

SAYAN MITRA

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RESEARCH INTERESTS Hybrid, distributed, and real-time systems.

DESIGN Design and analysis of software for embedded systems.

- EDUCATION
- ◇ **Massachusetts Institute of Technology**, Cambridge, MA, USA.
PhD in Computer Science, expected graduation in June 2007.
Thesis: *A verification framework for ordinary and probabilistic hybrid systems*
Advisor: Professor Nancy Lynch
Minor: Game Theory and Optimization
 - ◇ **Indian Institute of Science**, Bangalore, India.
MSc in Computer Science and Automation, 2001.
Thesis: *A specification language for hybrid input/output automata.*
Advisor: Professor L. M. Patnaik
 - ◇ **Jadavpur University**, Kolkata, India.
BE in Electrical Engineering, 1999.
Project: *Controller design for an inverted pendulum using unsupervised learning.*
Advisor: Professor Tapan Ghoshal

AWARDS AND FELLOWSHIPS Research article selected for a special issue of the Journal on Design Automation for Embedded Systems, 2006.
NTT Fellowship (MIT 2001)
Barindra Memorial Medal and Subodh K. Basu Medal (Jadavpur University 1999)
Best paper award at Corona'99: Nationwide student paper contest (Chennai, India 1999)
Sandeep Tandon Memorial Prize for highest GPA in EE (Jadavpur University 1998)
Second prize in M.V. Chauhan student paper contest (IEEE Chapter of Kolkata 1997)

- RESEARCH EXPERIENCE
- ◇ **CSAIL, MIT**. 2005-ongoing. Probabilistic Timed I/O Automata. Developing a framework for describing probabilistic hybrid systems and proving approximate implementations of such systems. Applied this technique to verify robustness of a randomized consensus protocol.
 - ◇ **CSAIL, MIT**. 2004-ongoing. Stability verification of hybrid systems. Developed a set of techniques for verifying stability of hybrid systems including: (a) a new kind of abstraction for hybrid systems that preserves the rate of mode switches, and (b) methods for verifying that the average rate of mode switches of a given system is not too high. The methods rely on checking invariants and solving mixed integer linear programs. Applied these techniques to verify stability of several systems including a hysteresis-based switched controller.
 - ◇ **CSAIL, MIT**. 2003-2005. Tempo Toolkit project.
 - Co-designed the Timed I/O Automata (TIOA) Language (with Nancy Lynch and Dilsun Kaynar)—a specification language for real-time and hybrid systems. The Language is the basis for the Tempo Toolkit which is under development at MIT and Veromodo Inc.

- Played a leading role in designing a tool for translating TIOA specifications to the language of the PVS theorem prover.
- Ongoing collaboration with Myla Archer on developing strategies for automating verification of timed automata in the PVS theorem prover.

- ◇ **Summer Intern at Naval Research Laboratory, Washington D.C.** May-August 2003. Supervisor: Dr. Myla Archer. Extended the Timed Automaton Modeling Environment (TAME) and developed PVS theorem prover strategies for partially automating refinement and simulation proofs for timed automata.
- ◇ **CSAIL, MIT** 2001-2002. Designed, formally modeled and verified the safety of a supervisory pitch controller for the Quanser™ model helicopter system.
- ◇ **Research Assistant at Indian Institute of Science, Bangalore, India.** 2000-2001. Designed and implemented a front end for a language for specifying hybrid systems in Java. Carried out several usability studies for the language, including the specification of a flight controller of a combat aircraft.
- ◇ **Summer Intern at Indian Statistical Institute, Kolkata.** 1998. Developed software for classification using supervised neural networks and genetic algorithms. The system was used for classification of data on symptoms of cervical cancer.
- ◇ **Undergraduate Researcher at Jadavpur University, Kolkata, India.** 1999. Designed (with Aniruddha Ghosh and Prithwijit Guha) and implemented a microprocessor controlled power factor correction device. The device was tested successfully under varying inductive and resistive loads.

SUPERVISING
AND TEACHING
EXPERIENCE

- ◇ Informally supervised MEng student Hongping Lim who implemented a tool for translating Timed I/O Automata specifications to the language of the PVS theorem prover.
- ◇ Teaching assistant for MIT undergraduate course *Mathematics for Computer Science* in Fall term 2005 (Lecturers Professors Albert Meyer and Ronitt Rubinfeld). Tutored 25 students for 3 hours each week during in-class problem solving sessions; graded problem sets and exams, held office hours, lectured for final exam review session.
- ◇ Presented two lectures for MIT graduate course *Advanced Distributed Algorithms*, 2002.

