Indranil Saha, Ph.D.

Contact Information

Dept. of Comp. Science and Engineering, RM 408
Indian Institute of Technology Kanpur
Kalyanpur, Kanpur
Uttar Pradesh 208016, India

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Current Position

Assistant Professor
Department of Computer Science and Engineering
Indian Institute of Technology Kanpur
July 2015 – Present

Education

Ph.D. in Computer Science, University of California Los Angeles
June 2013

M.Tech. in Computer Science, Indian Statistical Institute, Kolkata
August 2005

B.Tech. in Electronics and Communication Engineering, Kalyani Govt. Engg. College
June 2003

Research Interests

Computer-aided verification and synthesis
Embedded and cyber-physical systems
Robotics and automation
Control theory
Real-time and hybrid systems
Model-based development

Research Experience

Postdoctoral Researcher at University of California Berkeley and University of Pennsylvania
July 2013 – June 2015

- Advisors: Prof. Sanjit A. Seshia and Prof. George J. Pappas
- Member of ExCAPE project (`https://excape.cis.upenn.edu/`)
- Member of TerraSwarm project (`https://www.terraswarm.org/`)

Research Assistant at the Computer Science Department of University of California Los Angeles
September 2008 – June 2013

Research Associate at Computer Science laboratory of SRI International, Menlo Park, CA, USA
June 2010 – September 2010, June 2011– September 2011, July 2012 – September 2012

Technical Consultant at Toyota Technical Center, North America
October 2010 – June 2012

Visiting Researcher at Max Planck Institute for Software Systems (MPI-SWS)
November 2010 – December 2010, April 2011 – June 2011, November 2011 – December 2011, May 2012 – June 2012, October 2012 – December 2012

Research Scientist at Honeywell, Bangalore, India
August 2005 – August 2008

Teaching Experience

Department of Computer Science and Engineering, IIT Kanpur
July 2017 – November 2017
Instructor for *CS652: Computer Aided Verification*

January 2017 – April 2017
Instructor for *CS220: Computer Organization*

July 2016 – November 2016
Instructor for *CS637: Embedded and Cyber-Physical Systems*

January 2016 – April 2016
Instructor for *CS698I: Formal Methods for Robotics and Automation*

Computer Science Department, University of California Los Angeles
January 2010 – June 2010

Teaching Assistant for *CS 130: Software Engineering*
- In Winter 2010 with Prof. Paul Eggert
- In Spring 2010 with Prof. Rupak Majumdar

Honeywell Research Lab, Bangalore
August 2005 – December 2005

Seminar series speaker for *Distributed Computing*

Awards And Recognitions

UCLA **Dissertation Year Fellowship** 2012-2013

ACM SIGBED **Frank Anger Memorial Award** 2012

UCLA nomination for **Microsoft Research Fellowship** 2011-2012

Best Paper Nomination in EMSOFT 2012 for the paper entitled "Synthesis of Minimal Error Control Software"

Best Paper Award in EMSOFT 2010 for the paper entitled "Automatic Verification of Control System Implementations"

Team Innovation Award from Honeywell Technology Solutions, Bangalore, India for the innovation project titled "A Pay-off Matrix Model for Collaborative Monitoring" in 2008

Exponent-Call For Proposal Award from Honeywell Technology Solutions, Bangalore, India in recognition and appreciation of collaboratively defining the winning proposal titled "Energy Efficient Algorithms for Distributed Wireless Networks" in 2007

Individual Excellence Award from Honeywell Technology Solutions, Bangalore, India for outstanding performance, dedicated efforts, excellent contributions and attitude during the completion of the 1st phase of the project "Translator from C to Simulink models" in 2007

COMSWARE 2007 top 8 paper

Finalist for **Sunity Kumar Pal Best Dissertation Award** in the graduating batch of Master of Technology in Computer Science at ISI Kolkata in 2005

National Scholarship in recognition of the high position secured in the list of meritorious candidates qualifying for awards in the Higher Secondary Examination in 1999

National Scholarship in recognition of the high position secured in the list of meritorious candidates qualifying for awards in the Secondary Examination in 1997

Research Fundings

Cloud-Assisted Receding Horizon Planning for Large Scale Multi-Robot Applications (PI)
Sponsor: Microsoft Azure Research Award Grant
Funding: USD 20,000
Duration: 1 year

