

Proceedings of the 2nd Annual World Conference
of the Society for Industrial And Systems Engineering
Las Vegas, NV, USA
November 5-7, 2013

Small Computer-Generated Designs as an Inexpensive Alternative to Central Composite Designs to Solve Robust Parameters Problems

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Abstract: In a robust parameter problem, the controllable factors of interest in a process are modeled along with the uncontrollable or noise factors with the goal of finding settings of the control factors that are insensitive or “robust” to noise variability. For example, in the development of gasoline, the ingredients in the blend are controllable variables and the driving conditions are noise variables. Response Surface Methodology (RSM) has been successfully applied to solve robust parameter problems. The most popular experimental design used so far has been the central composite design, which is modified to incorporate the noise factors. However, this modified central composite design may have an excessive number of experimental runs when the number of factors is large. Hajar and Garcia (2007) presented computer-generated designs that are smaller than the corresponding central composite designs and with the same efficiency to estimate the effects of interest. The purpose of this article is to compare the performance of a modified central composite design and a computer-generated design when they are used to solve a robust parameter problem. Thus, this research determines if we can obtain similar or better settings for the control variables using smaller computer-generated designs than the modified central composite designs. To do the comparison, two study cases were simulated including three control and two noise variables. The results indicated that both designs produced similar solutions while the computer-generated designs required fewer experimental runs than the corresponding modified central composite designs.

Keywords: robust parameter design, response surface methodology, central composite designs, computer-generated designs, design of experiments.