Control A rts
Control Software Review

Dr. Paul Gusciora, of Chevron Research and Technology Company, has observed that 20-30% of Chevron's multivariable controllers have an initial design flaw - trying to control systems that are inherently sensitive to model mismatch. This sensitivity is a plant property and is independent of the commercial controller. For more information on this critical issue, and what you can do to detect it, check out this newsletter.

Did you know that academic researchers have always preferred identifying low-order Laplace Transforms over step-weight models for advanced controllers? For a rigorous comparison between the 2 techniques, check out the MacGregor paper in I&EC Research, 1996, p4078, or contact Control Arts.

✶ Spotlight ✶
Alarm Enforcer: The Right Alarm at the Right Time

Many TDC sites don't let operators have access to alarm values in order to manage their alarms tighter. A good safety practice? Maybe, maybe not: there's two drawbacks to this method - it can result in excessive alarming (all of which may be ignored), and it's cumbersome for operators to change alarms during special operations such as during turnaround or catalyst regeneration - times when alarms are especially required.

The Control Arts TDC-based Alarm Enforcer helps with both these problems by enforcing a database of alarm values at user-specified times (such as shift change), or on demand. That means you can let the operators change alarm values, knowing that the alarm enforcer will set them back. You can also maintain multiple databases, and enforce the right database at the right time just by touching a few targets. You can even have the enforcer just print out which alarms are different from the database without changing them.

Given the increase emphasis on plant reliability, and the fact many operators feel the alarm system is flooding them with alarms, the effort spent on the Control Arts Alarm Enforcer will be one of your most profitable and visible achievements.

Transfer Function Identification

Want to know how to substantially improve your DMC modeling? The Control Arts Transfer Function Identification software contains improved technology that gives better models with less data.

A recent paper, by researchers at McMaster University, illustrates how using Laplace transfer functions for model identification (as employed by the Control Arts Transfer Function Identification software) results in models that are up to ten times more accurate than step weight models. That also means that you can drastically reduce the amount of plant test data you need.

How is this possible? Laplace Transforms require only 3 or 4 parameters to generate a curve, as opposed to the 30 (or 60 or 90) parameters required for step-weight models. And that means much more efficient model building. It also means you can use rigorous statistical tests to determine whether your models are good enough - no

more using "engineering judgment" to pick the best curve.

Just some of the immediate benefits from using the Control Arts Transfer Function Identification package are:

- Better and more robust controllers that don't get turned off.
- Less extensive plant testing which means savings of time and money.
- Insight into process dynamics and system interactions.
- Meaningful model fidelity and system analysis tests.

Can you use Laplace Transforms in DMC-type controllers? Sure - it's a trivial step to go from Laplace transfer functions to step weight models; the Control Arts package will output files in DMC controller compatible format. You can't, however, go the other way, so if you think you might be using TDC3000 controllers, a PI tuning package, or a variety of other controllers, make sure you use the Control Arts

Do your engineers look like this after exhausting days and nights of doing tests to collect modeling data for DMC? Switch to Control Arts and give your engineers their nights back.

Transfer Function Identification (cont'd)

Below is a comparison of the Control Arts Transfer Function package to one you're probably using. For a complete demonstration or a test evaluation, contact Control Arts.
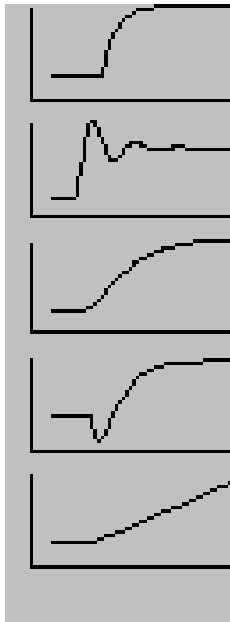
Feature	Step Weight Identification	Control A rts Identification
Efficient Parameter Estimation	NO!	YES
DMC Compatible	YES	YES
TDC3000 Controller Compatible	NO	YES
Advanced Regulatory Controller Compatible	NO	YES
System Interaction Analysis	NO	YES
Rigorous Statistical Tests	NO	YES
Insensitive to Feedback	NO	YES
Non-Biased Model ID	NO	YES
Suitable for Block Diagram Manipulation	NO	YES
Closed-Loop Identification	NO	YES

Ill Condition Plants - A Short Primer

It's tempting with multivariable controllers to include all possible inputs and outputs in the controller, and let the controller algorithm sort out the control connections. Unfortunately, this black-box approach can often lead to controllers that are very sensitive to model mismatch (which is, of course, always present). In this situation, the controller will ultimately fail - much to the angst of the control engineer and the operators.

What's an example of an ill-conditioned plant? Consider a standard distillation column, where it's desired to control the overhead and bottom temperatures using steam and reflux. Although the reflux affects the overhead more than the bottom, and the steam affects the bottom more than the overhead, by and large the effects of both inputs are the same - they either cool down or heat up the column. In matrix terms, the system will be ill-conditioned, and the inverse of the dynamic matrix (which is what controllers use) will vary widely with small changes in the dynamic model.

Sorry, tuning won't help - ill conditioning is a function of the system, and is independent of any games you can play with the controller. In other words, you should remove one or more of the outputs from your controller, or find additional inputs.

So how do you determine if your process has this problem before spending months with a troublesome controller? The Control Arts Transfer Function Identification package includes analysis tools that will check your system for ill-conditioning. Best of all, you've already got all the information required for this analysis - all it needs is the identified dynamic models, a few mouse clicks, and you're done. While you're at it, the program will also determine interactions so you can see if you really need a multivariable controller, or not!

Unfortunately, most processes that are multivariable are also ill-conditioned to some extent; checking for ill-conditioning should be a required step in your controller design.   A little bit of analysis can go a long way - don't get caught expecting your controller to control an "uncontrollable" plant.

Control Arts Information

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