FMSAFE: A Networked Centre for Formal Methods in Validation and Certification Procedures for Safety- Critical ICT Systems (Co-PI)
Sponsor: MHRD IMPRINT Program and Indian Railways
Funding: INR 1,15,70,000
Duration: 3 years

A Framework for Synthesizing Robust Motion Primitives for UAVs (PI)
Sponsor: DST SERB Early Career Research Award
Funding: INR 52,47,000
Duration: 3 years

An End-to-End Software Development Framework for Robot Swarm Applications (PI)
Sponsor: DAAD Research Stay Grant
Funding: EUR 4,525
Duration: 2 months

Formal Methods Assisted Software Development Frameworks for Complex Robotic Applications (PI)
Sponsor: IIT Kanpur Initiation Grant
Funding: INR 25,00,000
Duration: 2 years

Publications

Journal

Suman Roy, Janardan Misra and Indranil Saha. **A Simplification of a Real-Time Verification Problem**. *Software Testing, Verification and Reliability* 26(8): 548-571 (2016)

Indranil Saha, Suman Roy and S. Ramesh. **Formal Verification of Fault-Tolerant Startup Algorithms for Time-Triggered Architectures: A Survey**. *The Proceedings of the IEEE*, special issue on *Industrial Cyber-Physical Systems* (2016)

Janardan Misra and Indranil Saha. **Artificial Neural Networks in Hardware: A Survey of Two Decades of Progress.** *Neurocomputing* 74(1-3): 239-255 (2010)

Indranil Saha, Lokesh K. Sambasivan, Ranjeet K. Patro, Subhas K. Ghosh. **Distributed Fault Tolerant Topology Control in Wireless Multi-hop Networks.** *Wireless Networks* 16(6): 1511-1524 (2010)

Indranil Saha, Bhargab B. Bhattacharya, Sheng Zhang, and Sharad C. Seth. **Planar Straight-Line Embedding of Double-Tree Scan Architecture on a Rectangular Grid.** *Fundamenta Informaticae* 89(2-3): 331-344 (2008)

Conference and Workshop

Sankar Narayan Das and Indranil Saha. **Receding Horizon Multi-Robot Coverage**. In *Proceedings of the 9th ACM/IEEE International Conference on Cyber-Physical Systems(ICCPS 2017)*, ACM/IEEE, Porto, Portugal, April 11-13, 2018

Yasser Shoukry, PierLuigi Nuzzo, Ayca Balkan, Indranil Saha, Alberto L. Sangiovanni-Vincentelli, Sanjit A. Seshia, George J. Pappas and Paulo Tabuada. **Linear Temporal Logic Motion Planning for Teams of Underactuated Robots Using Satisfiability Modulo Convex Programming.** In *Proceeding of the 56th IEEE Conference on Decision and Control (CDC 2016)*, IEEE, Melbourne, Australia, December 12-15, 2017

Ivan Gavran, Rupak majumdar, Indranil Saha. **ANTLAB: A Multi-Robot Task Server** In *Proceedings of the International Conference on Embedded Software (EMSOFT 2017)*, ACM/IEEE, Seoul, South Korea, October 15-20, 2017

Ankush Desai, Indranil Saha, Jianqiao Yang, Shaz Qadeer, Sanjit A. Seshia. **DRONA: A Framework for Safe Distributed Mobile Robotics**. In *Proceedings of the 8th ACM/IEEE International Conference on Cyber-Physical Systems(ICCPS 2017)*, ACM/IEEE, Pittsburgh, USA, April 18-21, 2017

Yasser Shoukry, PierLuigi Nuzzo, Indranil Saha, Alberto L. Sangiovanni-Vincentelli, Sanjit A. Seshia, George J. Pappas and Paulo Tabuada. **Scalable Motion Planning Using Lazy SMT-Based Solving.** In *Proceeding of the 55th IEEE Conference on Decision and Control (CDC 2016)*, IEEE, Las Vegas, USA, December 12-14, 2016

Indranil Saha, Rattanachai Ramaitithima, Vijay Kumar, George J. Pappas and Sanjit A. Seshia. **Implan: Scalable Incremental Motion Planning for Multi-Robot Systems.** In *Proceedings of the ACM/IEEE 7th International Conference on Cyber-Physical Systems (ICCPS 2016)*, ACM/IEEE, Vienna, Austria, April 11-14, 2016

