

Iterative feedback tuning (IFT) is a flexible methodology for tuning controllers of arbitrary structure. The key feature is that closed-loop experimental data is used to directly compute a change of the controller parameters such that some performance objective is improved. Since no modeling step is required, the method is relatively simple to use. Thorough presentations of the method are provided in Hjalmarsson (2002). There is also a Special Issue on IFT in Control Engineering Practice (2003). IFT is also applied to relay auto-tuning (Ho et al., 2003). Given the simplicity of the scheme, it became clear that this new scheme had wide-ranging potential, from the optimal tuning of simple PID controllers to the systematic design of controllers of increasing complexity that have to meet some pre-specified specifications. In particular, the IFT method is appealing to process control engineers because under this scheme, the controller parameters can be successively improved without ever opening the loop. In addition, the idea of improving the performance of an already operating controller, on the basis of closed loop data, corresponds to a natural way of thinking.

In the area of semiconductor, the trend is towards larger wafer size and the linewidth going below 100nm. One of the challenges is to control the resist thickness and uniformity to a tight tolerance in order to minimize the thin-film interference effect on the linewidth. In Lee et. al (2002) the Generalized Predictive Controller (GPC) was used to improve resist thickness control and uniformity through the softbake process. There is however, no adaptation and a fixed controller may not be suitable for different batches of photoresist and wafers.

In this project, replace the GPC controller with the PI controller and apply IFT to tune the PI parameters for the above semiconductor manufacturing problem (Lee et. al, 2002). Show through simulation that the PI controller can adapt to new batches of photoresist and wafers. There is no need to consider constraint on the control signal.

Reference

Hjalmarsson, H. (2002). Iterative feedback tuning – an overview. *International Journal on Adaptive Control and Signal Processing*, Volume 16, pp. 373-395.

Control Engineering Practice (2003). Special Section on Algorithms and Applications of Iterative Feedback Tuning, Volume 11, Issue 9, pp. 975-1094.

Ho W.K., Y Hong, A. Hansson, H. Hjalmarsson and J.W. Deng (2003). Relay Auto-Tuning of PID controllers using Iterative Feedback Tuning, *Automatica* Volume 39, pp. 149-175.

Lee L.L., C.D. Schaper and W.K. Ho (2002). Real-Time Predictive Control of Photoresist Film Thickness Uniformity, *IEEE Trans. On Semiconductor Manufacturing*, Volume 15, No 1, pp. 51-59.