

ABSTRACT

Robust Multiple-Response System Design

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The primary goal of this research is to develop a new method for robust multiple-response system design using computer simulation experiments. Taguchi's robust-design technique focused on making product and process designs insensitive (robust) to hard-to-control variations. The strategy of attempting to design for robustness is sound and novel. However, the tactics, in which Taguchi implemented his strategy, have been found to have some theoretical limitations.

To achieve the goal of this research, the robustness of the system configuration and multiple desired responses must be considered simultaneously. In this research the mean and the standard deviation of each response are modeled by second-order regression equations and then combined in the form of MSE (Mean Square Error). Then, the desirability function approach is adapted to transform a set of multiple responses (a set of MSEs) into a univariate objective function which can be optimized using univariate optimization techniques.

An automated system (ROMSYS) is developed to implement the proposed design method on a microcomputer. ROMSYS automatically performs all the steps of the proposed method. With the verified and validated simulation model it generates the experimental designs, executes the simulations to produce the response variable observations, performs least squares regression, obtains the objective function, and performs optimization. The utility of the proposed robust multiple-response design method is demonstrated with an example from the manufacturing domain. Furthermore,

the ROMSYS approach is applied to two examples from past related research to evaluate the proposed method. The success of the proposed method is evaluated.

Currently, there exist no quantitative methods to design robust multiple-response systems, using computer simulation as the experimental tool. Consequently, this research is intended to enhance the state-of-the-art in simulation based system design methodologies.