Indranil Saha and Rupak Majumdar and Sanjoy Baruah. **Dynamic Scheduling for Networked Control Systems.** In *Proceedings of the International Conference on Hybrid Systems: Computation and Control (HSCC 2015)*, ACM, Seattle, USA, April 14-16, 2015

Indranil Saha, Rattanachai Ramaitithima, Vijay Kumar, George J. Pappas and Sanjit A. Seshia. **Automated Composition of Motion Primitives for Multi-Robot Systems from Safe LTL Specifications** In *Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2014)* IEEE/RSJ, Chicago, USA, September 14-18, 2014.

Rupak Majumdar, Indranil Saha, Koichi Ueda and Hakan Yazarel. **Compositional equivalence checking for Simulink models and C code** In *Proceedings of the 52nd IEEE Conference on Decision and Control (CDC 2013)*, IEEE, Florence, Italy, December 10-13, 2013

Eva Darulova, Viktor Kuncak, Rupak Majumdar and Indranil Saha. **Synthesis of fixed-point programs.** In *Proceedings of the International Conference on Embedded Software (EMSOFT 2013)*, ACM, Montreal, Canada, September 29-October 4, 2013

Indranil Saha and Rupak Majumdar. **Trigger Memoization in Self-Triggered Control.** In *Proceedings of the International Conference on Embedded Software (EMSOFT 2012)*, ACM, Tempere, Finland, October 9-14, 2012

Rupak Majumdar, Indranil Saha, Majid Zamani. **Synthesis of Minimal Error Control Software.** In *Proceedings of the International Conference on Embedded Software (EMSOFT 2012)*, ACM, Tempere, Finland, October 9-14, 2012 (Best Paper Nomination)

Sam Owre, Indranil Saha and Natarajan Shankar. **Automatic Dimensional Analysis of Cyber-Physical Systems.** In *Proceedings of Formal Methods Europe (FM 2012)*, LNCS, Paris, France, August 27-31, 2012

Rupak Majumdar, Indranil Saha, K. C. Shashidhar and Zilong Wang. **CLSE: Closed-Loop Symbolic Execution.** In *Proceedings of the 4th NASA Formal Methods Symposium (NFM 2012)*, LNCS, Norflok, Virginia, USA, April 3-5, 2012

Indranil Saha and Natarajan Shankar. **ModelRob: A Simulink Library for Model-Based Development of Robot Manipulators.** In *Proceedings of the International Conference on Robotics and Automation (ICRA 2012)*, IEEE, St. Paul, Minnesota, USA, May 14-18, 2012

Rupak Majumdar, Indranil Saha, Majid Zamani. **Performance-Aware Scheduler Synthesis for Control Systems.** In *Proceedings of the International Conference on Embedded Software (EMSOFT 2011)*, ACM, Taipei, Taiwan, October 9-14, 2011

Adolfo Anta, Rupak Majumdar, Indranil Saha, Paulo Tabuada. **Automatic Verification of Control System Implementations.** In *Proceedings of the International Conference on Embedded Software (EMSOFT 2010)*, ACM, Scottsdale, USA, October 24-29, 2010 (Best Paper Award)

Rupak Majumdar, Indranil Saha, Zilong Wang. **Systematic Testing for Control Applications.** In *Proceedings of the 8th ACM/IEEE International Conference on Formal Methods and Models for Codesign (MemoCODE 2010)*. IEEE Computer Society, Grenoble, France, July 26-28, 2010 (Invited Paper)

Rupak Majumdar, Indranil Saha. **Symbolic Robustness Analysis.** In *Proceedings of the 30th IEEE Real-Time Systems Symposium (RTSS 2009)*, IEEE Computer Society, Washington DC, USA, December 1-4, 2009

Indranil Saha, Debapriyay Mukhopadhyay. **Quantitative Analysis of a Probabilistic Non-Repudiation Protocol through Model Checking.** In *Proceedings of the 5th International Conference on Information Systems Security (ICISS 2009)*, LNCS 5905, Springer, pp. 292-300, Kolkata, India, December 14-18, 2009

