

Peter M. Musial
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Research Interests

- Design, verification, analysis, and implementation of fault-tolerant distributed systems
- Methods for distributed code derivation
- Documentation driven development of complex systems
- Task scheduling in asynchronous distributed settings
- Design and analysis of parallel algorithms

Education

University of Connecticut Storrs, CT
Ph.D., Computer Science, 2007

Thesis title: *From High Level Specification to Executable Code:
Specification, Refinement, and Implementation of a
Survivable and Consistent Data Service for Dynamic Networks*

Thesis advisor: Prof. Alexander A. Shvartsman
Committee advisor: Prof. Nancy A. Lynch
Committee advisor: Prof. Laurent Michel

University of Connecticut Storrs, CT
M.S., Computer Science, 2001

University of Connecticut Storrs, CT
B.S., Computer Science and Engineering, 1999
Minor in Mathematics

Research Experience

- My postdoctoral research project involves derivation and formalization methods of system documentation and its use during the software design phase. The key difficulty is that the client is an expert in their domain, but is not aware of the software design and implementation processes. Whereas, the software developers are experts in the domain of software design and implementation, but they are not aware of specifics of client's domain. This work proposes new methods for developing and managing project documentation to reduce specification ambiguities, verify system requirements, and simplify architecture design.
- My thesis research topic is the formal specification and refinement of a distributed dynamic data service, and a methodic derivation of executable code according to precise rules designed to preserve the meaning of the formal specification. In these developments I use

the Input/Output Automata (IOA) model to reason about safety guarantees of my algorithms. A specification of an atomic dynamic data service that is versatile and adaptive to a variety of deployment strategies has a wide range of practical uses, such as data sharing in civilian rescue and military operations.

- I implemented a sophisticated consistent memory service for dynamic networks. The target platform was a cluster of heterogeneous machines, and the target programming language was JAVA. Prior to the implementation many technical issues had to be addressed, such as resolving nondeterminism of the specification and ensuring liveness of the implementation. Allowing a dynamically changing set of participating processors posed added difficulty. The remaining issue was mapping high-level actions to the JAVA API.
- Another of my contributions is in the area of processor coordination in asynchronous distributed systems. Specifically, I developed a set of schedules with combinatorial properties that ensure efficient work in terms of redundantly performed tasks by all non-failed processors. The schedules are constructed using expander graphs, and is the first polynomial time construction.
- In my master's thesis I presented processing and data mapping analysis for Space Time Adaptive Processing (STAP) on a high-performance cluster. This type of data processing is used in airborne radar systems to detect and track objects in the presence of natural and hostile interference. STAP requires processing of a large amount of data in a very short time. The specialized hardware for STAP processing is inflexible and expensive to update. I investigated Beam Space Post-Doppler approach for implementing STAP and calculated the required amount of work in terms of the number of arithmetic/floating point operations. Based on these calculations, I made an assessment of the available high-performance clusters built using commercial-off-the-shelf technology. Finally, I introduced optimization of the computational process that take advantage of the target hardware architecture.

Teaching Experience

- **Assistant Professor:** Univ. of Puerto Rico Rio Piedras Spring 2009
Computer Networking MATE 4995

Lectured a course on computer networks, while ensuring that students are exposed to the theoretical and practical aspects related to the subject. Student programming project was a chat-tool with file transfer and chat-room functionality (chat clients use IP addresses for initial connection, so no centralized log-on server).
- **Teaching Assistant:** Univ. of Connecticut Fall 2006
Digital Logic Design CSE 210W

Lectured two laboratory sections, where I explained the necessary theoretical and low-level concepts required to successfully complete assignments. Students built virtual circuits in LogicWorks 5 in addition to physical circuits on a protoboard.
- **Lecturer:** Univ. of Connecticut Spring 2005
Operating Systems CS 258

This course covered the key aspects of operating systems such as: process scheduling, memory and cache architectures, and resource management. Managed teaching assistant assigned to the course.

