

**Shivakumar Sastry**

**Curriculum Vitae**

**June 2012**

## SHIVAKUMAR SASTRY, Ph.D.

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### Education

- |  |                                 |      |
|--|---------------------------------|------|
| • Ph.D. Computer Engineering & Science | Case Western Reserve University | 1998 |
| • M.S. Computer Science                | University of Central Florida   | 1992 |
| • M.S. Electrical Engineering          | Indian Institute of Science     | 1987 |
| • B.E. Electronics Engineering         | Bangalore University            | 1984 |

### Academic Positions

#### June 2002 – present      The University of Akron

- |                  |   |
|------------------|---|
| • 2008 – present | <i>Associate Professor</i><br>Department of Electrical & Computer Engineering<br>Department of Mechanical Engineering |
| • 2008 – 2008    | <i>Assistant Professor</i><br>Department of Electrical & Computer Engineering   |

Teach graduate and undergraduate and graduate computer engineering courses including Computer Systems, Object Oriented Design, Programming for Engineers, Networked Embedded Systems and Real-time Scheduling.

**Areas of Expertise:** Networked Embedded Systems, Automation, and Graph Algorithms.

## **Visiting/Adjunct Academic Positions**

- |  |                |
|--|----------------|
| 1. Case Western Reserve University, Adjunct Associate Professor<br>Department of Electrical Engineering and Computer Science | 2011 – present |
| 2. Indian Institute of Science, Department of Electrical Engineering   | Summer 2011    |
| 3. Case Western Reserve University,<br>Department of Electrical Engineering and Computer Science                             | AY 2010 – 2011 |
| 4. Indian Institute of Science, Department of Electrical Engineering   | Summer 2010    |
| 5. Indian Institute of Science, Department of Electrical Engineering   | Summer 2009    |
| 6. Indian Institute of Science, Department of Electrical Engineering   | Summer 2008    |
| 7. Indian Institute of Science, Department of Electrical Engineering   | Summer 2007    |
| 8. Indian Institute of Science, Department of Electrical Engineering   | Summer 2006    |
| 9. Case Western Reserve University, Department of Biology  | Summer 2005    |
| 10. Indian Institute of Science, Department of Electrical Engineering  | Summer 2004    |

**Industry Positions  
and  
Experience**

## **1994 – 2001, Rockwell Automation**

*Senior Engineer, Project Engineer, Senior Research Scientist & Advisory Software Developer*

- Investigated and developed innovative software solutions and real-time distributed control systems to support strategic product development.
- Designed and architected system to verify functionality of communications software product, and led a team through system implementation. Introduced object oriented programming and rapid prototyping techniques to integrate diverse existing efforts to verification.
- Led a team to develop an integrated platform that verified the functionality of Ethernet interfaces in Programmable Controllers and Communications modules. Project was completed within budget, ahead of schedule, and resulted in two Business Impact awards.
- Investigated new paradigms for distributed automation systems programming resulting in U.S. Patent for data exchange format.
- Developed UML models, control strategies, characterizations of application domain needs, high-level control specifications, and methods to translate high-level specifications to executing ladder programs.

## **1991 – 1994, GE Consulting Services / Keane, Inc. (assigned to Xerox Corp.)**

*Senior Consultant*

- Developed innovative tool for designing communications network topology using genetic algorithms and graph theory. This tool reduced costs for network management group.
- Re-engineered service planning application and demonstrated benefits of object oriented techniques in re-engineering APL applications; received “Outstanding Cooperation” award.
- Evaluated emerging technologies; developed technology deployment and adoption strategies as a member of the Advanced Technology Group.

- Conducted knowledge acquisition sessions, architected, and implemented prototypes for customer-requirements analyzer, process-flow modeler, and solutions configurator.

