SIMULATION OPTIMIZATION RESEARCH: TRANSITION METHODS FOR A TWO-PHASED STRATEGY

John D. Hall, Ph.D.
APT Research, Inc.
4950 Research Drive
Huntsville, Alabama 35805
email: jhall@apt-research.com

Royce O. Bowden, Ph.D.
Department of Industrial Engineering
Mississippi State University
Mississippi State, Mississippi 39762
email: bowden@engr.msstate.edu

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ABSTRACT

The authors identify six domains that are common to any automated simulation optimization tool: Methods, Classification, Strategy and Tactics, Intelligence, Interfaces, and Problem Formulation. These domains are the cornerstones for a unified strategy for simulation optimization and should guide future research in the field and development of next generation simulation optimization tools. The authors present work on a two-phased strategy for simulation optimization. In this strategy, Phase 1 or Exploration uses a globally oriented search heuristic to find a region of the solution space containing very good solutions. Phase 2 or Exploitation then uses a locally oriented search method to quickly converge on the best solution in the region. This method has shown to improve the efficiency of the simulation optimization procedure. The authors describe a transition strategy for use with the scatter search heuristic that makes the transition from Exploration to Exploitation. Experimentation is described that determined the maximum number of restarts allowed for the scatter search heuristic prior to transition to Phase 2.

SIMULATION OPTIMIZATION

Simulation optimization is rapidly becoming an important process design tool for simulation practitioners. Simulation optimization is the practice of linking an optimization method with a simulation model to determine appropriate settings of certain input parameters so as to maximize the performance of the simulated system. Dennis E. Smith proposed the architecture for an automated simulation optimization tool for practitioners were formulated in the early 1970s. Smith suggested an automated optimizer would be a computer application external to the simulation model. The optimizer would use model inputs and outputs as well as user supplied information to determine an optimal solution. The optimizer would possess the requisite intelligence to determine an appropriate optimization method for a given problem (Smith 1973a and 1973b).

Dennis Pegden and Michael Gately were among the first to describe linking an optimization algorithm to commercially available simulation packages. They used the Hooke-Jeeves pattern search method, a direct search heuristic, to find optimal parameter settings for systems modeled with GASP IV and SLAM simulation packages (Pegden and Gately 1977 and 1980). This research illustrated the utility of simulation optimization; however, it required knowledge of optimization. Therefore, simulation optimization was not a practical tool for the general simulation practitioner.

Simulation optimization became available to the general practitioner when ProModel Corporation introduced the SimRunner optimizer for the ProModel simulation package in 1995. Other simulation software vendors have since included optimization products with their simulation software. Examples include the OptQuest96 optimizer for Micro Analysis and Design's Micro Saint simulation product, WITNESS Optimizer for Lanner Group's WITNESS simulation product, and AutoStat for AutoSimulation's AutoMod simulation product. These simulation optimizers use newer direct search techniques such as evolutionary algorithms (e.g. genetic algorithms and evolution strategies), scatter search, and simulated annealing. Simulation practitioners now have access to robust optimization algorithms and they are using them to solve a variety of "real world" simulation optimization problems (Akbay 1996). This first generation of commercially available simulation optimization software provides a new and needed analytical tool for simulation practitioners. However, improvements will be made in the next generation of simulation optimization tools to give even greater product and process design power to the user.

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