- **Teaching Assistant:** Univ. of Connecticut Fall 2004
Introduction to Discrete Systems CSE 254
Provided help to the students in the understanding of concepts thought in class. Graded and prepared solutions for homework assignments.
- **Teaching Assistant:** Univ. of Connecticut Fall 2000 until Fall 2004
Microprocessor Laboratory CSE 268
Helped to setup and maintain the hardware used during the course, which included the MPC823 and MPC860 development boards as well as the Diab compiler. Lectured during the laboratory and helped students with their tasks. I participated in the planning of assignments and graded laboratory reports.

Professional Experience

University of Puerto Rico - Rio Piedras Since January 2009

This is a tenure track faculty position, where I am required to develop a successful and funded research program in the area of my expertise while at the same time being devoted to providing quality education to the undergraduate students of the computer science department.

VeroModo, Inc. Since Summer 2005 until November 2007

I was a Research Associate at VeroModo, Inc., a start-up company developing computer-aided tools for specification and analysis of complex distributed systems, founded by Profs. Nancy Lynch (MIT) and Prof. Alex Shvartsman (UConn). VeroModo is a company committed to the development of a comprehensive toolset for verification and simulation of specifications written in the Timed Input/Output Automata (TIOA) model. My main responsibility is the development of the simulator plug-in. This tool can be used to guide the strategy to be followed in proving correctness of a source specification. In addition, we are investigating an extension of the toolkit to include an automated code generator, which will translate a restricted set of TIOA specifications into executable code for target distributed platforms. My work at VeroModo was funded through a DARPA STTR grant.

Awards and Honors

- Recipient of *National Research Council Postdoctoral Fellowship* in 2007. This award is for one year, with the Naval Postgraduate School, Computer Science Department with Prof. Luqi as an adviser.
- Recipient of *Doctoral Dissertation Fellowship Award* in 2006 from the Research Foundation at University of Connecticut.
- Recipient of *ICDCS-2005 Student Travel Grant*.
- Four-time recipient of *Graduate PreDoctoral Fellowships* over the period of 2003-2005. Award based on recommendation by the department faculty on the premise of academic achievement and the extent of involvement in the department.
- *Taylor L. Booth Memorial Scholarship* in 2003. Award based on effort, excellence, and experience in teaching.

Skills

- **Languages:** L^AT_EX, Java, Input/Output Automata notation, PowerPC ASM, HTML, C/C++, BASH shell scripting
- **Operating Systems:** Linux (Fedora), Solaris, Windows
- **Miscellaneous:**
 - Technical contact (while at Univ. of Conn.) and local administrator for *Planet-Lab*. Initial setup and hardware maintenance.
 - Built, maintained, and used a Beowulf cluster (Linux) of 14 machines.
 - System administration in various UNIX flavors, TCP/IP networking, software configuration management, strong verbal and written communication skills, excellent troubleshooting and debugging skills.
 - Completed a three day course on *Professional Grant Proposal Writing*, 2007, offered by the Institute for Communication Improvement *The Grant Institute*. This course covered following topics: program development and evaluation, professional grant writing, and grant research.

Publications

Note that authors are listed in alphabetical order. Publications annotated with the asterisk are currently submitted for a Journal review.

Journal Publications

- C. Georgiou, P.M. Musial, and A.A. Shvartsman. *Developing a Consistent Domain-Oriented Distributed Object Service*. IEEE Transactions on Parallel and Distributed Systems, accepted.
- G. Chockler, S. Gilbert, V.C. Gramoli, P.M. Musial, and A.A. Shvartsman. *Reconfigurable Distributed Storage for Dynamic Networks*. In Journal of Parallel Distributed Computing, 96(1): 100–116, 2009.
- C. Georgiou, P.M. Musial, and A.A. Shvartsman. *Long-Lived RAMBO: Trading Knowledge for Communication*. In Journal of Theoretical Computer Science, 383(1): 59–85, 2007.

