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Efficient emulators of computer experiments using compactly supported correlation functions, with an application to cosmology

Cari G. Kaufman, Derek Bingham, Salman Habib, Katrin Heitmann, Joshua A. Frieman

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Statistical emulators of computer simulators have proven to be useful in a variety of applications. The widely adopted model for emulator building, using a Gaussian process model with strictly positive correlation function, is computationally intractable when the number of simulator evaluations is large. We propose a new model that uses a combination of low-order regression terms and compactly supported correlation functions to recreate the desired predictive behavior of the emulator at a fraction of the computational cost. Following the usual approach of taking the correlation to be a product of correlations in each input dimension, we show how to impose restrictions on the ranges of the correlations, giving sparsity, while also allowing the ranges to trade off against one another, thereby giving good predictive performance. We illustrate the method using data from a computer simulator of photometric redshift with 20,000 simulator evaluations and 80,000 predictions.

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