Design Space Description through Adaptive Sampling and Symbolic Computation

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Abstract

In this paper, we propose a novel solution strategy to explicitly describe the design space in which no recourse is considered for the realization of the parameters. First, to smooth the boundary of the design space, the Kreisselmeier-Steinhauser (KS) function is applied to aggregate all inequality constraints, and project them into the design space. Next, for creating a surrogate polynomial model of the KS function, we focus on finding the sampling points on the boundary of KS space. After testing the feasibility of Latin hypercube sampling points, two methods are presented to efficiently extend the set of boundary points. Finally, a symbolic computation method, cylindrical algebraic decomposition, is applied to transform the surrogate model into a series of explicit and triangular subsystems that can be further converted to describe the KS space. Two case studies are considered to show the efficiency of the proposed algorithm.

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