ADVANCED PROCESS CONTROL

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Abstract:

Many proven technologies are now available for implementing advanced process controls with economic optimization. Major quality and productivity benefits can be obtained by developing and using software based on these technologies for advanced control process. Adaptive technologies are now being increasingly used in software for implementing advanced process controls.

1. **Introduction**:

The nature of a process largely determines how well it can be controlled. It has been observed that around ninety percent of the control loops, found in most process plants, can be reasonably controlled with a combination of proportional, integral and derivative modes of control. The question often arises whether proportional, integral and derivative modes are really the best control modes for a majority of applications. For the easier-to- control processes, their use can be justified.

It has been estimated that around ten percent of the control loops found in the process plants are very difficult to control. PID control (proportional plus integral plus derivative) is not very effective in such loops. These loops can be very effectively controlled by using adaptive model predictive controllers. This type of controllers has proved beneficial for the following types of applications.

- When processes have complex interactions and long-time constants, so that effects of change in conditions may not be seen for several hours.
- When the process exhibits nonlinearities, inverse response and unusual process dynamics.
- When process disturbances are frequent.
- When processes have multiple constraints.

In recent years several new adaptive technologies of neural networks, fuzzy logic and chaotic systems theory have appeared. These technologies are now being increasingly used for developing adaptive software for implementing model-based advanced process controls.

Performance of sensors and microprocessor based systems has considerably improved, while cost has dropped dramatically during the last few years. As a result, many new process plants have installed distributed control systems, and are in the process of implementing advanced controls with economical optimisation. These plants accumulate massive amounts of process data, a major portion of which is never used.

The unused process data can now be used to build dynamic models, by applying the adaptive technologies of neural networks, fuzzy logic and chaotic system theory. This is done by studying the underlying relationships between the input data and the output response, so as to create an adaptive model.

2.Neural networks:

A neural network is designed as an imitation of the human brain, in a way that the system can learn from the data. A neural network can be built into the software or the microprocessor itself, essentially simulating the structure of the brain's nerve cells and network of interconnections. The most important benefit that accrues from such a structure is adaptability. Thus, a neural network can take data and learn from it. In other words, it can be trained.

The biggest obstacle to the implementation of neural networks is formatting and pre-processing the production data, required to train the network effectively. Around two-thirds of the time spent on neural network development goes into isolating the right data and getting it ready for the network.

Neural network is another exciting tool that the rapid advances in computer hardware and software are making possible for on-line process control and optimisation.

3. Fuzzy logic:

Fuzzy logic harnesses the power of such phrases as 'very high', 'fairly low', 'very fast', 'many' and 'rarely', all of which are used by experienced engineers and operators to describe practical rules of thumb for controlling a process.

In chemical process plants, many processes are too complex to fit into mathematical models. This need is spurring the growth of fuzzy logic in chemical process plants.

Models can be trained to recognise and characterise the relationships between various process variables of a process unit. These can then be employed to detect failed sensors by monitoring current readings and providing failure alarms, when a measured variable no longer makes sense. In addition, a reconstructed value can often be synthesised by the model for this failed sensor, while the instrument is out of service for repair.

4.Conclusion:

Advanced process controls are intended to improve profitability of a process plant while ensuring safety of operation. Profitability is improved by minimising feedstock consumption, increasing throughput, decreasing energy consumption, increasing yields, minimising waste products and optimising production. These goals can only be achieved by developing and using software's for implementing advanced process controls and economic optimisation.

DCS (distribution control system) is now considered a basic requirement for instrumentation and control. However, stopping capital investment at the DCS does not exploit its full potential benefit. The benefit from capital investment in advanced control increases significantly faster than the benefit obtained from investment on DCS. Packaged software makes the implementation of advanced controls very easy. Once proper instrumentation and control systems are in place, pay outs for implementation of software's for advanced process controls are typically measured in a few months.

References and notes

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