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Bayesian Active Learning Methods for Structural Reliability Analysis

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Abstract

Structural reliability analysis is essential for evaluating the ability of engineering structures to perform their intended functions, including safety, serviceability, and durability. Although numerous methods have been developed for structural reliability analysis over the past few decades, traditional methods are still inefficient and/or inaccurate for practical engineering problems. In response to this need for more efficient and accurate methods, the author and their co-workers have proposed a family of Bayesian active learning methods [1-10]. These methods feature an organic integration of Bayesian statistical inference and active learning techniques. To be specific, estimation of the failure probability integral is first treated with Bayesian inference. Then, key components for active learning (i.e., learning function and stopping criterion) are developed based on the posterior statistics of the failure probability. Our Bayesian active learning methods have been empirically shown to be capable of estimating extremely small failure probabilities with good efficiency and accuracy.

Key words: Structural reliability analysis; Bayesian active learning; Learning function; Stopping criterion

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