

Better PID Control with FF than 4-20 mA

Understanding the User Case for CIF

HK YEO
Honeywell



Fieldbus
Foundation

Video: Understanding the User Case for CIF

- 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 loop using 4-20 mA signals

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 [1 second] controller cycle time; significant if loops are run slow to decrease controller load; more loops per controller)

Controller Scan Time	Step Disturbance Improvement	Stochastic Disturbance Improvement
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 Improvement	Stochastic Disturbance Improvement
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

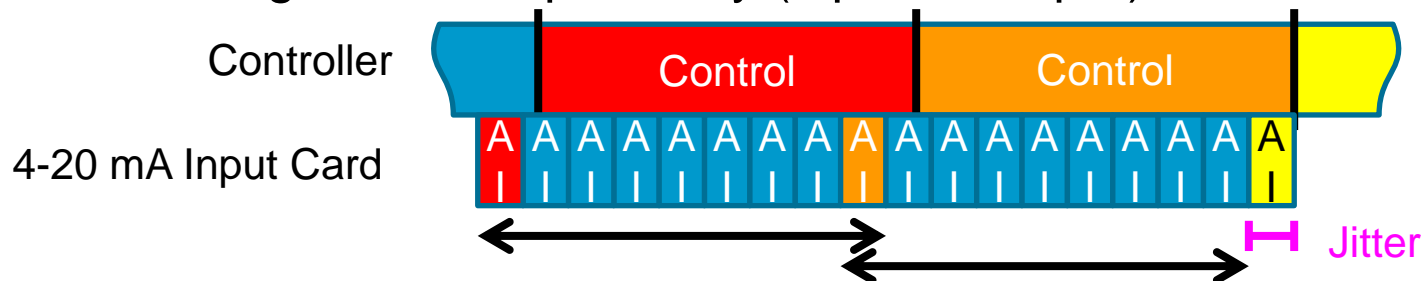
Significance of the ISC Study



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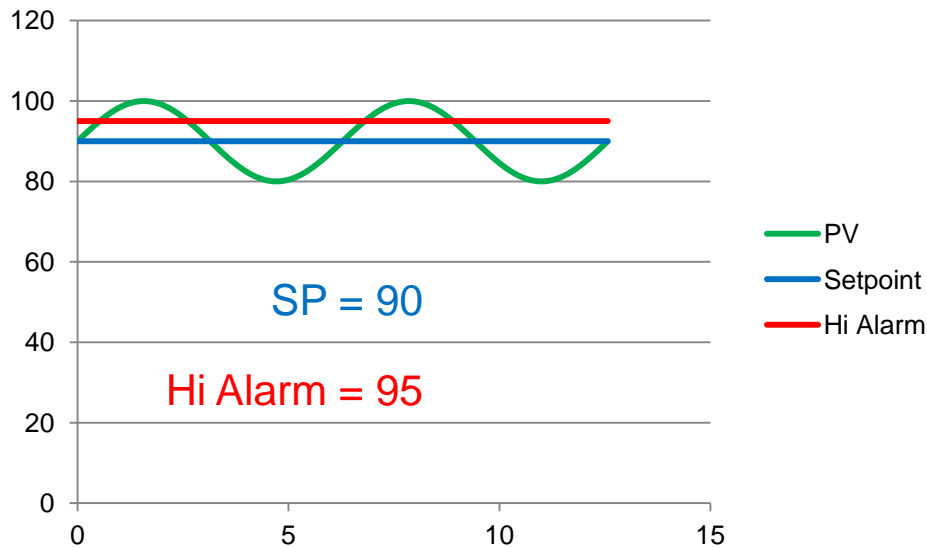
Why Does Fieldbus Control Better than Analog?

- 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 sampling in AI and AO cards is not time synchronized with the controller
 - AI and AO scan is independent of control
 - A 4-20 mA loops have:
 - Varying sampling time (not ideal for PID)
 - Longer total loop latency (input to output)

