Decentralized control vs. Distributed control. A control solution for large – scale systems

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Abstract

Presently, many control systems are built in decentralized structure using a large number of simple single-input single-output (SISO) controllers enabling a stable operation of most unit operations. However, this approach is not the optimal control solution because, in these structures the subsystems of a plant do not communicate between them even if they significantly interact. Recently, the control strategy of complex large-scale systems started to be reasoned in a new and modern way from the point of view of distributed control. The distributed control approach is relied on the assumption that the information about the controllers from other loops is exploited in designing the controllers. In this paper, the candidate to compare the performances of decentralized and distributed control is represented by a fluid catalytic cracking (FCC) process selected due to its economic importance of the process in a refinery. The FCC simulator has been developed using MatLab/Simulink using real industrial data. The dynamic model of the FCC plant comprise the feed system model, the reactor riser model, the reactor stripper model, the regenerator model, the air blower model, the catalyst circulation lines model, and the wet gas compressor model. The mathematical model has been developed based on momentum, mass and energy balances containing the process hydrodynamics, the heat transfer, the mass transfer and the catalytic cracking kinetics. The goal of this paper was to develop decentralized and distributed control systems for the FCC unit using the model predictive control strategy. The performances in rejecting disturbances are compared. The results indicate that the proposed control systems approach the performance of a fully centralized MPC system and distributed control system provides significant improvement over the decentralized control because the strong interactions between the subsystems are comprised in the process design of the control system increasing the overall control performances.

Keywords: fluid catalytic cracking, decentralized control, distributed model predictive control