Final Report

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Creating a New Generation of Software Development Environments, Compilers, and Algorithms for High Performance Computing, Networks, and Data Management

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1 Introduction

The PI was tenured and promoted to Associate professor in Computer Science at Florida State University in 2004 (two years into the grant project).

The funding was used to support several graduate students (MS and PhD), to prepare research publications, to deliver presentations at conferences, to purchase small equipment, and to provide summer month research support for the PI.

This report gives the expenditures and lists the details of the accomplishments, a summary of research results obtained, and the artifacts produced with the DOE grant funding.

2 Project Results and Accomplishments

2.1 Project Production

This section describes the production of the project for the duration of the award (August 15, 2002 to August 14, 2006).

2.1.1 Journal Publications Citing DOE Support (Reviewed)

The reviewed journal publications produced by the project are listed below. These publications acknowledge DOE grant support.


2.1.2 Conference Publications Citing DOE Support (Reviewed)

The reviewed journal publications produced by the project are listed below. These publications acknowledge DOE grant support.


2.1.3 Workshop Publications Citing DOE Support (Reviewed)

The reviewed journal publications produced by the project are listed below. These publications acknowledge DOE grant support.


2.1.4 Other Publications (Not Reviewed)

The non-reviewed publications and reports produced by the project are listed below.


2.1.5 **Talks and Addresses**

A selection of the presentations delivered during the project are listed below.

- Invited presentation *gSOAP Web Services*, Microsoft, Redmond, September 21, 2005.


- Research seminar at Argonne National Labs on joint gSOAP and OGSA efforts, October 7, 2002.

### 2.1.6 Conferences Organized

The conferences, conference tracks, and workshops organized by the PI are listed below.

- Track chair for the ACM Symposium on Applied Computing (SAC) 2006 track on *Distributed Systems and Grid Computing*.

- Co-track chair for the GlobusWorld conference 2005 on Web Services Performance Aspects.

- Track chair for the ACM Symposium on Applied Computing (SAC) 2005 track on *Distributed Systems and Grid Computing*.

- Track chair for the ACM Symposium on Applied Computing (SAC) 2004 track on *Parallel and Distributed Systems*.


- Track chair for the ACM Symposium on Applied Computing (SAC) 2003 track on *Parallel and Distributed Systems and Networks*.

The PI served on the following program committees


- IEEE International Conference on Services Computing (SCC) program committee member, 2007.


- ACM International Conference on Supercomputing (ICS) program committee member, 2003.
2.1.7 Web Sites Developed and Maintained

The Web sites and Web pages developed for the project:

- Chains of recurrence algebra package for Polaris compiler. This package provides an induction variable recognition algorithm and dependence analyzer based on the CR algebra. Demo and software is available from http://people.scs.fsu.edu/~birch/research.

- gSOAP toolkit web site: http://gsoap2.sourceforge.net (approx 30 pages). The gSOAP toolkit is an open source project and offers compilers, web servers, and tools to develop efficient SOAP/XML web services in C and C++. The software package has been downloaded over 150,000 times since 2003.

2.2 Overview of Project Expenditures and Justification

This section provides an overview of the expenditures. Justification is provided.

2.2.1 Personel

Personel appointed on the grant during the project:

- The PI was appointed on the grant for 1 month of summer salary in 2003.
- The PI was appointed on the grant for 1 month of summer salary in 2004.
- The PI was appointed on the grant for 1 month of summer salary in 2005.
- The PI was appointed on the grant for 2 months of summer salary in 2006.
- Johnnie Birch, Research Assistant, PhD candidate. Johnnie pursues a PhD in the area of restructuring compilers for scientific computing. He is expected the graduate in 2007.
- Yixin Shou, Research Assistant, PhD candidate. Yixin pursues a PhD in the area of flow-sensitive dependence analysis for compilers. She is expected to graduate in 2008.
- Subhajit Datta, Research Assistant, MS student (continues with PhD). Subhajit developed software engineering metrics that can benefit scientific application development by analyzing the impact of requirement changes on software. The metrics are obtained by compiler analysis methods developed for the project.
- Arthi Gokarn, Research Assistant, MS student. Arthi provides essential software development support for the gSOAP toolkit for Web and Grid services as mentioned in the grant proposal. Her accomplishments include a new toolkit for Grid computing with MATLAB. She graduated with a MS in 2004.
2.2.2 Equipment

Small equipment purchased for the project:

- Apple Macintosh Titanium Powerbook.

2.2.3 Travel

Travel sponsored by the project during the project year to deliver presentations related to the project:

1. North Carolina State University, colloquium talk, February 24, 2006.
2. CPC Workshop, January 2006, A Coruna, Spain.
5. CPC Workshop 2004, Germany, July 7-9.

3 Summary

The published research results during the project year are summarized below.

1. Published 7 journal papers acknowledging grant support, and 17 conference and 6 workshop papers acknowledging grant support

2. Presented several talks at conferences and workshops.

3. Developed innovative compiler analysis methods for recurrences, induction variables, and array dependences. The work is implemented in Polaris and made available to the public. The widely-used GCC compiler uses a simplified version adapted from our work.

4. Implemented the gSOAP toolkit for efficient Grid computing with Web services. The gSOAP software is developed by the PI and is used by several DOE-sponsored projects related to Grid computing, such as Globus GT3 and Harness. The PI established an active collaboration with the Globus team Argonne National Laboratories (contact: Kate Keahey). The gSOAP software is also used by many companies such as IBM, Adobe Systems, AOL, eBay, HP, Xerox, WindRiver, OpenWave, and Siemens. gSOAP is available from http://gsoap2.sourceforge.net it has been downloaded > 150,000 times since the initial release in 2003). The book “Professional Open Source Web Services” devotes a chapter on gSOAP. Reviews of the PI’s software can be found on developer’s Web sites such as Dr.Dobbs.
5. Completed work on validating compiler transformations in collaboration with Professors D. Whalley and X. Yuan (originally funded by an NSF grant).

6. Completed work on a new type of compiler transformation to merge branches in collaboration with Professors D. Whalley and X. Yuan.

7. Investigated timing analysis methods and designed new algorithms based on Newton-Gregory interpolating polynomials.

8. Investigated and implemented improvements in gSOAP for embedded systems.

9. Developed new parametric algorithms for intra-task voltage scaling.

10. Investigated and implemented secure layer for Grid computing with gSOAP. In this work we developed a Globus secure infrastructure (GSI) plugin for gSOAP for Grid systems in collaboration with M. Cafaro (member of the European Sara project, GRB project, GridLab project).

11. Investigated and designed new fast algorithms for scientific computing and networking with Web services.

12. Worked with IBM on a port of the gSOAP software to develop the IBM Web services toolkit for mobile devices (WSTKMD) for embedded systems, cell phones, and PDAs (software available from IBM Alphaworks).

13. Researched and co-developed Monte-Carlo Grid algorithms and application infrastructure.

4 Contact Information

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