PUBLICATIONS

SUBMITTED
MANUSCRIPTS

1. Sayan Mitra, Daniel Liberzon and Nancy Lynch. Verifying average dwell time of hybrid systems. *Submitted to ACM Transaction in Embedded Computing Systems*, May 2006.
2. Sayan Mitra and Nancy Lynch. Proving approximate implementations for probabilistic I/O automata. *Submitted to Electronic Notes in Theoretical Computer Science*, October 2006.

JOURNAL
ARTICLES AND
BOOK
CHAPTER

1. Myla Archer, Hongping Lim, Nancy Lynch, Sayan Mitra, and Shinya Umeno. Specifying and proving properties of timed I/O automata in the TIOA toolkit. To appear in *Special issue of the Journal on Design Automation for Embedded Systems*, 2007.
2. Sayan Mitra and Myla Archer. PVS strategies for proving abstraction properties of automata. *Electronic Notes in Theoretical Computer Science*, 125(2):45–65, 2005.
3. Sayan Mitra and L. M. Patnaik Specification language design for hybrid systems. *Computational Mathematics, Modeling and Algorithms*, edited by J. C. Misra. Alpha Science Int'l, January 2003.

CONFERENCE
PUBLICATIONS

1. Sayan Mitra and Nancy Lynch. Trace-based semantics for probabilistic timed I/O automata. To appear as an extended abstract in *Hybrid Systems: Computation and Control (HSCC'07)*, April 2007.

2. Radu Grosu, Sayan Mitra, Pei Ye, Scott Smolka, Emilia Entcheva, and I.V. Ramakrishnan. Learning Cycle-linear hybrid automata of excitable cell models. To appear in *Hybrid Systems: Computation and Control (HSCC'07)*, April 2007.
3. Myla Archer, Hongping Lim, Nancy Lynch, Sayan Mitra, and Shinya Umeno. Specifying and proving properties of timed I/O automata in the TIOA toolkit. In *Fourth ACM-IEEE International Conference on Formal Methods and Models for Codesign (MEMOCODE'06)*. Napa, CA 2006. (selected for special issue of Journal on Design Automation of for Embedded Systems)
4. Sayan Mitra, Daniel Liberzon, and Nancy Lynch. Verifying average dwell time by solving optimization problems. In Ashish Tiwari and João P. Hespanha, editors, *Hybrid Systems: Computation and Control (HSCC 06)*, volume 3927 of LNCS, Santa Barbara, CA, March 2006.
5. Hongping Lim, Dilsun Kaynar, Nancy Lynch, and Sayan Mitra. Translating timed I/O automata specifications for theorem proving in PVS. In *Proceedings of Formal Modeling and Analysis of Timed Systems (FORMATS'05)*, volume 3829 of LNCS, Uppsala, Sweden, September 2005.
6. Gregory Chockler, Nancy Lynch, Sayan Mitra, and Joshua Tauber. Proving atomicity: an assertional approach. In Pierre Fraigniaud, editor, *Proceedings of 19th International Symposium on Distributed Computing (DISC'05)*, volume 3724 of LNCS, pages 152 – 168, Cracow, Poland, September 2005.
7. Ben Leong, Sayan Mitra and Barbara Liskov. Path vector face routing: Geographic routing with local face information. In *Proceedings of 13th IEEE International Conference on Network Protocols (ICNP'05)*, Boston, Massachusetts, November 2005.
8. Nancy Lynch, Sayan Mitra, and Tina Nolte. Motion coordination using virtual nodes. In *Proceedings of 44th IEEE Conference on Decision and Control (CDC'05)*, Seville, Spain, December 2005. Full version available as *Technical Report MIT-LCS-TR-986*.
9. Sayan Mitra and Daniel Liberzon. Stability of hybrid automata with average dwell time: an invariant approach. In *Proceedings of the 43rd IEEE Conference on Decision and Control*, Paradise Island, Bahamas, December 2004.
10. Sayan Mitra, Yong Wang, Nancy Lynch, and Eric Feron. Safety verification of model helicopter controller using hybrid Input/Output automata. In *HSCC'03, Hybrid System: Computation and Control*, volume 2623 of LNCS, Prague, Czech Republic, 2003. Full version available as *Technical report MIT-LCS-TR-880*.