## **1990 – 1991, IntelliSys, Inc.**

### *Systems Engineer*

- Led team of engineers to architect, design, and implement commercial features of Real-time Expert Systems Shell (RT/AI). Planned releases and features and productizing RT/AI used to develop real-time artificial intelligence systems and simulation systems.
- Developed graphical user interface, knowledge acquisition and management system, graphical knowledge editor, and structured language translator for RT/AI.

## **1987 – 1987, Macmet India Pvt. Ltd.**

### *Consulting Software Engineer*

- Architected, designed and implemented software systems to solve engineering problems.
- Designed and implemented two expert systems for Quarry Scheduling and Process Simulation for cement manufacturer to plan preventive maintenance.
- Developed prototype expert system for monitoring interlocks in electrical switchyard simulator.

## **Professional Honors and Awards**

- |   |      |
|---|------|
| • Rockwell Automation Innovation Awards,            | 2001 |
| • Rockwell Software Outstanding Contribution Award, | 2000 |
| • Rockwell Automation Business Impact Award,        | 1998 |
|   | 1997 |
| • Rockwell Automation Customer Satisfaction Award,  | 1997 |
| • Xerox Outstanding Cooperation Award,              | 1993 |

# **Professional Activities**

## Professional Affiliation

- IEEE, Senior Member
- IEEE, Computer Society
- IEEE, Robotics and Automation Society

## Professional Committees

1. IEEE Conference on Automation Science and Engineering, 2011 Track Co-Chair, Networked Control Systems
2. IEEE Conference on Automation Science and Engineering, 2010 Workshop Chair
3. IEEE Conference on Automation Science and Engineering, 2009 Finance Co-Chair
4. International Networked Sensor Systems Conference, TPC Member, 2008-11
5. Innovations and Commercial Applications of Distributed Sensor Systems, TPC Member, 2006-08
6. IEEE Distributed Computing aspects of Sensor Systems, TPC Member, 2005
7. International Conference on Artificial Intelligence, Session Chair, 2003

## University and Departmental Committees

- |  |                |
|--|----------------|
| 1. Chair, University Council Research Committee                    | 2011 – present |
| 2. Member, University Council                                      | 2011 – present |
| 3. Member, Faculty Senate Academic Policies Committee              | 2008 – present |
| 4. ECE Graduate Policy Committee                                   | 2009 – present |
| 5. Co-Chair, ECE Chair Search Committee                            | 2011           |
| 6. Computer Science Faculty Search Committee (External Member)     | 2011           |
| 7. Faculty Senate Ad-hoc Committee on Organizational Effectiveness | 2010           |
| 8. ECE Undergraduate Policy Committee                              | 2008 – 2010    |
| 9. Integrated Biosciences Recruitment Committee                    | 2009           |
| 10. University Graduate Curriculum Committee                       | 2005 – 2006    |
| 11. ECE Endowed Chair Search Committee                             | 2005           |
| 12. ECE Chair-Selection Committee                                  | 2003           |



## Professional Review Activities

1. National Science Foundation
2. U.S. Department of Energy
3. IEEE Transactions on Computers
4. IEEE Transactions on Parallel & Distributed Systems
5. IEEE Transactions on Automation Science and Engineering
6. IEEE Transactions on Systems, Man and Cybernetics,
7. IEEE Transactions on Mobile Computing
8. IEEE Transactions on Instrumentation & Measurement
9. Journal of Software Testing, Verification and Reliability

## Editorial Boards

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|---|--------------|
| 1. IEEE Conference on Automation Science and Engineering<br><i>Conference Editorial Board, Associate Editor</i> | 2008-present |
| 2. International Journal of Distributed Sensor Networks<br><i>Subject Area Editor (Applications)</i>            | 2004-09      |
| 3. International Conference on Embedded Systems<br><i>Conference Associate Editor</i>                           | 2004         |

**Students**

## Graduate Student Supervision

### Current Ph.D. Students

- |                            |  |
|----------------------------|--|
| 1. Mr. Kranthi Mamidisetty | <b>Area:</b> Exploiting Multiple Shortest Paths in Systems |
| 2. Mr. Mukesh Chippa       | <b>Area:</b> Predictable Performance of Real-time Systems  |

