ACTC

The Applied Control Technology Consortium

Process Control Performance Benchmarking and Assessment Using *PROBE*

Control Benchmarking

When applied to a process, controls become part of a changing environment.

Over a period of time, processes are typically subject to:

- Product changes (new operating points etc.)
- Raw material source changes
- Plant modifications
- Wear and tear of actuators (valves, drives etc.)
- Degradation of measurement sensors
- Plant item (non-actuator) wear and tear

These changes often degrade control and plant financial performance.

Ideally, checks by instrument/control personnel identify and address such effects. However, if the root cause is not clearly established, control re-tuning activity can make matters worse. In practice, diagnosis tends to depend on human experience. This is against a background of increasing difficulty in recruiting experienced control personnel.

In order to remove this dependency, it is necessary to utilise process diagnostic tools. Typically process diagnostic techniques either require 'expert' users or are relatively crude and ineffective. (By contrast, diagnostic methods for car engines are simple to use and effective).

The challenge is to compare actual loop tuning against the optimum possible. This is defined as ***'control benchmarking'***.

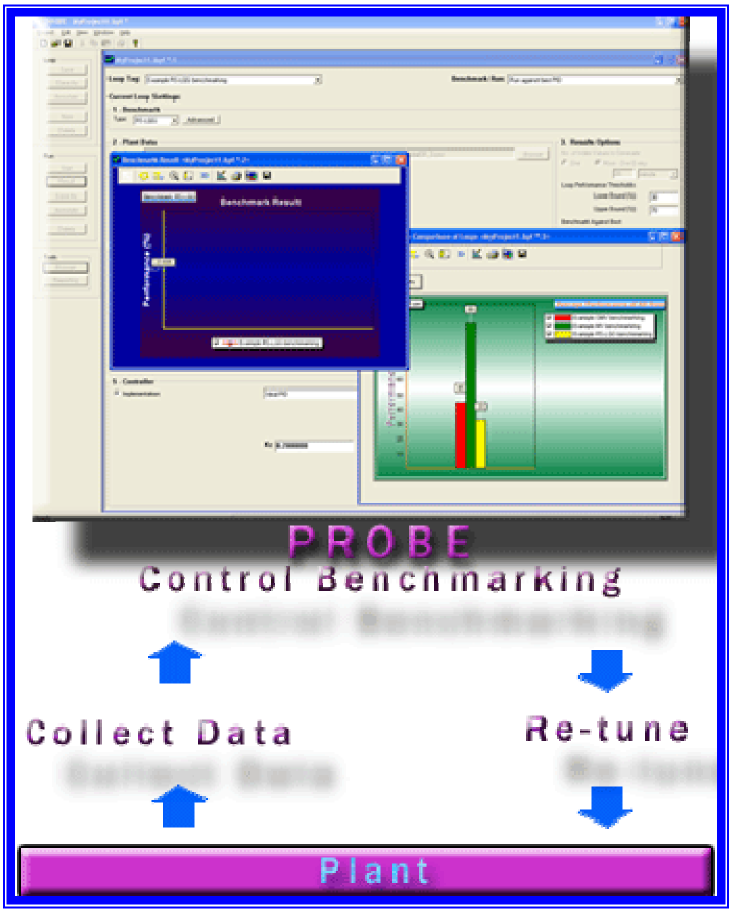
Nine years ago, Desborough and Harris developed the ***'minimum variance***' (**MV**) control benchmarking technique in Canada. The method has been utilised by a few process control suppliers (e.g. Honeywell). Unfortunately, it suffers from two deficiencies. Firstly, <u>it doesn't penalise actuator energy</u> in determining the optimum control performance. Secondly, it <u>doesn't take account of the available controller structure</u>. Specifically, it tends to assume that the plant model can be inverted and applied to the controller. Clearly if, when inverted, the plant model is of a high order this is not realistic in the process industry environment where 99% of controllers are either two-term PI or three-term PID.

