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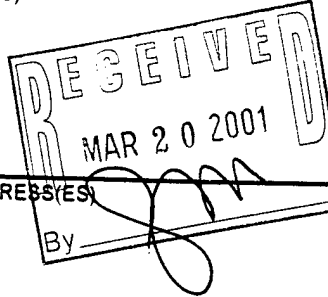
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13. ABSTRACT (Maximum 200 words)
This report summarizes the final progress on an investigation into an engineering-oriented approach for design of distributed-object software. The key results of the research are highlighted, including works published and personnel supported.

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Final Progress Report
Author/PI: S. Shatz

Statement of Problem Studied:

This research investigated an engineering-oriented approach for design of distributed-object software.

Summary of the most important results:

We developed a couple of results related to the use of Petri net-oriented models for design specification. For our State-Based Object Petri Net model (SBOPN), we demonstrated how to create models that support class-level models with instantiation rules to generate object-instance models, and how to synthesize models for objects with restricted behavior from more general ("superclass") models. We also proposed a framework for using the SBOPN notation as a basis for formal modeling of Aspect Oriented systems. We also expanded the SBOPN notation and developed templates of basic object components, defining a set of modules for plug-and-play modeling of a distributed software architecture. Finally, we formulated a scheme for translation of UML diagrams (Statecharts and Collaboration Diagrams) to an object-based Petri net format that can support design simulation and analysis. We are currently developing a prototype tool to demonstrate this capability.

We also developed a new line of research into modeling of agent-oriented software systems. To this end, we defined extensions to the G-net model (an existing object-based Petri net model) and developed a special-purpose agent-based G-net model. We used existing net theory to prove some properties of our agent-based model. In addition, we extended our agent-based model to include inheritance features, creating an agent-oriented model, and used some existing net tool to analyze the model.

Publications:

(a) Journals:

J. Saldhana and S. M. Shatz, "Formalization of Object Behavior and Interactions From UML Models," Accepted pending minor modifications to the *International Journal of Software Engineering and Knowledge Engineering*, 2001.

(b) Peer-reviewed Conference Proceedings

H. Xu and S. M. Shatz, "A Framework for Modeling Agent-Oriented Software," To appear in the *Proceedings of the IEEE 21st International Conference on Distributed Computing Systems (ICDCS)*, Phoenix, Arizona, April 2001.

H. Xu and S. M. Shatz, "An Agent-Based Petri Net Model with Application to Seller/Buyer Design in Electronic Commerce," To appear in the *Proceedings of the IEEE 5th International Symposium on Autonomous Decentralized Systems (ISADS)*, Dallas, Texas, March 2001.

M. Lemmon, K. He, and S. M. Shatz, "Dynamic Reconfiguration of Software Objects Using Petri Nets and Network Unfolding," *Proceedings of the IEEE Int Conf. on Systems, Man, and Cybernetics (SMC)*, Nashville, Tenn., Oct. 2000, pp. 3069-3074.

H. Xu and S. M. Shatz, "Extending G-Nets to Support Inheritance Modeling in Concurrent Object-Oriented Design," *Proceedings of the IEEE Int Conf. on Systems, Man, and Cybernetics (SMC)*, Nashville, Tenn., Oct. 2000, pp. 3128-3133.

X. Xie and S. M. Shatz, "An Approach to Using Formal Methods in Aspect Orientation," *Proceedings of the Int. Conf. on Parallel and Distributed Processing Techniques and Applications (PDPTA)*, (Special Session on Architectural Support for Aspect-Oriented Software Systems), Vol. 1, June 26-29, 2000, Las Vegas, Nevada, pp. 263-269.

J. Saldhana and S. M. Shatz, "UML Diagrams to Object Petri Net Models: An Approach for Modeling and Analysis," *Proceedings of the Int. Conference on Software Engineering and Knowledge Engineering (SEKE)*, Chicago, July 2000, pp. 103-110.

(c) Manuscripts submitted, but not yet published

X. Xie and S. M. Shatz, "Development of Class-Level and Instance-Level Design Models for Distributed-Object Software," Submitted to *Int. Journal of Computer Systems Science and Engineering*.

H. Xu and S. M. Shatz, "An Approach to Using Formal Methods in Agent-Oriented Design and Analysis" (to be submitted to the *IEEE Transactions on Knowledge and Data Engineering*).

X. Xie and S. M. Shatz, "Design Models for Components in Distributed Object Software," Submitted to the 2001 Monterey Workshop on Software Engineering.

Scientific Personnel:

X. Xie completed his PhD degree in 2000.

H. Xu is a continuing PhD student, expected to complete in Fall 2001.

4 other students participated on the project (non-pay) and completed MS degrees.

Report of inventions: None to report