On the Use of Machine Learning in the Semiconductor Industry: Examples and Case Studies

Semiconductor Manufacturers must wring all the available improvement in the quality and yields of existing products by any means possible. These means include designed experimentation and analysis of tightly controlled processes, many of which are approaching physical limits. Some questions faced when confronted with optimizing a 400-operation process are: At which operation to begin, and what factors in that operation influence what responses in the process? Then, after defined optimization projects have been completed: Have all the available opportunities for optimization been exhausted?

One of the ancillary products of microelectronics manufacturing is data: huge quantities of data are generated on every production lot processed through a fabrication facility. Complex, unknown structure, multicollinearities, and sparsity are rampant in these data, and severely compromise the ability of classical analysis methods to accurately answer the questions the engineer's ask.

Machine Learning is loosely defined as using computer algorithms that improve their performance by the analysis of data, rather than relying on the skill and intuition of the analysts. Promising methods of Machine Learning include Binary Recursive Partitioning, Stochastic Gradient Boosting, and Random Forests. This presentation will offer some theory behind these methods and discuss their application in semiconductor manufacturing. Case studies will be detailed that demonstrate the utility of these approaches in description, prediction, and hypothesis generation.

Key Words: Machine Learning, Binary Recursive Partitioning, Random Forests, Stochastic Gradient Boosting

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