### Current M.S. Students

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|-----------------------|---|
| 1. Ms. Shannon Whalen | <b>Area:</b> Visualizing large-scale real-time data streams |
|-----------------------|---|

### M.S. Thesis Supervised

- |                            |      |   |
|----------------------------|------|---|
| 1. Mr. Mukesh Chippa       | 2011 | <i>Performance of Tree-based Data Collection in Wireless Sensor Systems</i>   |
| 2. Ms. Chandana Cheerla    | 2011 | <i>A Learning Automata Approach for Input-rate Control in Composable Conveyor Systems</i>   |
| 3. Ms. Sanchita Subedi     | 2011 | <i>Characterizing and Visualizing Contours in Regular 3D Mesh Topologies</i>  |
| 4. Mr. John McGonnell      | 2011 | <i>Contact Point Detection and Contact History Tracking in Biomimetic Whiskers</i><br>(Co-Supervisor: A. Dhinojwala, Polymer Science) |
| 5. Mr. Chidi Anoize        | 2011 | <i>Event-triggered Design of Networked Embedded Automation Systems</i>  |
| 6. Mr. Branden Archer      | 2010 | <i>Profiling Primitives of Networked Embedded Automation</i>  |
| 7. Ms. Maithili Ghamande   | 2010 | <i>A Domination Approach to Data Aggregation in Networked Embedded Systems</i>  |
| 8. Mr. Hamza Abubakari     | 2008 | <i>IEEE 1588 Style Synchronization over a Wireless Link</i>   |
| 9. Mr. Kranthi Mamidisetty | 2008 | <i>Generalizing Contours for Mesh Topologies</i>  |
| 10. Mr. Saju Kuruvilla     | 2007 | <i>Reliability Evaluation of Composable Conveyor Systems</i>  |
| 11. Ms. Minlan Duan        | 2007 | <i>Quality of Service of Contour Guided Dissemination</i>   |
| 12. Mr. Nunzio Hayslip     | 2006 | <i>A Discrete Event Simulator for Coupled Conveyors</i>   |
| 13. Mr. I-Hsein Chu        | 2005 | <i>Contour Guided Dissemination for Networked Embedded Systems</i>  |

- |                        |      |   |
|------------------------|------|---|
| 14. Mr. Omer Gundogmus | 2005 | <i>A Goal-Seeking Approach to Coordinating the Discharge of a Collection of Batteries</i> |
| 15. Mr. Murat Kose     | 2004 | <i>Efficient Implementation of Encryption Algorithms on a Microcontroller</i>             |

### Other Graduate Student Committees

- |                      |      |       |                                    |
|----------------------|------|-------|------------------------------------|
| 1. Mr. Yu Zou        | 2012 | Ph.D. | The University of Akron (Expected) |
| 2. Mr. Dinesh Gade   | 2011 | M.S.  | The University of Akron            |
| 3. Mr. Firas Hassan  | 2007 | Ph.D. | The University of Akron            |
| 4. Mr. Richie Thomas | 2007 | M.S.  | Kent State University              |
| 5. Mr. Jingfeng Cai  | 2006 | Ph.D. | The University of Akron            |
| 6. Ms. Lily Dong     | 2005 | M.S.  | The University of Akron            |

### Undergraduate Capstone Project Teams Supervised

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|---|------|
| 1. <i>Wireless Restaurant Pager System</i>                              | 2011 |
| Amanda Vespoint, Nicholas Rochford, Steven Talarchek, and Mike Seppanen |      |
| 2. <i>BalanceBOT</i>  | 2010 |
| Stephanie Koseck, Nicole Beck, Stefan Baranoff, and Chris Hamrock       |      |
| 3. <i>LED Marquee</i>   | 2009 |
| Tom Bresson, Dan Kephart and Ben Radey                                  |      |
| 4. <i>Composer</i>  | 2008 |
| Branden Archer, Jeffery Bennet and Chris Evers                          |      |
| 5. <i>Model Airplane Engine Benchmark Rig</i>                           | 2007 |
| Megan Dillon, Ben Bloss, Chris Feyerchek and Jon Soudry                 |      |
| 6. <i>Weather Sensitive Car</i>   | 2003 |
| Darnell Johnson, Abdul Al-Sherifi and Duy Nguyen                        |      |

