Abstract:

This EAGER award project will develop and demonstrate new simulation optimization algorithms that integrate methods of analysis, experimental design, and modeling to exploit the many unique characteristics of simulated systems. Current simulation experiments are almost indistinguishable from conventional real-system experiments. They take little or no advantage of the fact that in a computer experiment everything is controllable. Unlike conventional “black-box” experimental designs, where different scenarios are applied to distinct experimental units, simulations can simultaneously run many scenarios on the same processor. The basic concept is to have competing simulated systems “race” rather than the current approach of running them sequentially (usually each on a single processor). The foundation for this research is that simulation codes are “clear boxes”, at least to their creators. One not only can look inside this box, they can reach inside and change it while the simulation experiments are running.

Simulations impact almost all aspects of modern society to help optimize system designs and policies. Problems that warrant simulation projects are typically high-impact and pressing. Preliminary (ad-hoc) integrated simulation experiment/models prior to this research include one involving emergency inventories of biopharmaceuticals to make their supply chains more robust to sudden disruptions (like earthquakes). This indicates that integrated simulation model/experiments can be considerably more efficient than conventional experimental designs run on simulations. This allows exploring many more options, ultimately leading to more informed decision making.