Better PID Control with FF than 4-20 mA

Video

- A study made by Industrial Systems and Control (ISC) in Glasgow
- A spin-off company from University of Strathclyde

http://www.controleng.com/media-library/videos/videos/video-understanding-the-user-case-for-cif.html

Summary

- For fast loops the performance of fieldbus control in the field is significantly better than 4-20 mA
- Benefits of the very highly deterministic nature of control in the field really come into its own on fast process control loops:
  - Pressure
  - Flow
- For pressure and flow loops the performance improved by 10-15% over a 4-20 mA loop

Summary (Cont'd)

- For slow loop (50 second or a 1 minute) the performance benefit is less

Test Results (250 ms process time)

- No performance difference between fieldbus and 4-20 mA loops for P and PD controllers

- For PI and PID fieldbus (CIF) performs better than 4-20 mA
  - 14.8% better for regular stepping disturbance
  - 29.3% better for stochastic disturbance
  - If the disturbance is varying slowly the improvement is less significant

Test Results (10 second process time)

- Negligible performance difference between fieldbus and 4-20 mA loops for P and PD controllers – for slow disturbances
- Fieldbus improvement for PI and PID
  - (Most beneficial at slow controller cycle time; significant if controller is run slow to decrease load; more loops per controller)

Controller Scan Time	Step Disturbance	Stochastic Disturbance
250 ms	6%	5.5%
500 ms	1%	8.5%
1000 ms	8%	15%

Test Results (50 second process time)

- Fieldbus improvement for PI and PID
  - (Most beneficial at slow controller cycle time; significant if controller is run slow to decrease load; more loops per controller)

Controller Scan Time	Step Disturbance	Stochastic Disturbance
250 ms	1.5%	1.5%
500 ms	2.4%	2.5%
1000 ms	4.4%	4.8%

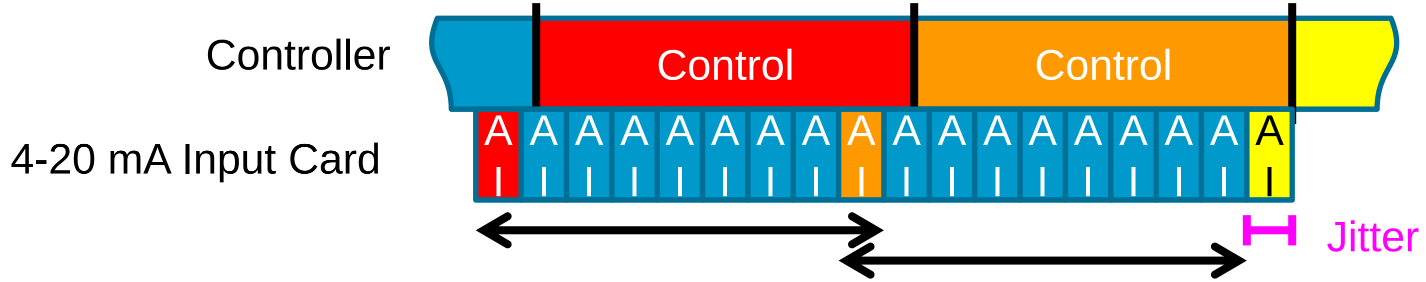
Disturbance Rejection

- Loops affected by fast disturbances benefit the most
- Slowly varying disturbance like ambient temperature sees no performance benefit
- There are a lot more benefits to using control in the field than just the determinism
  - This study just looking at the control loop performance
    - i.e. how much the process variability can be reduced by fieldbus

Significance of the ISC Study

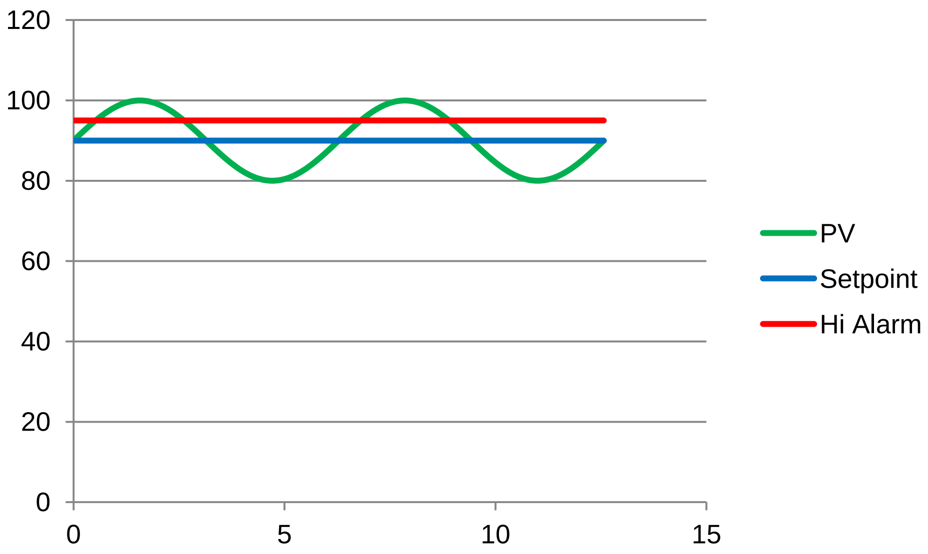
Why Does Fieldbus Control Better than Analog?