Janardan Misra, Indranil Saha. **A Reinforcement Model for Collaborative Security and its Formal Analysis.** In *Proceedings of 2009 New Security Paradigm Workshop (NSPW2009)*, ACM, Oxford, UK, September 8-11, 2009

Indranil Saha, Kuntal Chakraborty, Suman Roy, I. VishnuVardhan, Venkatappaia Kurapati. **An Approach to Reverse Engineering of C program to Simulink Models with Conformance Testing.** In *2nd Indian Software Engineering Conference (ISEC 2009)*, ACM, pp. 137-138, Pune, India, February 22-26, 2009

Indranil Saha, Debapriyay Muhkopadhyay. **Security against Sybil Attack in Wireless Sensor Network through Location Verification.** In *Proceedings of 10th International Conference on Distributed Computing and Networking (ICDCN 2009)*, LNCS 5408, Springer, pp. 187-192, Hyderabad, India, January 3-6, 2009

Indranil Saha, Janardan Misra, Suman Roy. **Timeout and Calendar based Finite State Modeling and Verification of Real-Time Systems.** In *Proceedings of the 5th International Symposium on Automated Technology for Verification and Analysis (ATVA 2007)*, LNCS 4762, Springer, pp. 284-299, Tokyo, Japan, October 22 -25, 2007

Indranil Saha, Suman Roy, Kuntal Chakraborty. **Modeling and Verification of TTCAN Startup Protocol Using Synchronous Calendar.** In *P*roceedings of the 5th IEEE International Conference on Software Engineering and Formal Methods (SEFM 2007), IEEE Computer Society, pp. 69-79, London, UK, September 11-15, 2007

Indranil Saha, Debapriyay Mukhopadhyay. **A Distributed Algorithm of Fault Recovery for Stateful Failover.** In *Proceedings the 4th Annual Conference on Theory and Applications of Models of Computation (TAMC07)*, LNCS 4484, Springer, pp. 738-749, Sanghai, China, May 22-25, 2007

Indranil Saha, Suman Roy. **A Finite State Analysis of Time-triggered CAN (TTCAN) Protocol using Spin.** In *Proceedings of the International Conference on Computing: Theory and Application (ICCTA 2007)*, IEEE Computer Society, pp. 77-81, Kolkata, March 5-7, 2007

Indranil Saha, Lokesh K. Sambasivan, Ranjeet K. Patro, Subhas K. Ghosh. **Distributed Fault Tolerant Topology Control in Static and Mobile Wireless Ad-hoc Networks.** In *Proceedings of the 2nd International Conference on Communication System Software and Middleware (COMSWARE 2007)*, IEEE Computer Society, Bangalore, India, January 7-12, 2007 (A Top 8 Paper)

Debapriyay Mukhopadhyay, Indranil Saha. **Location Verification Based Defense against Sybil Attack in Sensor Networks.** In *Proceedings of the 8th International Conference on Distributed Computing and Networking (ICDCN 2006)*, LNCS 4308, Springer, pp. 509-521, Guwahati, India, December 27-30, 2006

Indranil Saha, Debapriyay Mukhopadhyay, Satyajit Banerjee. **Designing Reliable Architecture for Stateful Fault Tolerance.** In *Proceedings of the 7th International Conference on Parallel and Distributed Computing, Applications and Technologies (PDCAT2006)*, IEEE Computer Society, pp. 545-551, Taipei, Taiwan December 4-7, 2006

Indranil Saha, Suman Roy. **A Finite State Modeling of AFDX Frame Management using Spin.** In *Proceedings of the 11th International Workshop on Formal Methods for Industrial Critical Systems (FMICS 2006)*, LNCS 4346, Springer, pp. 227-243, Bonn, Germany, August 26-27, 2006

Indranil Saha, Lokesh K. Sambasivan, Ranjeet K. Patro, Subhas K. Ghosh. **Distributed Fault Tolerant Topology Control in Wireless Ad-hoc Sensor Networks.** In *Proceedings of the 3rd International Conference on Wireless and Optical Communication Networks (WOCN 2006)*, IEEE Computer Society, Bangalore, India, April 11-13, 2006

