A Bayesian Method for Robust Tolerance Control and Parameter Design

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Abstract

This paper proposes a Bayesian method to set tolerance or specification limits on one or more responses and obtain optimal values for a set of controllable factors. The existence of such controllable factors (or parameters) that can be manipulated by the process engineer and that affect the responses is assumed. The dependence between the controllable factors and the responses is assumed to be captured by a regression model fit from experimental data, where the data is assumed to be available. The proposed method finds the optimal setting of the control factors (parameter design) and the corresponding specification limits for the responses (tolerance control) in order to achieve a desired posterior probability of conformance of the responses to their specifications. Contrary to standard approaches in this area, the proposed Bayesian approach uses the complete posterior predictive distribution of the responses, thus the tolerances and settings obtained consider implicitly both the mean and variance of the responses and the uncertainty in the regression model parameters.