Stratification Pattern Enumerator and its Applications

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Abstract

Space-filling designs are widely used in computer experiments. A minimum aberration-type space-filling criterion was recently proposed to rank and assess a family of space-filling designs including orthogonal array-based Latin hypercubes and strong orthogonal arrays. However, it is difficult to apply the criterion in practice because it requires intensive computation for determining the space-filling pattern, which measures the stratification properties of designs on various subregions. We propose a stratification pattern enumerator to characterize the stratification properties. The enumerator is easy to compute and can efficiently rank space-filling designs. We show that the stratification pattern enumerator is a linear combination of the space-filling pattern. Based on the connection, we develop efficient algorithms for calculating the space-filling pattern. In addition, we establish a lower bound for the stratification pattern enumerator and present construction methods for designs that achieve the lower bound using multiplication tables over Galois fields. The constructed designs have good space-filling properties in low-dimensional projections and are robust under various criteria.