PROBE

To overcome these problems, a different approach has been developed through research at the Industrial Control Centre (ICC) of Strathclyde University. This approach is called the ***generalised minimum variance*** (**GMV**) calculation which applies a weighting to both the actuator energy and the loop output. The technique has been extended so that it also acknowledges the order of controller available within a benchmark calculation. This approach is called the ***restricted structure linear quadratic Gaussian*** (**RS-LQG**) calculation.

The success of this research has motivated the development of a ***'Control Benchmarking'*** software tool by Industrial Systems and Control Limited, called ***PROBE***, enabling the comparison of actual v. 'realistic' potential control loop performance.

Currently running on a Windows platform, PROBE provides users with the capability of assessing the performance of control loops based on the above benchmarking techniques using off-line loop data.



Control Benchmarking Using PROBE

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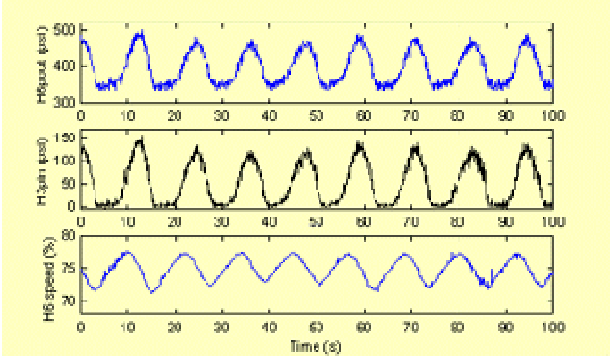
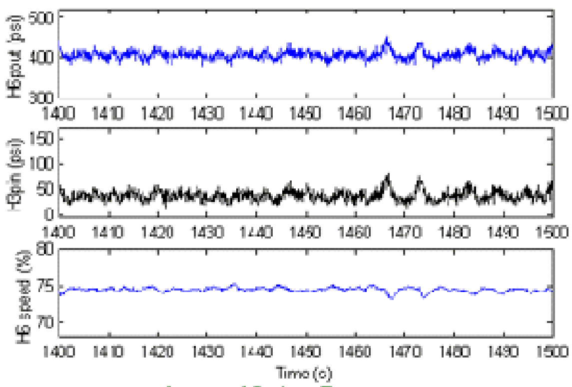
Benchmarking Using PROBE

Case 1 (Food Industry)

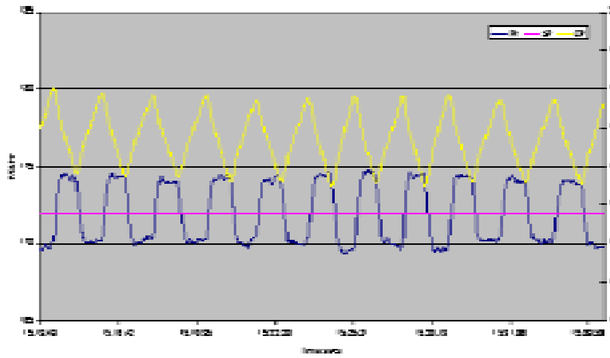


Original System Responses
larger variances causing excessive wear
(Controller Performance Index = 10.9%)

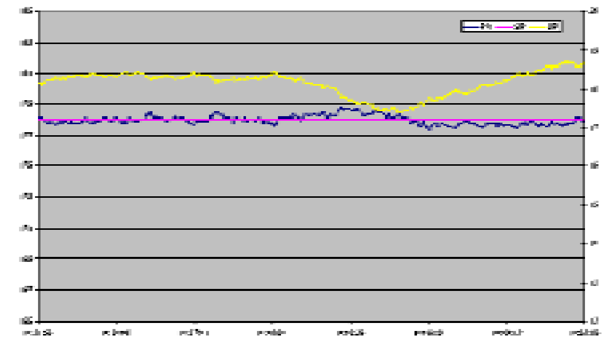


Improved System Responses
(Controller Performance Index = 79.6%)

Case 2 (Petrochemical Industry)



Oscillations (Limit Cycles) in Controlled Flow
(Controller Performance Index = 2%)



Cause of Limit Cycles Removed
(Most Probable Cause: Sticking Valve)
(Controller Performance Index = 18%)

For further information on ***PROBE***, please contact:

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