



An Effective and Efficient Computational Approach to Constructing the Pareto Frontier for Multi-Objective Optimal Experimental Design

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Abstract: Optimal experimental design (DoE) is currently the most popular choice for planning studies in industrial engineering and manufacturing. While this approach can elucidate the experiment that ‘gives the most bang for the buck’ for a single research goal, it cannot guarantee that the proposed design will maintain high quality on other research objectives and requirements.

To address this drawback, a small group of leaders in statistical design began researching and adapting multi-objective optimization (MOO) to the optimal DoE problem about a decade ago. Formulating the problem from the MOO perspective ensures that the resulting, proposed candidate design will inherit high quality properties for all research objectives. However, the degree to which the candidate design can be high quality on each objective is problem dependent.

In this talk I will define the MOO problem from the optimal DoE perspective. Introduce and define related concepts such as: the ideal point, the utopia region, desirability, and the Pareto Frontier. I will give a summary of the state-of-the-art for this problem in the statistical design literature. And then I will present some emerging results from ongoing research with Statisticians from Los Alamos National Laboratory and the University of South Florida.

Our current approach relies on the Tchebychev metric (the asymptotic form of the L_p -norm) and Particle Swarm Optimization. Preliminary results suggest a significant advancement to the state-of-the-art and our (Statisticians) capability for generating Pareto-Optimal designs.

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