MASTER'S THESIS

Case studies in computer experiments, applications of uniform design and modern modeling techniques

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Abstract

Computer Experiments have been widely used in many areas of scientific research. The purpose of computer experiments is to approximate a complex physical system by a mathematical model in order to understand the output or analyze it more efficiently. Computer experiment consists of two parts, experimental design and modeling. The design is a plan to select data (information) for the system. In the past, many designs such as Latin hypercube and uniform design have been used for computer experiments.

In this thesis, we will consider four methodologies on the modeling of computer experiments, Bayesian method, linear regression method, Sliced inverse regression and principal Hessian directions. We will apply them on computer experiments. The data are collected according to uniform design, Latin hypercube design and orthogonal design. The motivation is to compare the estimating ability of these methodologies on computer experiments which is based on different choice of designs. It was found that the higher level of the design can have the better estimating ability. If two designs have the same level for each factor, we will prefer to use one with better uniformity.

Besides the computer experiments, we will consider the foldover design method on 2 level fractional factorial design. With a suitable choice of foldover plan, we can generate a better resolution design (smaller discrepancy design) with larger number of runs. In this thesis, we will introduce a method to find out the better foldover plan for regular fractional factorial design. Moreover, we will introduce a way to reduce the complexity for searching the best foldover plan on both regular and non-regular fractional factorial design.

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