Talks

Automated Task and Motion Plan Generation for Multi-Robot Systems from Complex Specifications at
- DRDO Center of Artificial Intelligence and Robotics (CAIR), Bengaluru, July 18, 2016
- First Cyber-Physical Systems Symposium, IISc, Bengaluru, July 19, 2017
- QIP Short Term Course on Deep Learning and Computational Intelligence in Automation & Control, IIT Kanpur, December 4, 2017

Implan: Scalable Incremental Motion Planning for Multi-Robot Systems at 7th International Conference on Cyber-Physical Systems (ICCPS), Vienna, Austria, April 14, 2016

Dynamic Scheduling for Networked Control Systems at 18th International Conference on Hybrid Systems: Computation and Control (HSCC 2015), Seattle, USA, April 15, 2015

Automated Software Synthesis for Cyber-Physical Systems at
- University of Illinois Chicago, USA, March 13, 2015
- Indian Institute of Science, Bangalore, India, March 30, 2015
- Indian Institute of Technology, Kanpur, India, April 7, 2015
- Microsoft Research, Redmond, USA, April 23, 2015
- TEQIP Workshop on Advanced Robotics at IIT Kanpur, March 19, 2016
- Workshop on Development Aspects of Intelligent Adaptive Systems (DIAS 2017), February 5, 2017
- A Short course on Control of Cyber Physical Systems at IIT Kanpur, March 24, 2017

Compositional Synthesis of Multi-Robot Motion Plans via SMT Solving at
- Dagstuhl seminar on verification of cyber-physical systems, Dagstuhl, Germeny, March 17-21, 2014
- IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2014), Chicago, September 15, 2014.

Program Analysis and Synthesis for Control Applications at
- CPSGame Seminar Series, UC berkeley, USA, Dec 6, 2013
- Galois Inc., Portland, USA, May 3, 2013
- ExCAPE project webinar, April 18, 2013
- Shanghai Tech University, Shanghai, China, March 29, 2013

Trigger Memoization in Self-Triggered Control. at International Conference on Embedded Software (EMSOFT 2012), Tempere, Finland, October 11, 2012

Synthesis of Minimal Error Control Software. at International Conference on Embedded Software (EMSOFT 2012), Tempere, Finland, October 11, 2012

Automatic Dimensional Analysis of Cyber-Physical Systems at Formal Methods Europe (FM 2012), Paris, France, August 29, 2012

ModelRob: A Simulink Library for Model-Based Development of Robot Manipulators at
- International Conference on Robotics and Automation (ICRA 2012), St. Paul, Minnesota, USA, May 16, 2012
- Fortiss, Munich, Germany, June 12, 2012

Performance-Aware Scheduler Synthesis for Control Systems at
- International Conference on Embedded Software (EMSOFT 2012), Taipei, Taiwan, October 12, 2011
- GM India Science Lab, Bangalore, India, November 2, 2011
- Fortiss, Munich, Germany, June 11, 2012

Automatic Verification of Control System Implementations at
- International Conference on Embedded Software (EMSOFT 2011), Scottsdale, USA, October 25, 2010
- Computing, Informatics and Decision Systems Engineering Department, Arizona State University, Tempe, USA, October 29, 2010
- In the Meeting of IFIP Working Group 2.3 at SRI International, Menlo Park, CA, USA, June,

2011.
- GM India Science Lab, Bangalore, India, November 2, 2011

Symbolic Robustness Analysis at 30th IEEE Real-Time Systems Symposium (RTSS 2009), Washington DC, USA, December 4, 2009

Quantitative Analysis of a Probabilistic Non-Repudiation Protocol through Model Checking at 5th International Conference on Information Systems Security (ICISS 2009), Kolkata, India, December 18, 2009

A Reinforcement Model for Collaborative Security and its Formal Analysis at New Security Paradigm Workshop (NSPW2009), Oxford, UK, September 10, 2009

Modeling and Verification of TTCAN Startup Protocol Using Synchronous Calendar at 5th IEEE International Conference on Software Engineering and Formal Methods (SEFM 2007), London, UK, September 13, 2007

A Finite State Analysis of Time-triggered CAN (TTCAN) Protocol using Spin at the International Conference on Computing: Theory and Application (ICCTA 2007), Kolkata, India, March 5, 2007

