Dr. Ying Hung

CAREER: An Efficient Framework for Design and Modeling of Complex Computer Experiments

The primary objective of this research is to develop an efficient framework for design and modeling of complex computer experiments, especially those with diverse and high-dimensional inputs and massive outputs. Computer experiments, i.e., experiments using simulation or numerical codes, have been widely used as alternatives to physical experiments, especially for studying complex phenomena. The investigator introduces new classes of designs that can efficiently accommodate large numbers of both quantitative and qualitative factors in computer experiments. The investigator also proposes a new adaptive design that is flexible and robust, yet takes into account uncertainties in the complex systems. Apart from experimental design, a novel sampling/modeling technique is proposed to reduce computational complexity and quantify model uncertainty in the analysis of computer experiments with massive data.

The proposed approaches are readily applicable to a variety of scientific disciplines and will have immediate impact on accelerating discoveries in numerous fields involving complex experiments like biomechanical engineering, systems biology, and environmental science. In particular, the proposed modeling techniques can dramatically enhance the efficiency and prediction accuracy in the analysis of cell adhesion, which plays an important role in tumor metastasis in cancer research. Moreover, the proposed methods can benefit the analysis of massive data for climate change, response to natural disasters, and the spread of pandemic disease. Integrated into the research outlined in this proposal is an education plan that emphasizes interdisciplinary training for a broad body of students and increasing participation from underrepresented groups. Results of the proposed research will be integrated into the Research Experience for Undergraduates program offered by Rutgers. Female and undergraduate students from underrepresented groups will be recruited and actively involved in the PIs research. Software will be written, which allows graduate and undergraduate students to have hands-on experience to implement the new methods on real examples.