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Powerful Foldover Designs

The foldover technique for screening designs is well known to guarantee zero aliasing of the main effect estimators with respect to two factor interactions and quadratic effects. It is a key feature of many popular response surface designs, including central composite designs, definitive screening designs, and most orthogonal, minimally-aliased response surface designs. In this paper, we show the foldover technique is even more powerful, because it produces degrees of freedom for a variance estimator that is independent of model selection. These degrees of freedom are characterized as either pure error or fake factor degrees of freedom. A fast design construction algorithm is presented that minimizes the expected confidence interval criterion to maximize the power of screening main effects. An augmented design and analysis method is also presented to avoid having too many degrees of freedom for estimating variance and to improve model selection performance for second order models. Simulation studies show our new designs are at least as good as traditional designs when effect sparsity and hierarchy hold, but do significantly better when these effect principles do not hold. A real data example is given for a 20-run experiment where optimization of ethylene concentration is performed by manipulating eight process parameters.

Special/ Invited session

Classification

Both methodology and application

Keywords

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