VIRGINIA TECH DEPARTMENT OF STATISTICS COLLOQUIUM

Stacking designs: designing multi-fidelity computer experiments with confidence

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Abstract: In an era where scientific experiments can be very costly, multi-fidelity emulators provide a useful tool for cost-efficient scientific discovery. For many scientific applications, the experimenter is often limited by a tight computational budget, and thus wishes to (i) maximize predictive power of the multi-fidelity emulator via a careful design of experiments, and (ii) ensure the resulting emulator model achieves a desired error bound with confidence. Existing design methods, however, do not jointly tackle objectives (i) and (ii). We propose here a novel stacking design approach which addresses both goals. Using a recent multi-level Gaussian process emulator model, our stacking design provide a sequential approach for designing multi-fidelity runs such that a desired prediction bound is met under regularity conditions. We then prove a novel cost complexity theorem which, under this multi-level Gaussian process emulator, establishes a bound on the computation cost (for training data generation) needed to ensure a prediction bound. Finally, we demonstrate the effectiveness of the proposed stacking designs in a suite of simulation experiments and an application to finite element analysis.

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