375e Pls Based Run-to-Run Controller

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In recent years both industry and academia had a strong interest in the development and application of run-to-run (RtR) feedback control in the semiconductor manufacturing industry. With device tolerances shrinking, it becomes necessary to achieve maximum performance possible out of the existing processes. Due to the lack of in situ measurements of the product qualities of interest, the products must be moved from the processing chamber to a metrology tool before an accurate measurement of the control variable value can be taken.

Although extensive studies were done to improve or tune the RtR controller, the development was limited to single-input single-output processes. Controlled processes in nearly all-semiconductor manufacturing frequently encounters with inherently more than one variable to be controlled. The control of multivariable systems is not always an easy task due to its complex and interactive nature. The modification of the PLS (partial least squares) modeling procedure is developed. It permits incorporation of a dEWMA (double exponentially weighted moving average) control algorithm into the standard run-to-run controller design. This makes it possible to extract the strongest relationship between the input and the output variables by using the resulting structure PLS model. It is particularly useful for inherent noise suppression. Also, the non-squared MIMO control system can be decomposed into a multiloop control system by employing precompensators and postcompensators of the PLS model constructed from the input and output loading matrices. Then the conventional dEWMA controller can be separately and directly applied to each SISO control loop. The performance of the proposed method is illustrated through a Chemical-Mechanical Polishing (CMP) process which is a critical semiconductor manufacturing processing step.