Conference Publications

- C. Georgiou, N. Hadjiprocopiou, P.M. Musial. *Evaluating a Dependable Sharable Atomic Data Service on a Planetary-scale Network*. To appear in Proc. of the 9th International Conference on Algorithms and Architectures for Parallel Processing, 2009.
- V. Berzins, Luqi, P.M. Musial. *Formal Reasoning about Software Object Translations*. In Proc. of 15th Monterey Workshop, 2008.
- K.M. Konwar, P.M. Musial, and A.A. Shvartsman. *Spontaneous, Self-Sampling Quorum Systems for Sensor Networks*. To Proc. of 7th International Symposium on Parallel and Distributed Computing (ISPDC), 2008.

- C. Georgiou, P.M. Musial, A.A. Shvartsman, and E. Sonderegger. *An Abstract Channel Specification and an Algorithm Implementing It Using Java Sockets*. In Proc. of 7'th IEEE International Symposium on Network Computing and Applications (IEEE NCA), pp. 211–219, 2008.
- K. Konwar, P.M. Musial, N. Nicolau, and A.A. Shvartsman. *Indirect Learning in Dynamic Networks to Enhance Operation Liveness*. In Proc. of the 6th IEEE International Symposium on Network Computing and Applications (IEEE NCA), pp. 223–230, 2007.
- V. Berzins, Luqi, P.M. Musial. *Reliability Properties of Models for Flexible Design and Run-time Analysis*. In Proc. of 13'th Monterey Workshop, pp. 207–219, 2006.
- G. Chockler, S. Gilbert, V.C. Gramoli, P.M. Musial, and A.A. Shvartsman. *Reconfigurable Distributed Storage for Dynamic Networks*. In Proc. of the 9'th International Conference on Principles of Distributed Systems (OPODIS), pp. 272–283, 2005.
- V.C. Gramoli, P.M. Musial, and A.A. Shvartsman. *Operation Liveness in a Dynamic Distributed Atomic Data Service with Efficient Gossip Management*. In Proc. of the 18'th International Conference on Parallel and Distributed Computing Systems (PDCS), 2005.
- C. Georgiou, P.M. Musial, and A.A. Shvartsman. *Developing a Consistent Domain-Oriented Distributed Object Service*. In Proc. of the 4'th IEEE International Symposium on Network Computing and Applications (IEEE NCA), pp. 149–158, 2005.
- * D. Kowalski, P.M. Musial, and A.A. Shvartsman. *Explicit Combinatorial Structures for Cooperative Distributed Algorithms*. In Proc. of the 25'th International Conference on Distributed Computing Systems (ICDCS), pp. 49–58, 2005.
- C. Georgiou, P.M. Musial, and A.A. Shvartsman. *Long-Lived RAMBO: Trading Knowledge for Communication*. In Proc. of the 11'th Colloquium on Structural Information and Communication Complexity (SIROCCO), pp. 185–196, 2004.
- P.M. Musial and A.A. Shvartsman. *Implementing a Reconfigurable Atomic Memory Service for Dynamic Networks*. In Proc. of the 18'th International Parallel and Distributed Symposium – FTPDS WS. (2004) 208b.
- P.M. Musial, A.C. Russell, and A.A. Shvartsman. *Reducing Doppler Filtering Processing in STAP Implementations*. In TechOnLine: OSEE II, 2001.

Short Papers, Workshops, and Technical Reports

- C. Georgiou, P.M. Musial, A.A. Shvartsman, and E. Sonderegger. *Implementing Abstract Channels with Java Sockets*. In Proc. of the 26'th Symposium on Principles of Distributed Computing (PODC) as a Brief Announcement, pp. 334–335, 2007.
- S. Dolev, S. Gilbert, N. Lynch, P. Musial, A.A. Shvartsman, J. Welch. *Atomic object services for mobile and dynamic networks*. In Proc. of the the 7'th International Workshop on Interconnection Networks (IWIN), 2003, pg. 15.
- C. Georgiou, K. Konwar, P.M. Musial, and A.A. Shvartsman. *Survivable and Consistent Data for Dynamic Networks*, a poster abstract for International Conference on Advanced Technologies for Homeland Security (ICATHS), Storrs, CT, 2003.