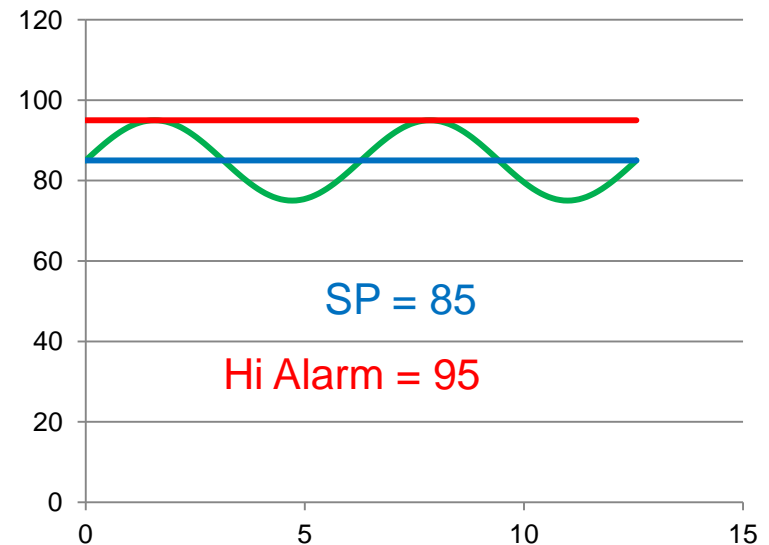


Why is High Process Variability Bad?

- 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



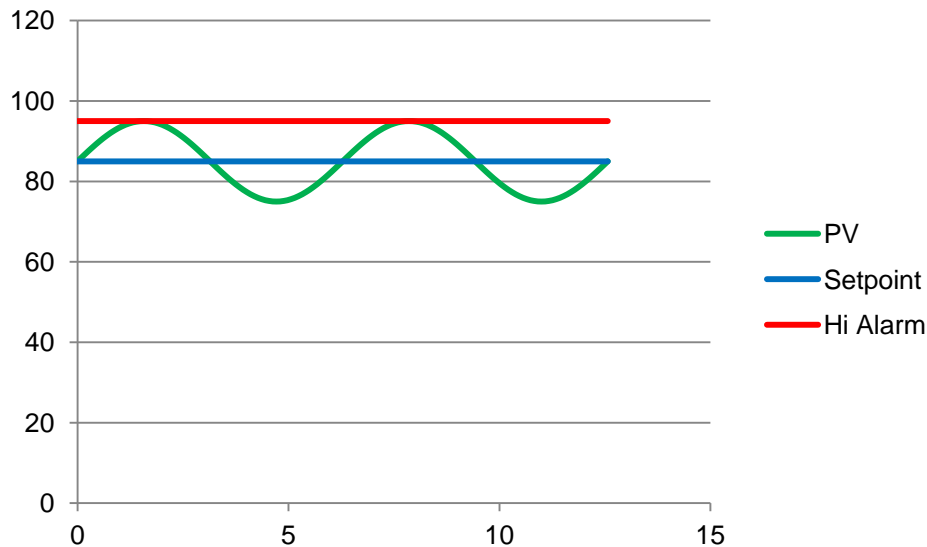
High variability: causes alarms...



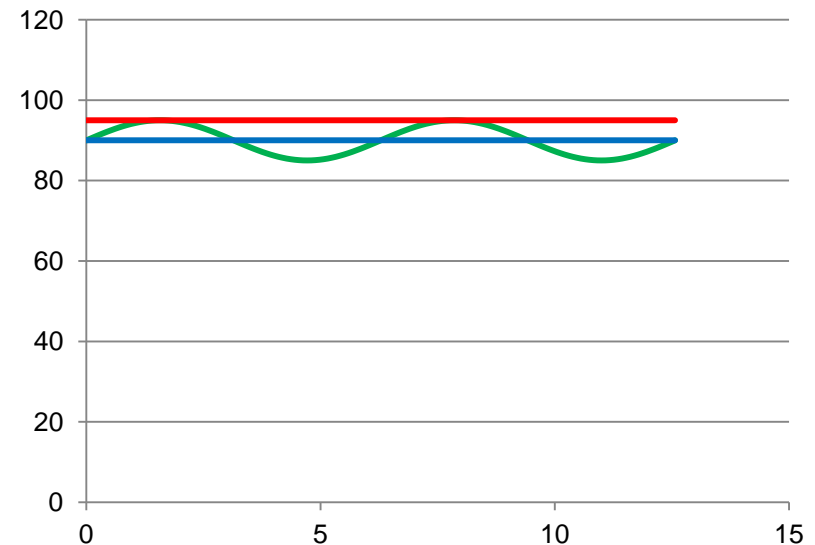
...so operators shift the setpoint

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: operators shift the setpoint away



Low variability: setpoint closer to ideal

Conclusion

- Digital (fieldbus) is better for control than analog (4-20 mA) signals
- This can translate into:
 - Higher throughput
 - Lower consumption of energy and other utilities
 - More uniform product: greater quality/yield