## Undergraduate Honors Projects Supervised

- |    |                     |      |   |
|----|---------------------|------|---|
| 1. | Mr. Branden Archer  | 2008 | <i>Task Scheduling with Branch and Bound</i>  |
| 2. | Mr. Chris Feyerchek | 2007 | <i>Generating Communications Software for Desktop/Embedded System Interaction</i>             |
| 3. | Mr. Ben Bloss       | 2007 | <i>Two Algorithms for Automated Data Collection in Remote Control Aircraft Engine Testing</i> |

## Undergraduate Student Mentees

- |    |                   |                                   |                                       |
|----|-------------------|-----------------------------------|---------------------------------------|
| 1. | Mr. PJ Morley     | 2010 – present, UG Student Member | <i>Complex Engineered Systems Lab</i> |
| 2. | Mr. Jon Fortunato | 2011                              | Summer, UA Tiered Mentoring Program   |
| 3. | Mr. Jon Proch     | 2010                              | Summer, UA Tiered Mentoring Program   |

## K-12 Student Mentees

- |    |                |      |   |
|----|----------------|------|---|
| 1. | Mr. Jack Giles | 2011 | Junior, St. Vincent and St. Mary High-School  |
| 2. | Mr. PJ Morley  | 2010 | Senior, St. Vincent and St. Mary High-School<br>(now ECE UG Student, The University of Akron) |
| 3. | Mr. Isaac Cabe | 2010 | Senior, St. Vincent and St. Mary High-School  |

**Publications,  
Presentations,  
and  
Patents**

## Publications in Refereed Journals

1. *Systematic Selection of Cluster Heads for Data Collection*, Journal of Network and Computer Applications, Vol. 35, 2012, pp. 1548-1558 (with K.K. Mamidisetty and M.J. Ferrara)
2. *Multipath Dissemination in Regular Mesh Topologies*, IEEE Transactions on Parallel and Distributed Systems, Vol. 20, No. 8, August 2009, pp. 1188-1201 (with K.K. Mamidisetty, M. Duan, and P.S. Sastry)
3. *Failure Detectors for Wireless Sensor Actuator Systems*, Ad Hoc Networks, Vol. 7, Issue 5, July 2009, pp. 1001-1013 (with H. Zia and N. Sridhar)
4. *Contour Guided Dissemination for Networked Embedded Systems*, International Journal of Distributed Sensor Networks, Vol 5, Issue 5, 2009, pp. 502-530 (with I. Chu and M. Duan)
5. *Coordinated Discharge of a Collection of Batteries*, Journal of Power Sources, Vol. 166, pages 284-296, 2007 (with O. Gundogmus, T.T. Hartley, R. J. Veillette)
6. *Networked Embedded Automation*, Assembly Automation, Vol. 26, No. 3, 2006 (with N. Hayslip and J. Gerhardt)
7. *Real-time Sensor Actuator Networks*, International Journal of Distributed Sensor Networks, Volume 1, No. 1, pages 17-34, 2005 (with S.S. Iyengar)
8. *A SmartSpace for Automation*, Assembly Automation, Special issue on Man-Machine Interfaces, Vol. 24, No. 2, pages 201-209, 2004
9. *Sensor Technologies for Future Automation Systems*, Sensor Letters, Vol. 2, No. 1, pages 9-17, 2004 (with S.S. Iyengar)
10. *Foundations of Data Fusion for Automation*, IEEE Instrumentation and Measurement Magazine, Vol. 6, No. 4, pages 35-41, 2003 (with S.S. Iyengar and N. Balakrishnan)
11. *On Finding Euler Tours in Parallel*, Parallel Processing Letters, Vol. 3, No. 3, 1993. (with N. Deo, E. Caceres, and J. Schwarcfiter)

