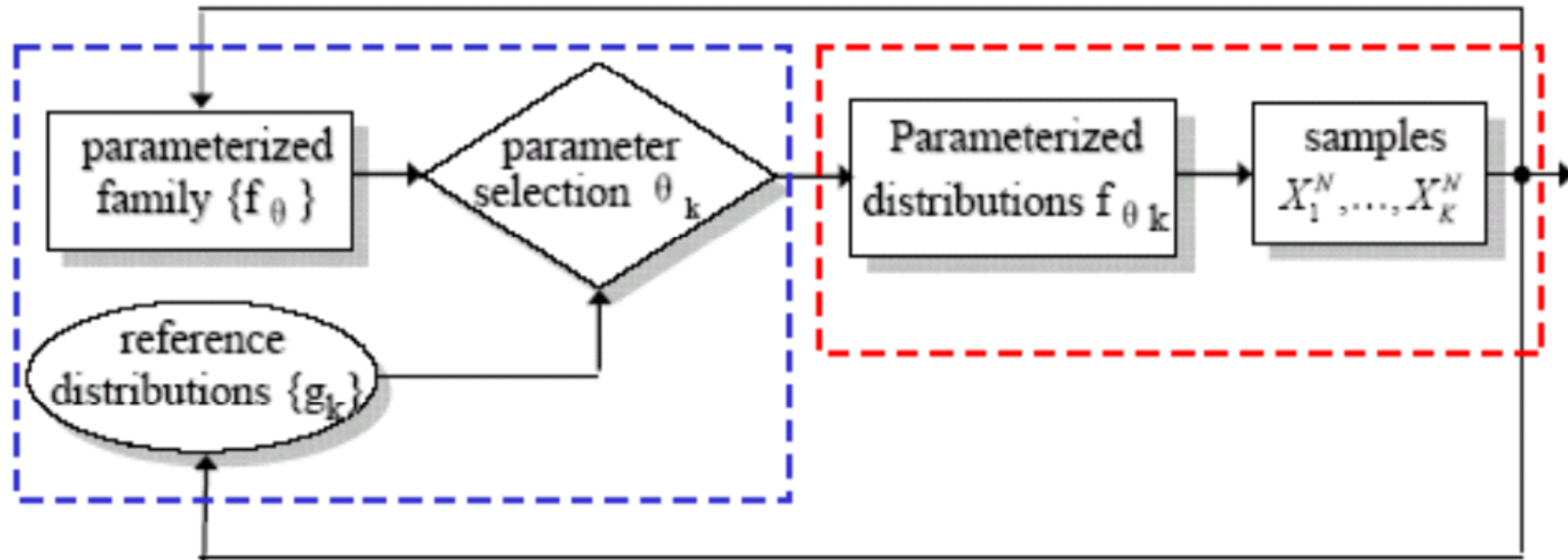# Research Overview

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NSF Simulation Optimization Workshop

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STONY BROOK UNIVERSITY

Simulation-Based & Sampling Methodologies

- Model Reference Adaptive Search framework

  - Provable convergence in both deterministic and stochastic settings

    - J. Hu, M.C., Fu, and S. I. Marcus, "A Model Reference Adaptive Search Method for Global Optimization," *Operations Research*, 2007.
    - J. Hu, M.C., Fu, and S. I. Marcus, "A Model Reference Adaptive Search Method for Stochastic Global Optimization," *Communications in Information and Systems*, 2008.

Simulation-Based & Sampling Methodologies

– Asymptotic convergence rate analysis
  - connections to stochastic approximation
  - solve the original problem on the transformed parameter space
  - improved numerical performance

  - J. Hu and P. Hu, "On the Performance of the Cross-Entropy Method," *Proceedings of the 2009 Winter Simulation Conference*, 2009.
  - J. Hu, P. Hu, and H. S. Chang, "A Stochastic Approximation Framework for a Class of Randomized Optimization Algorithms," working paper, 2010.
  - J. Hu and P. Hu, "Annealing Adaptive Search, Cross-Entropy, and Stochastic Approximation in Global Optimization," working paper, 2010.

– Applications to Markov Decision processes and optimal drug dose-response experimental designs

  - J. Hu and E. Feinberg, "An Approximate Stochastic Annealing Algorithm for Finite Horizon Markov Decision Processes," *Proceedings of the 49th IEEE Conference on Decision and Control*, submitted, 2010.
  - J. Hu, W. Zhu, Y. Su, and W. K. Wong, "Controlled Optimal Design Program for the Logit Dose Response Model," *Journal of Statistical Software*, 2010.
  - H. S. Chang, J. Hu, M. C. Fu, and S. I. Marcus, "Adaptive Adversarial Multi-Armed Bandit Approach to Two-Person Zero-Sum Markov Games," *IEEE Transactions on Automatic Control*, 2010.

Simulation-Based & Sampling Methodologies

- – Open problems
    - ▪ finite time performance analysis (for specific problem class)
    - ▪ further extensions to simulation optimization
    - ▪ new algorithms incorporating problem structures

- **Simulation and sampling efficiency**

    - – Computing budget allocation
        - ▪ maximize algorithm performance subject to a given sample budget constraint
        - ▪ formulate the sample allocation problem as a sequential decision making problem
        - ▪ adaptive allocation rules via MDP theory

        - • J. Hu and H. S. Chang, "A Population-Based Cross-Entropy Method with Dynamic Sample Allocation," *Proceedings of 47th IEEE Conference on Decision and Control*, 2008.
        - • J. Hu, H. S. Chang, M. C. Fu, and S. I. Marcus, "Dynamic Sample Budget Allocation in Model-Based Optimization," *Journal of Global Optimization*, 2010.

Simulation-Based & Sampling Methodologies

- Importance sampling with applications to bootstrap distribution/quantile estimation and sequential clinical trial designs

  - J. Hu and Z. Su, "Efficient Error Determination in Sequential Clinical Trial Design," *Journal of Computational and Graphical Statistics*, 2008.
  - J. Hu and Z. Su, "Adaptive Resampling Algorithms for Estimating Bootstrap Distributions," *Journal of Statistical Planning and Inference*, 2008.
  - J. Hu and Z. Su, "Bootstrap Quantile Estimation via Importance Resampling," *Computational Statistics and Data Analysis*, 2008.