MPC Unsustainable Benefits
12/10/2008

On the question of MPC sustainable benefits; comments and suggestions based on first hand experience of applying MPC in a major USA Oil Company over a period of 10 years.

In simple words, MPC is an 800-pound gorilla. It can be big and ugly.

Benefits are retained by thin threads. Benefits tend to leak.

Unwieldy design (Win-Lose Design Decision by definition)

It begins with the first design step, which preordains its re-design.

Open/Close regulatory controllers

Open Regulatory Control Loop –

Give up on best control practice - fastest and closest to source disturbance rejection

Keep Regulatory Control Loops closed –

Suffer from terrible model mismatch errors –

It is a WIN-LOSE situation.

If it does not work one way then try the other way and in doubt apply this rule over and over. By design it is meant to be endless re-tuning, re-design and re-testing.

Paradoxically any improvement in regulatory control means more work on MPC. This is the case of the whole is less than the sum of the parts. Something is fundamentally inconsistent here.

Same unit, re-designed multiple times – something does not fit well

FCC Unit MPC is still being re-designed and re-done at many sites. See latest publications in control literature.

Control Models discredited

Control centric models used are not in tune with the innate process behavior.

Models break down at or near control valve saturation

In other words, models break down at or near optimum condition resulting in producing more of off-spec quality products.

In other words, just when finer control is needed, MPC delivers increased variance.

Valve linearization is commonly done, yet at or near valve saturation controlled variables variance increases. The manipulated variable SP does not track its PV resulting in increased model mismatch error. Use of control valve OP models prevents the SP to change any further but does not assist well enough in tracking it to its PV value. Depending on the unmeasured/measured disturbance pattern, the product quality variance can vary significantly and unexpectedly. End result is unit throughput may be increased with higher product quality spec violations.

Again, a Win-Lose benefits. It cannot be valve non-linearities, it is the failure to track the SP to its PV upon the control valve saturation that is wrecking the havoc.

A control valve re-seating costing hundred of dollars would require MPC upgrade costing tens of thousands of dollars. So much for advanced control advantage. All benefits credit can easily evaporate.

Within a 5 percent change in feed rate, the process becomes too much non-linear for MPC to sustain the benefits, it is all to do with control valve saturation and failure to track manipulated variable SP to its PV. The operating process conditions do not become non-linear within a 5 percent range; it is the control valve saturation that breaks the back of the camel.

The irony is that most MPC practitioners do not even recognize that by design MPC will produce increased variance at or near control valve saturation. A 5 percent increase in variance of unmeasured disturbance will gobble up the 5 percent acclaimed benefits in no time. So, the 5 percent benefits claimed are within unmeasured disturbance variance variance.

MPC math is simple and elegant; MPC engineering is not.

Large-scale MPCs are monolithic.

A large-scale MPC views effect of feed to end product quality as a one step transformation, the process does not behave that way. A large-scale process is a multi-stage process so why is that a large scale MPC views the end product quality as one step model. The control models used are inconsistent with the innate process characteristics. This is the biggest form of model mismatch to overcome. How can one expect robust performance with control models, which are amorphous to real process? Control model forms that are good for simple process cannot be stretched too far to represent a chain of processes.

Lack of modularity and uniformity

MPC control models are treated as “black box” of controlled variables to manipulated variables effect based on a lot of extraneous conditions remaining intact.

Controller scope does not match with process and sub-process boundary.

Process design and equipment design is modularized so why is that MPC is not.

MPC as practiced in the industry has legacy problems. The essentials of MPC of last 25 years have not changed. It is time for CHANGE. CHANGE WE NEED…….