Optimal Measurement Selection for Controlled Variables for Kaibel Distillation Column

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Control structure selection plays vital role to operate the process plants at optimum. The decision on which variables to be controlled, which variables to be measured, which inputs to be manipulated and which links should be made between them are called control structure selection. Generally control structural selection is done based on heuristics or intuition of process engineers. This makes it difficult to compare different control structures and improve the proposals. Skogestad and coworkers (Skogestad, 2000, Morari et al. 1980) have proposed to use the steady state process model to find “self-optimizing” variables with an assumption that plant economics are governed by the pseudo/steady state behavior. The idea of “self- optimizing control” can be defined as suitable selection of **c**'s and by keeping these CVs (**c**'s) at constant set points, the operation gives acceptable steady state loss from the optimal operation even in the presence of disturbances. In this framework, we seek to find the optimal controlled variables, **c = Hy** (**y** are the measurements) as combinations of fewer/all the measurements. The objective here is to find the combination matrix **H**. Here we briefly present the methods of Mixed Integer Quadratic Programming methodology to (i) select the optimal individual measurements; (ii) select the optimal fewer measurements and (iii) handle few structural constraints that result in minimal loss (Yelchuru and Skogsetad, 2011) from optimal operation.

A 4 product Kaibel column has high energy saving potential (Halvorsen and Skogestad, 2003), but is a difficult control problem with limited degrees of freedom compared to a conventional distillation sequence for 4 product separation. This case study is an interesting example for the demonstration of the proposed systematic procedure to select the control variables as individual measurements or combinations of fewer measurements with measurements from different sections of the column, as it highlights importance of structural constraints feature of the method. Structural constraints are important for dynamic considerations, for example, at least one temperature in the prefractionator should be controlled (Strandberg and Skogestad, 2006) in the regulatory layer.

References

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