Model-Free Adaptive Control of Lab Systems

"Why model when you can MFA?"

Lab Applications

- High-speed adaptive control at one millisecond rate
- Rapid thermal processing - RTP
- Ultrasonic wind-tunnels
- Lab chemical or bio-tech reactors
- Lab distillation columns
- Water treatment – pH control
- Prototyping and testing of engines, turbines, compressors, motion systems, semiconductor equipment, mechanical systems, and robotics.

MFA Controller Types

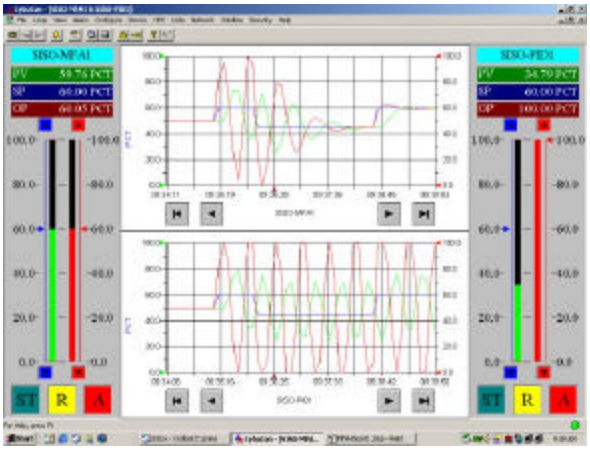
- SISO MFA to replace PID
- Nonlinear MFA to control extremely nonlinear processes
- Anti-delay MFA to control processes with large time delays or with large τ/T Ratios
- Feedforward MFA to deal with measurable disturbances
- MFA pH to control pH processes
- MIMO MFA to control multivariable processes.

MFA Benefits

- Using no process models delivers lower development costs and faster time to market
- More robust and precise control delivers better lab test results
- No manual tuning delivers lower operating costs and longer up time
- User friendly - MFA is easier than PID to launch and maintain
- Use of MFA as enabling control technology in final products.

The Inside of Model-Free Adaptive (MFA) Control

MFA Features	MFA Inside Story	Key Points	Description
Controls complex systems		Adaptive	Adaptive weighting factors are updated in every sample interval to minimize error e(t).
Requires no precise process models		Robust	Provides a wider robust range than PID and many other controllers.
Requires no process identification		Speed	No time consuming model training; controls process immediately.
Requires no controller design		Stability	Guarantees closed-loop stability for passive processes.
Requires no complicated manual tuning		Ease of Use	Easy to configure, launch, and maintain.



Left: When MFA (top) and PID (bottom) start from the same oscillating control condition, PID will continue to oscillate while the MFA will quickly adapt to an excellent control condition.

Item	PID	Model-Based	MFA Control
General-purpose	Yes	No	Yes
Needs Models	No	Yes	No
Needs controller design	No	Yes	No
Manual tuning	Yes	No	No
Controls complex systems	No	Yes	Yes