Geometry Unifies Process Control, Production Control and Alarm Management

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When you lift your hand to catch a ball it is very unlikely that your brain actually formulates or solves the equations of motion in working out when and where to place your hand to catch the ball. It's much more likely that you use, unconsciously, something that's much more akin to the geometrical methods underlying the all-new Geometric Process Control Technology described in this article.

Summary

Geometric Process Control (GPC) combines the three key plant applications of Process Control, Production Control (i.e. Achievement of Business Objectives such as producing in-spec product, maximising Yield or Recovery, minimising waste and many other Key Performance Indicators) and Alarm Management[1].

It improves all three applications which were previously quite separate as they lacked a unifying mathematical basis. They came together only in the different brains of individual process operators hence inconsistently. Substantial economic and safety improvements result.

The mathematical basis for the breakthrough is the use of n-dimensional geometry together with Inselberg's coordinate transformation that makes it possible to see a multi-variable graph containing perhaps several hundred variables (such as temperatures, pressures, flows and product qualities) and thousands of different observations in a single picture. Lets say that again. One graph that can show all the contents of a spreadsheet of hundreds of columns and thousands of rows in a single picture. Today, and for the last several thousand years, the world has been restricted to graphs that could show at most half-a-dozen variables. This has affected and limited understanding of multi-variable processes by forcing over-simplification. Behaviour could then only be represented within the limitations imposed by the very few variables that could be shown in a simple graph.

We use the multi-variable graph to choose a set of 'Best Practice' operating points, the values of all the variables, which gave us the good results we wanted and exclude the points that didn't. We obtain the data to decide on these points from analysing past

process operations. Then we construct a multi-dimensional solid object from those points and having done that we can now test any other point against that object by saying that geometrically we need to stay inside the object so that we achieve the same 'Best Practice' objective used in choosing the good points. A new-format Operator Display is part of the method.

We have used GPC on test cases from oil refineries right the way down to bakeries so another benefit is that the methods are very simple to apply. It doesn't need advanced mathematics, algebra or equations. We cut out the first two steps of traditional mathematical modelling which were (1) describe your problem with equations (2) solve them. We go directly from observation to the model in a few minutes. And this means we can use this technique in small plants where they don't have control engineers or advanced mathematics available to them. We have broadened the application of this advanced technology to a much wider range of industry than was possible before.

Economic Benefits arising from the Unification are, perhaps unsurprisingly, substantial and an outline is given at the end of actual achievement at one of the Field-Trial sites. The value of our first-ever method to calculate values for process alarm limits was recognised by the award of the European Process Safety Centres 2003 Award for the biggest single contribution to improving process safety.