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14. ABSTRACT

Surrogate models can be used to approximate complex systems at a reduced cost and are widely used when data generation is expensive or time consuming. The accuracy of these models is dependent on the samples used to create them. Therefore, proper sample selection within the parameter space is paramount. Numerous design of experiments (DOE) methodologies have been developed with the aim of identifying the optimal sample set to capture the system of interest. Adaptive sampling techniques are a subclass of DOE methods that identify optimal locations for new samples by leveraging response information from existing samples. By exploiting knowledge of the system, adaptive sampling methods have been demonstrated to significantly reduce the number of samples required to build a surrogate model of a given accuracy. However, utilizing the response information of the previous samples adds a computational cost associated with determining the ideal sample locations. Additionally, this cost typically grows with the sample count. This article presents techniques to reduce the cost associated with the adaptive sampling procedure so that the cost savings provided by adaptive sampling are maximized. A new K-fold cross-validation (KFCV)-Voronoi adaptive sampling technique is proposed to reduce the sample selection costs by adding a global KFCV filter to the cross-validation (CV)-Voronoi technique. The costs are further reduced through an innovative Voronoi batch sampling technique that is demonstrated to outperform naïve batch sampling. The proposed adaptive sampling acceleration techniques are evaluated using benchmark functions of increasing dimension and aerodynamic loading data.

15. SUBJECT TERMS
Adaptive Sampling, Surrogate modeling, Design of Experiments, Batch Sampling, K-Fold Cross-Validation

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