REFEREED
WORKSHOP
PUBLICATIONS

1. Sayan Mitra and Nancy Lynch. Approximate simulations for task-structured probabilistic I/O automata. In *LICS workshop on Probabilistic Automata and Logics (PAul06)*, Seattle, WA, August 2006.
2. Sayan Mitra and Myla Archer. Reusable PVS proof strategies for proving abstraction properties of I/O automata. In *STRATEGIES 2004, IJCAR Affiliated Workshop on strategies in automated deduction*, Cork, Ireland, July 2004.
3. Sayan Mitra and Jesse Rabek. Energy efficient connected clusters for mobile ad hoc networks. In *Proceedings of 3rd Annual Mediterranean Ad Hoc Networking Workshop (MED-HOC-NET'04)*, Bodrum, Turkey, 2004.
4. Dilsun Kaynar, Nancy Lynch, and Sayan Mitra. Specifying and proving timing properties with TIOA tools. In *Work in progress session of the 25th IEEE International Real-Time Systems Symposium (RTSS-WIP)*, Lisbon, Portugal, December 2004.
5. Sayan Mitra and Myla Archer. Developing strategies for specialized theorem proving about untimed, timed, and hybrid I/O Automata. In *STRATA 2003, Workshop on Design and Application of Strategies/Tactics in Higher Order Logics*, Rome, Italy, September, 2003.

PRESENTATIONS

- ◇ Verifying Hybrid Systems: Stability and Implementations. Invited talk at the *Self-Organizing Systems group meeting*, University of Washington, Seattle, WA, January 2007.
- ◇ Approximate Simulations for Task-PIOAs. *Workshop on Probabilistic Automata and Logics (PAuL'06) (Affiliated with LICS'06)*, Seattle, WA, August 2006.
- ◇ Verifying Average Dwell Time through Optimization. *Hybrid Systems: Computation and Control (HSCC'06)*, Santa Barbara, CA, March 2006.
- ◇ Translating TIOA specs for theorem proving in PVS. *Formal Modelling and Analysis of Timed Systems (FORMATS'05)*, Uppsala, Sweden, September 2005.
- ◇ Motion coordination with virtual nodes. *Theory of Distributed Systems Seminar*, MIT, Cambridge, MA, March 2005.
- ◇ Stability Verification of TIOA. *Timed I/O Automata Workshop*, MIT, Cambridge, MA, December, 2005.
- ◇ Modeling and Analysis of Complex Computational Systems. *MURI Meeting*, University of Illinois Urbana-Champaign, IL, June 2004.
- ◇ Reusable PVS proof strategies for proving abstraction properties of I/O automata. *STRATEGIES Workshop (Affiliated with IJCAR'04)*, Cork, Ireland, July 2004.
- ◇ On building PVS Interfaces for Abstraction Proofs. *CHACS Seminar*, Naval Research Lab, Washington D.C., August 2003.
- ◇ Safety Verification of Model Helicopter Controller. *Hybrid Systems: Computation and Control (HSCC'03)*, Prague, Czech Republic, April 2003.

REVIEWING IEEE Transactions on Automatic Control, Journal of Discrete Algorithms, Journal of Logic and Algebraic Programming.
FOSSACS 2007, DISC 2006, HSCC 2006, CDC-ECC 2005, DISC 2005, HSCC 2005, HSCC 2004.

GRANT
PROPOSALS ◇ Contributed research ideas and wrote key sections of a recently funded NSF grant proposal on stability analysis of probabilistic hybrid systems (PIs: Daniel Liberzon and Nancy Lynch).
◇ Senior personnel for a forthcoming NSF/EFRI grant proposal on modeling and analysis of excitable cells (PIs: Emilia Entcheva, Radu Grosu, George Pappas, I.V. Ramakrishnan and Scott Smolka); wrote an important section of the pre-proposal.
◇ Contributed to several other grant proposals for NSF, AFOSR, MURI; presented research results for funding agency meetings.

LANGUAGES English, Bangla, Hindi

CITIZENSHIP Citizen of India. F1 Visa.