TEXAS A&M Institute of Data Science

# Texas A&M Institute of Data Science Seminar Series

## Stacking Designs: Designing Multi-Fidelity Computer Experiments with Target Predictive Accuracy

In an era where scientific experiments can be very costly, multi-fidelity emulators provide a useful tool for cost-efficient predictive scientific computing. For 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 this model achieves a desired error tolerance with some notion of confidence. Existing design methods, however, do not jointly tackle objectives (i) and (ii). We propose a novel stacking design approach that addresses both goals. Using a recently proposed multi-level Gaussian process emulator model, our stacking design provides a sequential approach for designing multi-fidelity runs such that a desired prediction error of $\varepsilon>0$ is met under regularity assumptions. We then prove a novel cost complexity theorem that, under this multi-level Gaussian process emulator, establishes a bound on the computation cost (for training data simulation) needed to achieve a prediction bound of $\varepsilon$. This result provides novel insights on conditions under which the proposed multi-fidelity approach improves upon a standard Gaussian process emulator which relies on a single fidelity level. Finally, we demonstrate the effectiveness of stacking designs in a suite of simulation experiments and an application to finite element analysis.

**Chih-Li Sung, Ph.D.**
Assistant Professor
Department of Statistics and Probability
Michigan State University.

**Date:** Monday, August 28th, 2023
**Time:** 2:00 – 3:00 pm US Central Time
**Location:** Blocker 220
**Online:** 974 9688 4861 (ID) & 923446 (PWD)
**Faculty Host:** Rui Tuo, ISEN

## Biography

Dr. Chih-Li Sung is an Assistant Professor in the Department of Statistics and Probability at Michigan State University. His research interests include computer experiment, uncertainty quantification, machine learning, big data, and applications of statistics in engineering. He was awarded the Statistics in Physical Engineering Sciences (SPES) Award from ASA in 2019. He is currently an associate editor for Technometrics and Computational Statistics & Data Analysis (CSDA). His research is supported by NSF DMS 2113407. He received a Ph.D. at the Stewart School of Industrial & Systems Engineering at Georgia Tech in 2018. He also received a B.S. in Applied Mathematics and an M.S. in Statistics from National Tsing Hua University in 2008 and 2010, respectively.

You can also click this link to join the seminar: https://tamu.zoom.us/j/97496884861?pwd=Y2ZXRERyMU1EY1A2d2ZNS1JQTDIxdz09

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