12. *An Application of Functional Dependencies to the Topological Analysis of Protection Schemes*, IEEE Transactions on Power Delivery, Vol. 7, No. 1, Jan 1992 (with L. Jenkins and H.P. Khincha)
13. *Computer Aided Relay Coordination Techniques – A Survey*, Journal of Institution of Engineers, Vol. 71, June 1990 (with L. Jenkins and H.P. Khincha)
14. *An Application of Hypergraphs to the Topological Analysis of Power System Networks*, AMSE Journal on Modeling, Simulation, and Control, Part A. Vol. 17, No. 4, 1988 (with L. Jenkins and H.P. Khincha)

### **Peer Reviewed Conference Publications**

1. *WiP Abstract: TCP Congestion Control Principles for Highly Available Reconfigurable Conveyor Systems*, International Conference on Cyber-Physical Systems, Beijing, April 2012 (with A. Trewyn, A. Gokhale and M. Branicky)
2. *Learning Automata based Online Input-rate Control for Composable Conveyor Systems*, Proceedings of the Centenary Conference of the Electrical Engineering Department, Indian Institute of Science, Bangalore, December 2011 (with C. Cheerale and P.S. Sastry)
3. *Influence-graph Based Technique for System Level Diagnostics*, Proceedings of Machinery Failure Prevention Technology Conference, Virginia Beach, May 2011 (with K. Mamidisetty, B. Archer, K. Loparo, and F. M. Discenzo)
4. *Model-driven Performance Analysis of Reconfigurable Conveyor Systems used in Material Handling Applications*, International Conference on Cyber-Physical Systems, Chicago, April 2011 (with K. An, A. Trewyn, and A. Gokhale)
5. *Worst-case End-to-end Response Time Analysis for Composable Conveyor Systems*, Euromicro Conference on Real-time Systems (WIP Session), Belgium, July 2010 (with B. Archer)



6. *Profiling Primitives of Networked Embedded Automation*, IEEE Conference on Automation Science and Engineering, Bangalore, August 2009 (with B. Archer, A. Rowe, and R. Rajkumar)
7. *Hybrid Input/Output Automata for Composable Conveyor Systems*, IEEE Conference on Automation Science and Engineering, August 2009 (with S. Mitra)
8. *A Domination Approach to Clustering Nodes for Data Aggregation*, IEEE Globecom 2008, (with K.K. Mamidisetty, M. Ghamande, and M.J. Ferrara)
9. *IEEE 1588 Style Synchronization over a Wireless Link*, International Symposium on Precision Time Synchronization for Measurement, Control and Communication, 2008 (with H. Abubakari)
10. *Evaluating the Reliability of Reconfigurable Conveyor Systems*, IEEE Conference on Automation Science and Engineering 2008 (with S. Kuruvilla and S. Gokhale)
11. *A Methodology to Evaluate the Availability of Reconfigurable Conveyor Systems*, International Symposium on the Performance Evaluation of Computer and Telecommunication Systems 2008, (with Z. Qu and S. Gokhale)
12. *Optimal Dissemination in 3-Neighbor Wireless Mesh Topologies*, Centenary Conference of the Indian Institute of Science on Managing Complexity in a Distributed World, Bangalore, May 2008 (with K.K. Mamidisetty)
13. *Contour Guided Dissemination*, Northeast Ohio Networking Symposium, Cleveland, 2008 (with K.K. Mamidisetty)
14. *Cyber Physical Systems that Enable Automotive Assembly*, NSF Workshop on Cyber Physical Systems, April 2008
15. *Contour Guided Dissemination in 4-Neighbor Wireless Mesh Topologies*, Innovations and Commercial Applications of Distributed Sensor Networks, 2007 (with K.K. Mamidisetty)

