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Dissertation Abstract

Construction Of D-Optimal Experimental Designs Using Genetic Algorithms

Experimental designs are routinely used in many areas of scientific investigation as a framework in which experimental data may be accumulated. Catalogs of designs have been available for many years to provide researchers with designs that can be applied to standard experimental situations. When the design space to be investigated does not meet the assumptions required by standard experimental designs, optimum experimental design algorithms may be applied to search the design space for a design that best estimates the parameters of a specified linear model. Since searching the design space is a difficult combinatorial problem, experimenters have used specialized search algorithms to find designs. These search algorithms in general only guarantee to find local maximums or minimums within the design search space.

A review of the literature showed that the genetic algorithm approach heretofore has not been utilized to address the design of experiments problem. In this research, a genetic algorithm approach is proposed and developed to generate experimental designs. The difficulty in representing this problem with genetic strings is discussed and a representational scheme developed. In addition, a genetic algorithm stopping criterion is developed and utilized in appraising when the genetic algorithm approach has gone to completion. The genetic algorithm approach is compared to a random search, a sequential search and simulated annealing search methodologies using a test suite of typically encountered experimental designs.

This research demonstrates that the genetic algorithm approach is a viable method for generating experimental designs. The proposed stopping criterion is illustrated as being an effective method of terminating a genetic algorithm run. The performance of this approach is shown to be superior, with respect to the variability of solutions, when compared to some of the other design generation methods. Suggestions are made concerning performance improvement of the methodology.