Statistica Sinica **32** (2022), 1225-1243
doi:https://doi.org/10.5705/ss.202020.0110

CONSTRUCTION OF STRONG GROUP-ORTHOGONAL ARRAYS

Chunyan Wang, Jinyu Yang and Min-Qian Liu

Nankai University

Abstract: Space-filling designs with low-dimensional stratifications are desirable choices for computer experiments. In addition, column orthogonality is an important property of designs for such experiments, because it allows the estimates of the main effects in linear models to be uncorrelated with each other. However, few works have examined space-filling designs with both properties. This paper proposes a new class of designs called strong group-orthogonal arrays, the columns of which can be partitioned into groups, with the columns from different groups being column orthogonal and enjoying attractive low-dimensional stratifications. In addition, the overall arrays collapse to fully orthogonal arrays that accommodate large numbers of factors, making them particularly suitable for computer experiments. Methods for constructing this class of arrays based on both regular and nonregular designs are proposed. Difference schemes play a key role in the construction. Lastly, the proposed methods are easy to implement.

Key words and phrases: Column orthogonality, computer experiment, space-filling design, strong orthogonal array.

1. Introduction

Computer experiments are widely used in many fields, and space-filling designs are appropriate for such experiments (Fang, Li and Sudjianto (2006)). A space-filling design spreads its points in the design region uniformly, where the uniformity can be evaluated using some distance or discrepancy criteria. For a design in a high-dimensional region, it may be more reasonable to consider its space-filling properties in low-dimensional projections. Numerous approaches have been proposed for constructing space-filling designs with good properties in low-dimensional projections using orthogonal arrays (OAs), or other arrays that can be collapsed into OAs, such as strong orthogonal arrays (SOAs) and mappable nearly orthogonal arrays (MNOAs). McKay, Beckman and Conover (1979) introduced Latin hypercube designs (LHDs), which are OAs of strength one. Owen (1992) and Tang (1993) considered randomized OAs and OA-based

Corresponding author: Min-Qian Liu, School of Statistics and Data Science, LPMC & KLMDASR, Nankai University, Tianjin 300071, China. E-mail: mqliu@nankai.edu.cn.