16. *A Goal-Seeking Framework for Systems Health Management*, Machine Failure Prevention Technology, April 2006, (with F. M. Discenzo)
17. *Sensor-Actuator Systems for Automation*, IEEE Real-time Systems Symposium, WIP Session, Rio de Janeiro, Brazil, December 2006
18. *Contour Guided Dissemination for Networked Embedded Systems*, Innovative Real-time Applications of Distributed Sensor Networks, Washington D.C. October 16-17, 2006
19. *Sensor-Actuator Networks for Conveyor Systems*, Innovative Commercial Applications of Sensor Networks, Washington D.C., 2005
20. *Algebraic Semantics for Complete Interaction Sequences*, IEEE TENCON, Region 10 Conference, 2005 (with L. Narasimhan and Renyi)
21. *Evaluating Communication Protocols for a Sensor-Actuator Network*, Proceedings of the International Conference on Embedded Systems, ESA'04, Las Vegas, June 2004 (with K. Huang)
22. *A Taxonomy of Sensor Processing Architectures*, Proceedings of ASI NATO Workshop on DataFusion in Armenia - 2003, Fall 2004 (with Iyengar)
23. *Foundations of a SmartSpace for Automation*, Proceedings of International Conference on Artificial Intelligence, Las Vegas, pp. 3-9, June 23-26, 2003
24. *Firewall Regression Testing of GUI Sequences and Their Interactions*, Proceedings IEEE International Conference on Software Maintenance, Amsterdam, Netherlands, September 22-26, 2003 (with L.J. White and H. Almazan)
25. *From Ear Decompositions to Bandwidth-2 Labelings*, Southeastern Conference on Graph Theory and Combinatorics, Boca Raton, March 1998. (with Dr. L. J. White)
26. *New Perspectives in Power System Training Simulators – the impact of Artificial Intelligence*, Proceedings on the IEEE Conference on Power System Protection, Bangalore, India, 1988. (with Dr. V.A. Sastry, H.K. Kanodia, and R. Rana)

27. *Modeling and Performance Evaluation of Protection Systems – A Petri Net Approach*, Platinum Jubilee Conference on Systems and Signal Processing, Bangalore, India, 1986. (with Dr. Lawrence Jenkins and Dr. H.P. Khincha)

## **Book Chapters**

1. *Interfacing Distributed Sensor Networks with the Physical World*, in *Distributed Sensor Networks* (editors R. Brooks & S.S. Iyengar) (with S.S. Iyengar), 2012.
2. *Design and Transformation of Domain-specific Language for Reconfigurable Conveyor Systems*, in Formal and Practical Aspects of Domain-specific Languages: Recent Developments, Editor M. Mernik, 2012 (with K. An, A. Trewyn and A. Gokhale).
3. *A Taxonomy of Distributed Sensor Networks*, in Distributed Sensor Networks (editors R. Brooks & S.S. Iyengar) (with S.S. Iyengar) , Chapter 3, pages 29-44, 2005.
4. *Wireless Sensor Networks Enabling Ecological Informatics*, in Handbook of Ecology (with S.S. Iyengar and N. Balakrishnan), 2008
5. *Foundations of Data Fusion for Automation*, in Distributed Sensor Networks (editors Brooks, Iyengar) (with S.S. Iyengar and N. Balakrishnan), Chapter 15, pages 291-300, 2005
6. *A Taxonomy for Distributed Real-time Control Systems*, in Advances in Computers, Editor M. Zelkowitz, Vol. 49, pages 303-352, 1999 (with J. Agre and L. Clare)

## **U.S. Patents Issued**

1. **Patent Number: 6,104,962**, August 15, 2000, “System For and Method of Allocating Processing Tasks of a Control Program Configured to Control a Distributed Control System”
2. **Patent Number: 6,161,051**, December 12, 2000, “System, Method, and Article of Manufacture for Utilizing External Models for Enterprise Wide Control”

