Space-Filling Regular Designs

under a Minimum Aberration-Type Criterion

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Abstract

Space-filling designs plays a vital role in computer experiments. Common criteria for selecting such designs are either distance- or discrepancy-based. Recently, Tian and Xu introduced a minimum aberration-type criterion known as the Space-Filling Pattern (SFP). This criterion examines whether a design exhibits stratifications on a series of grids, and can effectively distinguish strong orthogonal arrays of same strengths. Subsequently, Shi and Xu refined the SFP to the stratification pattern (SP). They showed that designs excelling under the SFP construct better surrogate models than those meeting many other uniformity criteria. In this study, we provide a new justification for both SFP and SP, and discuss a new pattern that is similar to the SP. Then, our focus shits to the construction of space-filling regular designs. We show that both the SP and our proposed pattern of a regular design can be determined by counting different types of words of given lengths. This result allows for a complete search for the most space-filling regular designs of moderate run sizes.