Distributed Fault Tolerant Topology Control in Static and Mobile Wireless Ad-hoc Networks at 2nd International Conference on Communication System Software and Middleware (COMSWARE 2007), Bangalore, India, January 12, 2007

Location Verification Based Defense against Sybil Attack in Sensor Networks at 8th International Conference on Distributed Computing and Networking (ICDCN 2006), Guwahati, India, December 30, 2006

Distributed Fault Tolerant Topology Control in Wireless Ad-hoc Sensor Networks at 3rd International Conference on Wireless and Optical Communication Networks (WOCN 2006), Bangalore, India, April 11, 2006

Patents

Janardan Misra, Indranil Saha. **System and Method for Collaborative Monitoring of Policy Violations.** Patent application filed from Honeywell, Bangalore, India. Patent application number: 12/057855

Indranil Saha, Janardan Misra. **Probabilistic Modeling of Collaborative Monitoring of Policy Violation.** Patent application filed from Honeywell, Bangalore, India. Patent application number: 12/171225

Janardan Misra, Indranil Saha. **An Adaptive Learning Approach for Enterprise Threat Management.** Patent application filed from Honeywell, Bangalore, India. Patent application number: 12/171231

Software

Complan. A tool for compositional motion planning for multi-robot systems with complex specifications.
http://www.seas.upenn.edu/~isaha/complan.shtml

DimSim. A Tool for Automatic Dimensional Analysis of Simulink Models.
http://www.seas.upenn.edu/~isaha/dimsim.tgz

ModelRob. A Simulink Library for Modeling of Robot Manipulators.
http://www.seas.upenn.edu/~isaha/modelrob.tgz

Academic Service

Program Committee Member	HSCC 2018, EMSOFT 2018 ATVA 2017, HSCC 2017 EMSOFT 2014
Session Chair	HSCC 2017 EMSOFT 2015
Panel Member	DST ICPS IoT Proposal Review Panel, IIT Kharagpur, November 2017 DST ICPS Security Proposal Review Panel, IIT Kanpur, October 2017 NSF CPS Breakthrough Proposal Review Panel, May 2014
Reviewer - Journal	ACM Transactions on Embedded Computing Systems (TECS) IEEE Transactions on Computers (TC) Springer Journal on Discrete Event Dynamic Systems (DISC) IEEE Transactions on Robotics (TRO) Software and Systems Modeling IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems (TCAD) IEEE Transactions on Automatic Control (TAC) Wireless Communications and Mobile Computing IEEE Communications Magazine
Reviewer - Conference	ICRA 2018, HSCC 2018 ICRA 2017, ACC 2017, HSCC 2017, CDC 2017, CASE 2017, ATVA 2017 MemoCODE2016, IROS 2016, CDC 2016 ACC 2015, ICRA 2015, HSCC 2015, ICCPS 2015 FMCAD 2014, RTSS 2014, EMSOFT 2014, CDC 2014, IROS 2014, CAV 2014, ACC 2014, ICRA 2014 FMCAD 2013, IROS 2013, HSCC 2013, FoSSaCS 2013 HSCC 2012, RTSS 2012, EMSOFT 2012 EMSOFT 2011, ATVA 2011, SPIN 2011, HSCC 2011, TACAS 2011, DATE 2011 LPAR 2010, ISCAS 2010 TACAS 2009 FSTTCS 2009, RTSS 2009

Students

Postdoctoral Researchers	Dr. Sankar Das (Ph.D. from IIT Kharagpur, February 2016 – present)
Ph.D. Students	Tanmoy Kundu (January 2016 – present)
MS Students	Pratyush Varshney (January 2017 – present)
M.Tech Students	Ravi Kurail (January 2017 – present) Danish Khalidi (January 2017 – present)

References

Prof. Rupak Majumdar
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Prof. Sanjit A. Seshia
Electrical Engineering and Computer Science Department

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Prof. George J. Pappas
Department of Electrical & Systems Engineering
University of Pennsylvania
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Phone: +1 215 898 9780

Prof. Rajeev Alur
Department of Computer and Information Science
University of Pennsylvania
Email: alur@cis.upenn.edu
Phone: +1 215 573 7483

Prof. Vijay Kumar
GRASP Laboratory
School of Engineering and Applied Science
University of Pennsylvania
Email: kumar@seas.upenn.edu
Phone: +1 215 898 3630