## **Presentations (Other than Conferences)**

1. *Machinery Diagnostics Hands-on Workshop*, Machine Failure Prevention Technology Conference, April 2012 (with F. Kaffashi, M. Chippa, K. Loparo, F. Discenzo and P. Lowe).
2. *Cloud Conveyors: A Representative Cyber-Physical System?*, Robert Bosch Center for Cyber-Physical Systems, Indian Institute of Science, March 2012.
3. *Advanced Manufacturing Systems*, Ohio Supercomputer Center, Research Seminar, June 2011.
4. *High-speed, High-bandwidth Networks – A Key Enabler for Advanced Manufacturing Systems*, NSF GigU/IGNITE Workshop, Case Western Reserve University, June 2011.
5. *Multipath Exploitation*, Case Western Reserve University EECS Colloquium, Nov 2010
6. *Contour Guided Dissemination*, Indian Institute of Science, EE Colloquium, July 2010
7. *Networked Embedded Automation*, Indian Institute of Science/ Indian Space Research Organization Colloquium, July 2010.
8. *Material Processing Automation at AFMC*, Akron Functional Materials Center Inaugural Workshop, September 2009.
9. *Algorithms for Contour Guided Dissemination*, The University of Akron, Department of Computer Science, 2009.
10. *Networked Embedded Systems Research*, Institute for Software Integrated Systems, Vanderbilt University, 2009.

## Funding

## **EXTERNAL FUNDING RECEIVED (Research Awards)**

1. Ohio Department of Development, 2011, Center for Sensor Systems Engineering (co-PI). Total award **\$1,670,000**, 2010 (13 Collaborators at The University of Akron)
2. Austen Bioinnovation Center, (subaward to Sastry) Automation for Materials Processing and Discovery, **\$150,000**, 2010-2011
3. National Science Foundation (ORSSP #7564), Real-time Sensor-Actuator Systems for Automation, **\$280,000** (total award in collaboration with Prof. Rajkumar at Carnegie Mellon University is **\$680,000** for 2007-2010)
4. Ohio Board of Regents (ORSSP #R7564-OBR), Real-time Sensor-Actuator Systems for Automation, August 2007, **\$19,367**, 2007 (no indirect cost)
5. Wright Center for Sensor Systems Engineering (ORSSP #R7416), Secure Data Aggregation and Decision-Making, August 2007, **\$235,869**, 2006
6. OhioICE Research Award (ORSSP # R7290) for Predictable Monitoring, April 2006, **\$20,490** (in collaboration with Dr. N. Sridhar at Cleveland State University for total award of \$44,552, 2006
7. Ohio ICE Research Award (ORSSP # R7073) for Predictable Node-level Operating System, October 2005, **\$15,000** (in collaboration with Professors Branicky and Liberatore at Case Western Reserve University for total award of \$50,000)

## **INTERNAL FUNDING RECEIVED**

1. Indirect cost reduction from College of Engineering and Department of Electrical Engineering for ORSSP #R7564, **\$6,000** (no indirect cost), 2007
2. Firestone Research Initiative Award, College of Engineering, January 2003, **\$5,000**, 2003
3. College of Engineering, The University of Akron, Research Startup, 2002, **\$174,444**.

## **EQUIPMENT/SOFTWARE DONATIONS RECEIVED**

1. Rockwell Automation, Demonstration Conveyor Systems, 2011.
2. Rockwell Automation, Automation Controllers, 2006, **\$35,000** (with J. Grover)
3. Sandia National Laboratories (ORSSP #R6261), SmartSpace for Automation (JESS License for Software), April 2003, **\$5,000**
4. QNX Software (ORSSP #R6139), QNX Momentics for Automation Research, December 2002 **\$26,085**
5. Rational Rose Development Company Award (ORSSP #O3566), Rational Rose Software, September 2002, **\$148,550**