

64f Control Structure Design: New Developments and Future Directions

Vinay Kariwala and Sigurd Skogestad

Control structure design (CSD) deals with the following fundamental question: Given the process flowsheet, where should the controllers be placed, or more specifically, what variables should be measured (sensors) and manipulated (valves) and how should the two sets be interconnected for safe and economic operation? These choices are not obvious for most systems encountered in practice. The problem of CSD is also complicated by the increasing mass, energy and information integration among the different process units, which necessitates consideration of the whole plant together. In comparison with the vast amount of the literature available on controller design, CSD has received only limited attention. Despite the advances made, a systematic method is still lacking, which can be mainly attributed to the lack of proper mathematical formulation of the problem. Process control lore includes tales of multi-million dollar plants that never operated due to lack of sufficient theory for CSD (Luyben et al., 1998).

This paper first aims at providing an overview of the following simple, yet mathematically sound tools, which have been successful in applications:

- a. Selection of primary controlled variables using the idea of “self-optimizing control” (Skogestad, 2000)
- b. Stabilizing control layer design based on input performance (Havre and Skogestad, 2003; Kariwala, 2004)
- c. Regulatory layer design for disturbance rejection (Skogestad and Postlethwaite, 2005)
- d. Pairing selection based on integrity, performance etc. (Kariwala, 2004, Skogestad and Postlethwaite, 2005)

Next, it is suggested how these new tools can be integrated to develop a systematic sequential approach leading us closer to the Promised Land. The usefulness of the general methodology is demonstrated through applications drawn from classical as well as emerging areas. Finally, we present a number of specific challenges and problems that require further consideration and which may inspire new researchers to enter this important research field.

References

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