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Experiments With An Open Architecture for Parametric Discrete-Event Simulation

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6. AUTHORS
Dr. Robert P. Cook

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Georgia Southern University
Department of Mathematics and Computer Science
P.O. Box 8093
Statesboro, GA 30460

8. PERFORMING ORGANIZATION REPORT NUMBER
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12a. DISTRIBUTION/AVAILABILITY STATEMENT

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12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*
The goal of the proposed research is to experiment with an open architecture for a discrete-event simulation system so that it can be controlled by optimization programs that use strategies such as genetic algorithms or simulated annealing in order to realize an improved solution system for large-scale combinatorial optimization problems of interest to the Navy. The primary anticipated practical benefit would be to shorten solution runtimes.

The first phase of the project involves the implementation of a suitable experimental test-bed. The creation of the test-bed requires the implementation of a prototype discrete-event simulation system; the implementation of suitable search meta-strategies, and the implementation of several sample problems. The completion of the basis for experimentation in the first phase of the project basically duplicates the current state-of-the-art in the use of discrete-event simulation systems in combination with heuristic search techniques to solve combinatorial optimization problems.

14. SUBJECT TERMS
Prototype, Parametric Simulation, Discrete-Event, Combinatorial Optimization

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FINAL TECHNICAL REPORT

GRANT #: ONR N00014-00-10769

PRINCIPAL INVESTIGATOR: Robert P. Cook (e-mail: bobcook@gasou.edu)

INSTITUTION: Georgia Southern University

GRANT TITLE: Experiments With An Open Architecture for Parametric Discrete-Event Simulation

AWARD PERIOD: 1 August 2000 - 31 December 2001

OBJECTIVE: We have developed a discrete-event simulation environment. In addition, we have completed a Masters project to experiment with combinatorial algorithms interacting with a database system. We have also completed an investigation of OLAP (on-line analytical processing).

APPROACH: The scientific objective is to design a RTI (runtime type interface) for a simulation system. Such an interface could provide new control and optimization options for systems that solve combinatorial optimization problems by iteratively executing simulations with different parametric input. The existence of an RTI supports changing simulation parameters or execution behavior at runtime without the need to reprogram; thus resulting in an ability either to obtain better solutions or to obtain solutions faster.

ACCOMPLISHMENTS (throughout award period): The first phase of the project involved the implementation of a suitable experimental test-bed. The creation of the test-bed required the implementation of a prototype discrete-event simulation system; the implementation of a suitable search meta-strategy, and the implementation of several sample problems. The completion of the basis for experimentation in the first phase of the project basically duplicates the current state-of-the-art in the use of discrete-event simulation systems in combination with heuristic search techniques to solve combinatorial optimization problems.

The proposed research included the design of an experimental “open” architecture for the simulation system that would allow the search algorithm to interact with simulations during their execution. One obvious benefit would be the addition of a “cut” feature that would allow unproductive runs to be terminated early. The goals were to improve the quality of solutions and the speed with which they could be produced. Note that we did not propose to rewrite existing simulations, only to “open” the architecture of the simulation system so that the search strategy could interact with intermediate simulation states.

CONCLUSIONS: We have demonstrated that a “reflection” interface can be a valuable addition to the runtime of a discrete-event simulation package. Such an interface, enables a control program to interact with simulation variables by name at runtime. The interface can be used to monitor the state of a simulation either to terminate prematurely unproductive runs or to “direct” the simulation as it executes. The primary advantage of a “reflection”, or run-time type information, interface is that the simulation program does not have to be modified in order to enable the interaction with a control program. It would be advantageous to have a standard for such interfaces so that control programs could be “plugged in” without having to change them for every different simulation system.

SIGNIFICANCE: Our studies have provided a demonstration that discrete-event simulation packages can benefit from the addition of an interface that allows a control program to interact with simulation variables and entities while a simulation is running. The anticipated benefit is for systems that perform combinatorial optimization by varying parameters across multiple simulation runs. By interacting with the simulation during execution, unproductive runs can be prematurely terminated; thus, permitting more simulation runs per unit of time, which should result in better solutions.

We have also investigated a similar interface for an object-relational database system to facilitate analysis of data warehouse information in the form of data cubes.

PATENT INFORMATION: No patents have been filed.

AWARD INFORMATION: Faculty sponsor for two student programming teams at the ACM OOPSLA conference CodeFest in Tampa, FL. One of the teams won first place and were awarded Palm computers by Dr. Brent Hailpern, Associate Director, Computer Science at the IBM Thomas J. Watson Research Center.

Named a Yamacraw Professor (see www.yamacraw.org)

REFEREED PUBLICATIONS (for total award period):

1. "Web Testing Using an Object-Relational Database System Demonstration," OOPSLA 2001, Tampa, FL, (Oct. 2001).

2. "Learning in the Palm of Your Hand," WebNet 2001, Orlando, FL, (Oct. 2001).

BOOK CHAPTERS, SUBMISSIONS, ABSTRACTS AND OTHER PUBLICATIONS (for total award period)

1. “OLAP Support in an Object-Relational Database System,” DOLAP 2001 Workshop, Atlanta, GA (submitted).

2. “The Architecture of the World-Wide Web, A Retrospective,” International Conference on Internet Computing 2001, Las Vegas, NV (submitted).