Georgia Tech Sponsored Research

Project	C-36-X51
Project director	Fujimoto Richard
Research unit	Computing
Title	End-to-End and Parallel Simulation of Integrated Network Architectures
Project date	12/31/1998

C-36-X51 1+2 (New)

AUGMENTATION AWARDS FOR SCIENCE & ENGINEERING RESEARCH TRAINING (AASERT) REPORTING FORM

The Department of Defense (DoD) requires certain information to evaluate the effectiveness of the AASERT Program. By accepting this Grant which bestows the AASERT funds, the Grantee agrees to provide 1) a brief (not to exceed one page) narrative technical report of the research training activities of the AASERT-funded student(s) and 2) the information requested below. This information should be provided to the Government's technical point of contact by each annual anniversary of the AASERT award date.

1. Grantee identification data: (ARO Proposal Number and Grant numbers found on Page 1 of Grant)

a. Georgia Institute of Technology
University Name

b. Grant DAAH04-95-0234
Grant Number

c. P-34549-MA-AAS
ARO Proposal Number

d. Richard Fujimoto
P.I. Name

e. From: 6/1/95 To: 5/31/96
AASERT Reporting Period

NOTE: Grant to which AASERT award is attached is referred to hereafter as "Parent Agreement."

2. Total funding of the Parent Agreement and the number of full-time equivalent graduate students (FTEGS) supported by the Parent Agreement during the 12-month period prior to the AASERT award date.

a. Funding: $ 0

b. Number FTEGS: N/A

3. Total funding of the Parent Agreement and the number of FTEGS supported by the Parent Agreement during the current 12-month reporting period.

a. Funding: $ 124,000.00

b. Number FTEGS: one

4. Total AASERT funding and the number of FTEGS and undergraduate students (UGS) supported by AASERT funds during the current 12-month reporting period.

a. Funding: $ 33,333.00

b. Number FTEGS: one

c. Number UGS: none

VERIFICATION STATEMENT: I hereby verify that all students supported by the AASERT award are U.S. citizens.

Richard Fujimoto
Principal Investigator

5/29/97
Date

XC Rpts Coor

Part 1.
(a) Georgia Institute of Technology
(b) Grant DAAH04-95-1-0234
(c) P34549-MA-~~AAS~~
(d) Richard Fujimoto
(e) 6/1/95 to 5/31/96 ← This is Correct

Part 2.
(a) $0 (parent grant started at same time as AASERT)
(b) N/A

Part 3.
(a) $124,000
(b) One

Part 4.
(a) $33,333
(b) One
(c) None

Narrative Technical Report

The AASERT grant provided support Mr. Christopher Carothers, a PhD student in the College of Computing at the Georgia Institute of Technology. Mr. Carothers research is concerned with developing high performance parallel discrete event simulation technologies that enable one to execute large simulation programs on multiple processor parallel and distributed computers in order to reduce execution time. This technology can be applied to missile defense simulations to test battle management plans against anticipated threats. Such simulations are currently so time consuming that they cannot be performed on-line in "hot" situations. As a result, the simulations must be performed prior to deployment, using out-dated intelligence information.

Mr. Carothers is developing high performance parallel simulation software utilizing commercial off-the-shelf (COTS) cluster supercomputers (networked workstations and multiprocessors) to enable faster-than-real-time execution of missile defense scenarios. The focus of this research is in using optimistic execution techniques where rollback and recovery mechanisms are used to synchronize the computation. Optimistic processing offers greater exploitation of concurrent execution, simpler development of the simulation model, and greater performance robustness to changes in the model compared to so-called conservative approaches to parallel/distributed discrete event simulation. Optimistic simulation technology offers the capability of speeding up simulation software in proportion to the number of processors used.

During this period, Mr. Carothers worked on demonstrating application of these algorithms on simulations of large telecommunication networks. Specifically, he demonstrated over forty-fold speedups for models of large wireless networks including thousands of receiver/transmitter (bay) stations and tens of thousands of mobile entities.

C-36-X51
#3

Final Narrative Technical Report

Grant DAAH04-95-1-0234

Richard Fujimoto
College of Computing
Georgia Institute of Technology
Atlanta, GA 30332-0280

The AASERT grant extending from June 1995 through December 1998 provided support for two PhD students, Dr. Christopher Carothers and Ms. Maria Hybinette as graduate research assistants. Mr. Carothers graduated in August 1997, and Ms. Hybinette is just completing her degree requirements, and is expected to complete her "defense of dissertation research" in May 1999, with final graduation expected during the summer or fall of 1999. Mr. Carothers completed a postdoctoral program at Georgia Tech after graduating, and is now on the faculty at Rensalaer Polytechnic Institute (RPI) in New York. Ms. Hybinette will seek a full time position once she has completed her degree. Residual funds from the grant also supported Mr. Thom McLean, who recently joined the PhD program at Georgia Tech for a brief period of time.

Dr. Carothers research was concerned with developing, implementing, and experimentally evaluating load balancing strategies for optimistic parallel discrete event simulations, e.g., for missile defense simulations. He developed new algorithms in this regard. An important aspect of his work is he considered load distribution in the context of "background execution" of parallel simulation programs where unpredictable, externally generated workloads could be created. Using simulations of wireless telecommunication networks and synthetic workloads as benchmarks, he demonstrated that his algorithms effectively redistributed workloads, despite such unpredictable conditions.

Ms. Hybinette's research is concerned with developing interactive parallel discrete event simulation technologies. This work also has important applications in battle management and missile defense settings. A principal result of her work was the development and realization of a novel approach to interactive parallel simulation where running programs could be dynamically "cloned" or replicated. Each replication is given new state information in order to rapidly explore multiple possible futures that might arise based on decisions made during the course of the simulation. For example, in a battle management simulation, once might clone the simulation to evaluate results from utilizing different counter measures to respond to new threats that arise during the simulation. Ms. Hybinette developed the algorithms to dynamically clone parallel simulations and realized a prototype to evaluate the effectiveness of this approach. Extensive experiments were conducted on both synthetic and real-world (in this case, simulations for air traffic control) applications.