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MODELING AND OPTIMIZATION OF DOUBLE-DYNAMIC ROBUST DESIGN EXPERIMENTS

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Abstract. *The robust design method developed by Taguchi is a popular way of reducing response variations in products and processes through selecting control factors that provide the best performance and the least sensitivity to noise factors. However, the method has some limitations in practical applications, especially in dealing with dynamic problems. This study proposes a novel approach to modeling and optimizing double-dynamic robust design experiments. The proposed approach is based on artificial neural networks (ANN) and an electromagnetism-like mechanism (EM) algorithm. An ANN is used to build a system response function model. The performance measures, signal-to-noise ratio (SNR), and sensitivity used by Taguchi are then integrated by exponential desirability functions to formulate an objective function of the system. An EM algorithm then obtains the optimal factor settings through the response function model. The proposed approach allows the optimal parameter settings for quantitative factors to be any real values within the parameter bounds. A numerical example demonstrates the feasibility and the effectiveness of the proposed approach.*

Keywords: Back-propagation neural network, Double-dynamic characteristics, Electromagnetism-like mechanism algorithm, Robust design, Taguchi method

1. Introduction.

The robust design method developed by Taguchi is a powerful quality improvement technique for producing robust products at low cost in highly competitive marketplaces; the method has been successfully applied to optimizing product designs in many industries. A product or process is said to be robust when it is insensitive to the effects of the sources of variability, even though the sources themselves have not been eliminated [1]. Taguchi's robust design approach has been widely used in making quality improvements using orthogonal arrays (OA) and a simplified approach to the analysis of variance (ANOVA). This method determines the best combination of design parameters to reduce variability in product response and aligns the mean response at the desired level.