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Cascade, Feedforward, Constraint, Variable Structures. There are many different ways to configure PID controllers. In fact, Professor Tom Marlin in his textbook "Process Control" has several chapters outlining where these different structures should be used.

Would it be easier to disregard all this technology and apply DMC to every control problem? After all, DMC is an optimal controller, and you can't do better than optimal, right?

But how is optimal defined? For DMC, it's a simple mathematical criterion that may or may not account for all the objectives that should be considered.

Things like robustness, simplicity, and disturbance rejection are not always considered in an LP. For more details, see the article on Control Structures for a comparison of DMC to some *simple* , inexpensive, intuitive control techniques.

## à Spotlight à
### Alarm Capture Package

Wouldn't it be nice to maintain a long-term record of alarm and operator move occurrences? Sure, the TDC can store a limited number of these events, but these event journals probably only have a few days worth of data. And it's not exactly in a suitable format for anything other than printing.

If you want the alarm and operator move journals in a better format, consider the Control Art's Alarm Capture Program. With a standard PC you can capture alarm events and operator changes directly into a Microsoft ACCESS database. You probably have the Honeywell hardware - a spare printer port on any Universal station.

Not only will you have a long term journal, but you can easily search for the alarms/ moves you want. And it can be made available to anyone that has access to the PC.

That's not all. The program also prints out a summary of the day's alarms, so Operators and Managers can check out the alarms they

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## Control Structure - Which is Best?

It's commonly assumed that DMC-type controllers are flexible enough to optimize all control problems. Is this always true? Consider how the classical Cascade Control structure compares to 2 different DMC control structures:

**Cascade Control Structure (Fig. 1)**
Here an analyzer outputs to a temperature controller, which then outputs to a flow controller. Although simple, two inherent characteristics of this arrangement result in high-performance, robust control:
1) The temperature controller "catches" many of the disturbances before they affect the analyzer; the analyzer loop usually has a much longer deadtime, but approximately the same time constant, as the temperature loop.
2) The temperature controller provides reasonable control of the process if (when!) the analyzer fails.

**DMC Structure 1: Control Composition &Temperature (Fig. 2)**
This structure has DMC controlling both the temperature and analyzer within bounds. As it's not possible to control both the temperature and analyzer to a specified setpoint, the upper and lower bounds on the temperature are set far apart.

Now what happens when a *unmeasured* disturbance hits? Because the temperature often remains within bounds, no action is taken until the analyzer starts to move. In other words, the deadtime compensation benefit of the temperature controller is lost. And loss of this deadtime compensation has a tremendous detrimental effect on the quality of control.

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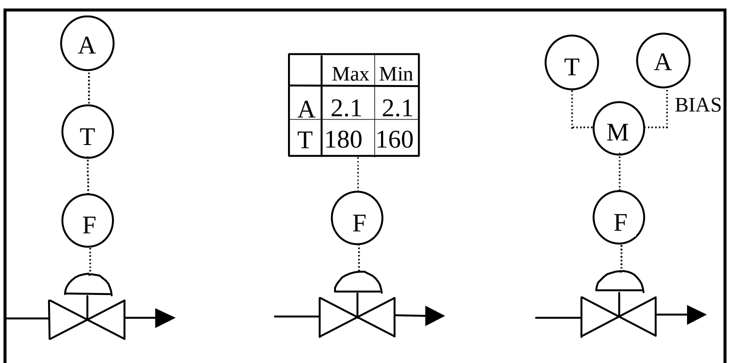


Figure 1 Cascade Control
Figure 2 DMC Control
Figure 3 Model Control

## Control Structure - Which is Best? (continued)

It gets worse. If the process gets hit by a large enough disturbance, the DMC controller will have to control both the analyzer and the temperature at their bounds. Of course, it can't control both values - they're so tightly coupled that anything that moves one will move the other in the same direction. This makes it virtually impossible for the controller to maintain both values at their constraints, and it will thrash about attempting to do so.

Lastly, consider what happens when the analyzer fails. If nothing else is done, the controller will drive the temperature to an upper or lower bound (depending on the LP costs), to the detriment of the process stability. Better add some logic to clamp down the temperature range to the current PV whenever you detect an analyzer failure. Complicated enough, but do you reverse the logic when the analyzer becomes good again? Are operators aware of these failure/recovery modes?

**DMC Structure 2: Control an Inferred Composition (Fig. 3)**

Another technique is to infer the current composition using the temperature (and perhaps some other measurements), and then use the analyzer to bias update the model. That way you have the deadtime compensation from the temperature, and a safe failure mode as no bias updating is done when the analyzer goes bad.

Trouble is, it results in terrible control. If you do all the block diagram manipulations, it's easy to show that this scheme is effectively the same as the original cascade control loop, with the master analyzer controller being mainly an integral-only controller. And an integral-only controller on a large deadtime system is close to the worst type of controller you can implement. You really need a proportional controller with a small amount of integral action, or a deadtime compensator controller (such as the Control Arts Single Loop LQG controller).

**Summary**

Can DMC controllers result in *worse* control? For this simple common situation, the answer is yes. And since composition controllers are often the most profitable (and expensive) loops in a plant, think carefully before "enhancing" your controllers.

Of course, it's difficult to observe the true effect of any controller unless you undertake a rigorous performance assessment analysis. Control Arts makes that easy - check out our web site for information on two Performance Assessment tools.

## Alarm Capture Package (continued)

get. It also prints out any alarm or controller parameter changes that the operators or engineers made over the last day (such as PVHITP, PVLOTP, SPHILM, etc.), so you can monitor anything that gets changed on an irregular basis.

What's the best thing to do with your database of alarms? The Control Arts Alarm History Analysis program will search through all the alarms and operator moves to uncover the troublesome alarms. After all, data is just data until you turn it into information, and only a computer can efficiently search through thousands of alarms for those nuggets of information.

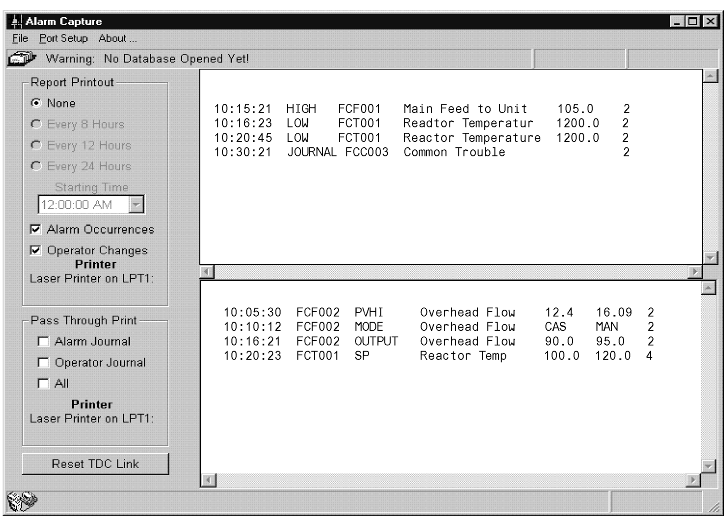


Fig 4. The Alarm Capture Screen shows the current status of the data coming from the TDC.

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