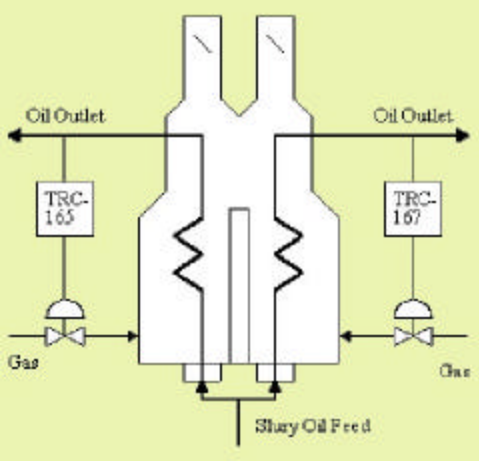
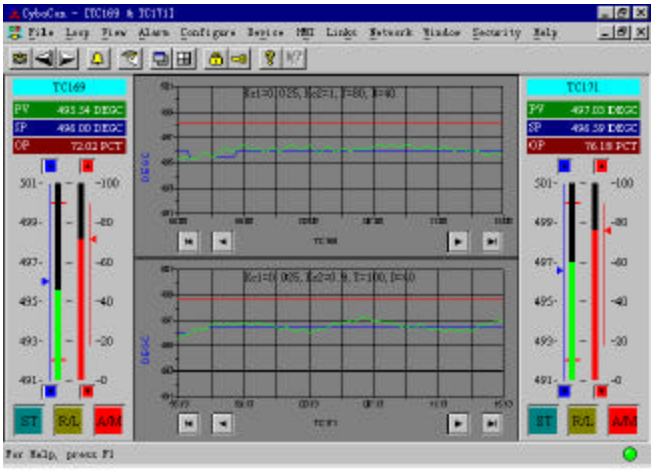
Model-Free Adaptive Control on Multi-Zone Temp Loops

Use of MFA Control	*Benefits*
Multivariable MFA handles interactions between temperature zones.	Temperature control is improved by at least a 50% reduction in temperature variability.
Prevents product overheating.	Fuel consumption is sharply reduced.
Reduces clogs in the vessel or pipes due to improved temp consistency.	Less cleaning and maintenance are required. Equipment life cycle is increased.
Reduces variation in temperature and product quality variable.	Product quality and production efficiency is improved.
Improves efficiency & productivity.	Full investment is returned in months if not sooner.





A 2-input-2-output MFA controller is able to handle the interactions between the 2 combustion chambers in this coking furnace so that tight temperature (green) control is achieved for its +/-1 degree C specification.

Case History: MFA at Guangzhou Petrochemical Complex reported in Hydrocarbon Processing Magazine

Control of temperature loops in multiple zones can be problematic, especially when a narrow specification is required. Successful installation of a Model-Free Adaptive (MFA) Control system in the delayed coking process at the Guang-Zhou Petrochemical Complex shows how this problem can be resolved.

A coker consists of two coking furnaces, each with two combustion chambers. High temperatures create carbon that clogs pipes, and a below-spec temperature causes an insufficient reaction so that the yield drops.

Control difficulties result from large time delays; serious coupling between loops because the separation wall between the two chambers is quite low; multiple disturbances in gas pressure, oil flowrate, oil inflow temperature and oil composition. The oil outlet temperature is sensitive to gas flowrate change, and the temperature specification is tight (+/-1°C).

An MFA Control system running on a PC was networked to the existing DCS. The original cascade control design was simplified to eliminate disturbances and uncertainties. The new system regulates fuel flow directly to control the oil outlet temperature. A 2x2 Anti-delay MFA controller on each furnace solved large time delay and coupling problems. MFA controllers compensated for dis turbances and uncertainties. Constraints on controller outputs prevent temperatures running too high or too low.

According to Mr. Delin Li, chief engineer at GPC, MFA controllers started automatic control with no bumps to the system. Commissioning took three days and resulted in:

- Both furnaces being automatically controlled under all conditions;
- Outlet oil temperature controlled to within its ±1°C with energy savings and consistent product quality;
- Operators have been relieved of tedious, ineffective manual control responsibilities; and
- Higher efficiencies and yields have been achieved.