Crossing weighted uncertainty scenarios assisted distribution-free metamodel-based robust simulation optimization

ABSTRACT

In practice, computer simulations cannot be perfectly controlled because of the inherent uncertainty caused by variability in the environment (e.g., demand rate in the inventory management). Ignoring this source of variability may result in suboptimality or infeasibility of optimal solutions. This paper aims at proposing a new method for simulation–optimization when limited knowledge on the probability distribution of uncertain variables is available and also limited budget for computation is allowed. The proposed method uses the Taguchi robust terminology and the crossed array design when its statistical techniques are replaced by design and analysis of computer experiments and Kriging. This method ofers a new approach for weighting uncertainty scenarios for such a case when probability distributions of uncertain variables are unknown without available historical data. We apply a particular bootstrapping technique when the number of simulation runs is much less compared to the common bootstrapping techniques. In this case, bootstrapping is undertaken by employing original (i.e., non-bootstrapped) data, and thus, it does not result in a computationally expensive task. The applicability of the proposed method is illustrated through the Economic Order Quantity (EOQ) inventory problem, according to uncertainty in the demand rate and holding cost.

Keyword: Metamodeling; Unknown distribution; Kriging; Bootstrapping; Robust design; Simulation optimization; Uncertainty