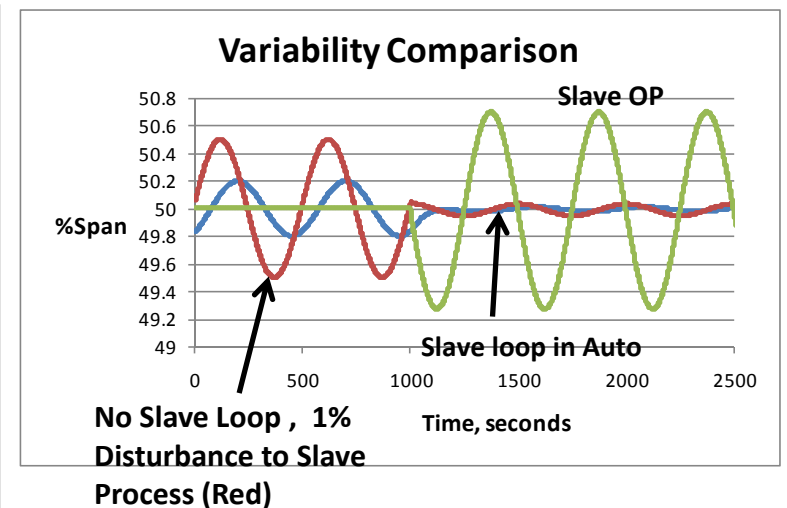
How does it Work?

A cascade control strategy consists of a master loop and a slave loop. The slave controller receives a remote setpoint from the master controller. The slave controller drives the slave process to the remote setpoint. The master process responds to a change in the slave process.



Benefits

The primary benefit of cascade control results from the faster dynamics in the slave loop. The slave loop can be tuned aggressively, effectively shielding the master process from disturbances to the slave process. The Slave loop also protects the Master loop from control valve related non-linearity. The fast slave controller will work through backlash and stiction relatively quickly, minimizing the variability impact to the Master process. The impact of non-linear process gain resulting from control valve flow characteristics will be minimized since the Master controller is adjusting a setpoint rather than a valve position. Remember that an oversized control valve operating at a highly throttled position usually has higher levels of valve related non-linearity.



Opportunities for Cascade Control

Identifying Good Candidates for Cascade Control

Control loops that exhibit some or all of the following characteristics may be good candidates for a cascade control strategy.

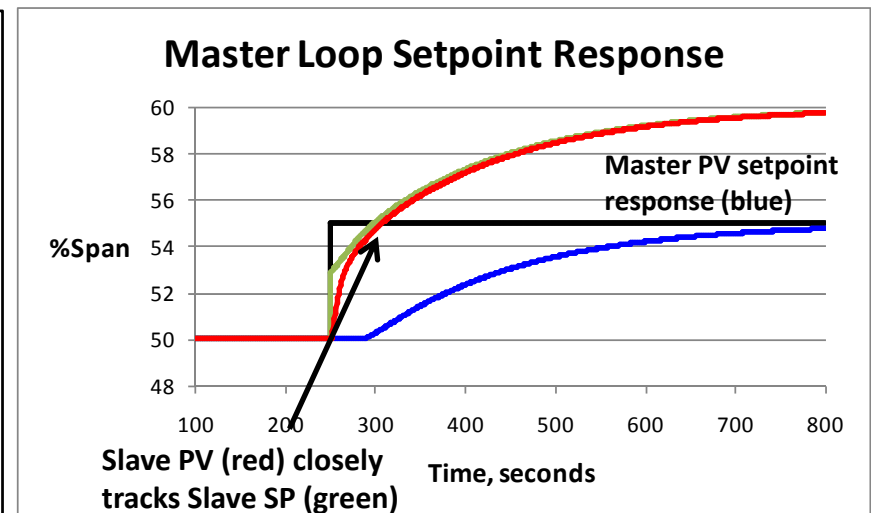
- The process dynamics are slow and contain deadtime. Even after optimizing the tuning, the controller is unable to attenuate the major external disturbances and the process variability targets are not being achieved.
- The closed loop dynamics of the proposed slave loop are fast enough to attenuate the major disturbances to the slave process. In addition, the slave process disturbances are a significant contributor to Master process variability.
- There are significant control valve related nonlinearities that are creating process cycles or compromising loop performance.

Typical Applications

- Level (master) to flow (slave).
- Concentration (master) to dilution flow (slave).
- Steam Header pressure (master) to air / fuel flow (slave)
- Temperature (master) to steam flow (slave)

Implementing the Strategy

- Ensure that the Slave controller tuning is fast enough to track the slave process to the remote setpoint.
- Install bumpless transfer logic so that the Master controller outputs tracks the slave loop PV when the slave controller is not in cascade mode.
- Make sure that the slave loop design is adequate to achieve the control objectives of the master loop. Typically, the slave loop PV span should match the 0 to 100% final control element range.



Opportunities for Cascade Control - Quiz

Process Description

The primary functions of the Saveall system (below) are to maximize recovery of fibre/fines and produce high quality (low solids) whitewater.

The following control objectives are important on this system.

- Ensure that the Saveall level is maintained below the overflow point. An overflow will upset Thick Stock consistency, potentially resulting in production losses.
- Minimize variation in the whitewater flowrate and the feed consistency to the Saveall. This will stabilize filtering efficiency and minimize disturbances to the Recovered fibre consistency.
- Maximize whitewater throughput (multiple passes via Cloudy Chest) in order to maximize fibre recovery.

Control Description

- The Saveall Level controller adjusts the WW flow to the Saveall. The output is split ranged adjusting the Cloudy Chest recirculation valve from 0 to 50% and the Saveall Bypass valve from 50 to 100%
- The WW Sump level controller adjusts the flow from the WW Sump to the Saveall. The Sump Level controller disturbs the Saveall Level and the Cloudy chest level controller.
- The Cloudy Chest Level controller adjusts the flowrate to the WW Storage Tank. This controller interacts with the Saveall Level controller.
- The Sweetener Flow controller maintains the sweetener (thick stock) flow at an operator entered flow target.

Quiz

Operations reports that the Saveall Vat overflows several times per week. This is upsetting the thick stock consistency and resulting in product quality losses .

- Identify the weaknesses in the current Saveall Level control strategy.
- What are the best applications for cascade control in this system. State the advantages in each case.
- Estimate the cost of implementing the cascade strategy(s). How will you justify the costs?

Opportunities for Cascade Control - Quiz