- CIF is ‘jitter’ free (constant sampling time)
  - Fieldbus devices are time synchronized
  - Fieldbus communication and control is scheduled
  - A 250 ms macrocycle is 250 ms every time
- 4-20 mA control loops have jitter
  - Because AI and AO cards are not time synchronized with the controller
  - AI and AO scan is independent of control
  - A 4-20 mA loops has:
    - Varying sampling time (not ideal for PID)
    - Longer total loop latency (input to output)

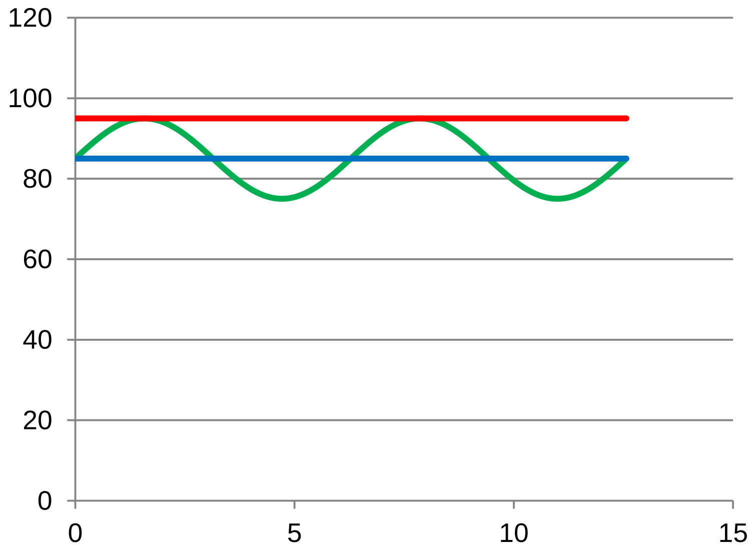


Why is High Process Variability Bad?

- High process variability causes alarms
  - So operators shift the setpoint away from ideal to avoid these alarms (“comfort margin”)
    - This reduces efficiency:
      - Lower throughput
      - Higher consumption of energy and other utilities



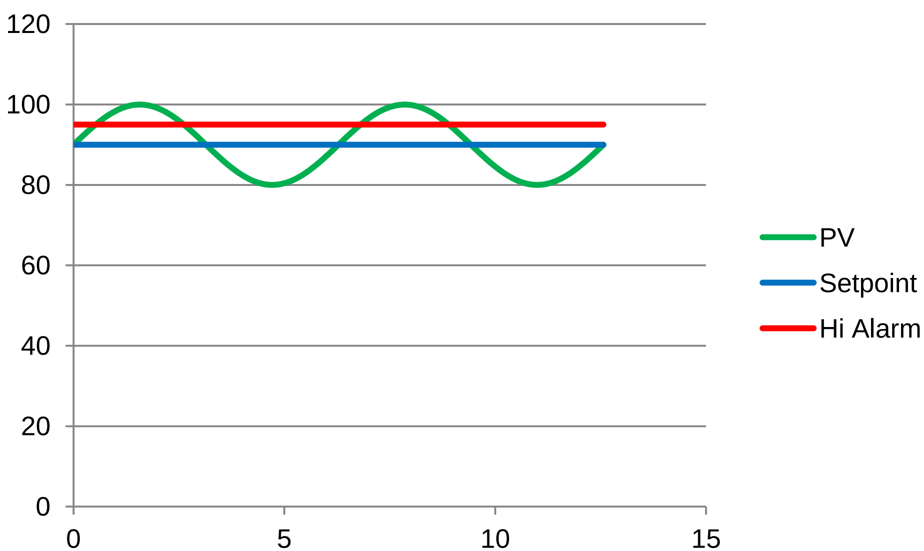
High variability: causes alarms...



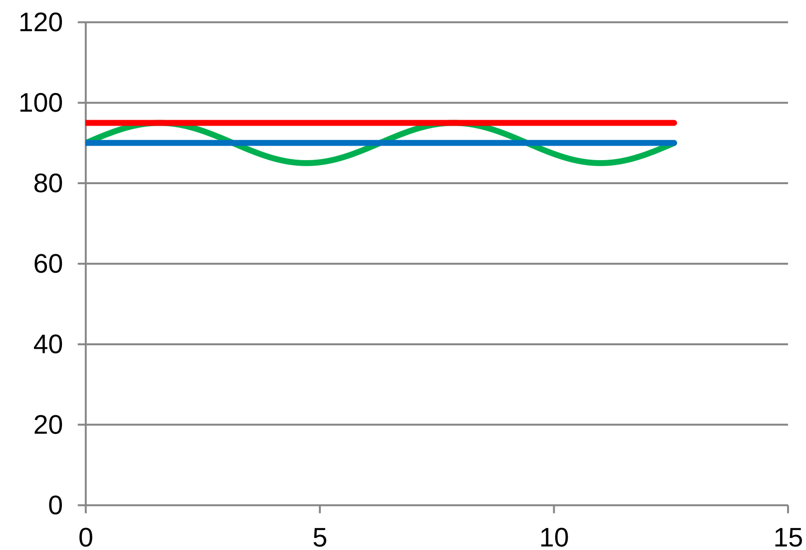
...so operators shift the setpoint

Low Process Variability with Fieldbus

- Low process variability
  - Setpoint can be set closer to ideal
    - This increases efficiency:
      - Higher throughput
      - Lower consumption of energy and other utilities
  - More uniform product: greater quality/yield



High variability: causes alarms...



Low variability: setpoint need not be changed