Manufacturing Process Quality Control via Machine Learning in Lieu of Destructive Testing

Gregory Banyay*, Clarence L. Worrell, Scott E. Sidener
Westinghouse Electric Company

banyayga@westinghouse.com, worrelel@westinghouse.com, sidenese@westinghouse.com

The objective of a recent Westinghouse analytics program was to provide a data-driven model that recommends the setting for a key manufacturing process input variable by recognition of patterns embedded in the historical accumulation of the relationship between that input variable, over 100 of other manufacturing process variables, and a key targeted outcome of the manufacturing process. In so doing, it may be shown that a costly testing process that previously provided insight for this input variable may be eliminated, for each production batch of material. Machine Learning (ML) methods were evaluated in both a forward and inverse sense. A forward model directly emulates the manufacturing process in that all process inputs served to predict the process output. Conversely, the inverse model reproduces the key manufacturing process input as a function of all other process inputs as well as the observed output. A hybrid approach was found to be optimal for the manufacturing process of interest. As such, ML was used for a partial forward model and, given those results, a statistical evaluation provided the optimal setting for the key manufacturing process input variable. The credibility of this hybrid approach was demonstrated by various approaches to verification of the analytical methods, validation to historical data, and substantiated by the ongoing realization of zero scrap. This narrative intends to illustrate to the real value provided to business by intelligent use of analytics methods, and to share lessons learned to demonstrate the credibility of data-driven modeling.