

Curriculum Vitae of Arun K. Somani

1. Personal Data:

Arun K. Somani

Associate Dean for Research, College of Engineering
Anson Marston Distinguished Professor
Philip and Virginia Sproul Professor
Department of Electrical and Computer Engineering
Iowa State University, Ames, IA, 50014
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2. Education Record:

- PhD in Electrical Engineering, September 1985, *McGill University, Montreal, Canada*
- MSEE in Electrical Engineering, September 1983, *McGill University, Montreal, Canada*
- M.Tech. in Computer Engineering, August 1979, *Indian Institute of Technology, Delhi, India*
- B. E. (Hons.) in Electronics Engineering, June 1973, *B. I. T. S., Pilani, India*

3. Professional Appointments:

3.a. Iowa State University:

- Philip and Virginia Sproul Professor, Electrical and Computer Engineering (August 16, 2014 - Contd). Support innovative research and education program in computer engineering.
- Associate Dean for Research, College of Engineering, Iowa State University, (July 1, 2013 - Contd.).
- Chair, High Performance Computing Steering Committee, Iowa State University, (July 1, 2012 - June 30, 2015).
- Anson Marston Distinguished Professor, Iowa State University, Electrical and Computer engineering, (August 16, 2007 - Contd.).
- Chair, Electrical and Computer Engineering, (May 16, 2003 - Sept 30, 2010). Duties included managing the overall responsibilities of the department, a state budget of more than \$8.0 Million and a research budget of around \$10.0 Million per year, 50 faculty, 20 adjunct faculty and 20 staff members.
- Director, Information Infrastructure Institute (July 1, 2002 - June 30, 2015). Duties include building collaboration to find solutions for disparate problem using common methods.
- Jerry R. Junkins Endowed Chair Professor of Electrical and Computer Engineering (August 16, 2002 - August 15, 2014). To support development of innovative research program in computer engineering areas.
- Associate Chair for Resources (August 16, 1999 - 2003). Duties included teaching, teaching assistant, and space assignment and management of \$500K/year budget for computing/electronics laboratories.
- David C. Nicholas Professor of Electrical and Computer Engineering (1997 - 2002). Develop innovative research program in computer engineering areas.

3.b. Appointments Outside Iowa State:

- Professional Development Assignment: Ram Rajindra Malhotra Professor October 1, 2010 - May 15, 2011, Indian Institute of Technology, Delhi, India.
- Honorary Distinguished Professor: National Taiwan University of Science & Technology, 2010-Contd.
- Visiting Professor: Gujarat Technological University (GTU), Ahmedabad, India, 2011-Contd.

- University of Washington, Seattle, WA 98195
 - Professor of Electrical Engineering and Computer Science and Engineering (September 16, 1995 - June 15, 1997).
 - Professional Development Assignment Leave: December 16, 1994 - December 15, 1995. to I. I. T. Delhi, India, University of Newcastle, Newcastle, Australia, and ICASE, Hampton, VA.
 - Associate Professor of Electrical Engineering and Computer Science and Engineering (September 16, 1990 - September 15, 1995).
 - Assistant Professor of Electrical Engineering (September 16, 1985 - September 15, 1990).
- Systems Group, Dept. of Electronics, Govt. of India: Senior Scientific Officer (August 79 - August 82). Leadership role in design and system integration of a state-of-the-art anti-submarine warfare (ASW) system for Indian Navy. The system was designed, implemented, tested, and was proved to Indian Navy. It was installed on two frigates and a third system was delivered to navy for training.
- Systems Group, Dept. of Electronics, Govt. of India: Junior Scientific Officer (December 74 - July 79). Design, development, implementation, and testing of a state-of-the-art anti-submarine warfare (ASW) system for Indian Navy.
- Computer Group, Electronics Corporation of India Limited: Technical Officer (November 73 - November 74). Worked on design and development of micro-programmed CPU's.

3.c. Consulting and Professional Practice:

- Boeing Commercial Group, Seattle, WA: January 1, 1993 - 2000.
- ICASE, Langley, VA: January 1, 1993 - 1997.
- Elsevier July 1, 1994 - Dec 31, 2006.
- Guidant July 1, 1999 - Dec 31, 2001.
- Rockwell January 1, 2002 - December 31, 2002.

4. Honors and Awards:

- Member of IPSJ/IEEE-CS Joint Award Committee Member, 2019 and 2020.
- Fulbright Specialist Roster, On the Roaster from October 11, 2019-Apr 11, 2024.
- Distinguish Alumnus Award-2018, Birla Institute of Technology (BITS), Pilani, India.
- Distinguish Alumnus Award-2017, Prof. L.K.Maheshwari Foundation, Birla Institute of Technology (BITS), Pilani, India.
- Anson Marston Distinguished Professor, Iowa State University, 2007-Contd.
- First Recipient of Philip and Virginia Sproul Professorship, Iowa State, 2014-2019.
- First Recipient of Jerry R. Junkins Chair Professorship, Iowa State, 2002-2014.
- First Recipient of David C. Nicholas professorship, Iowa State, 1997-2002.
- Honorary Distinguished Professor, National Taiwan University of Science & Technology (Taiwan Tech), 2010-Contd.
- Distinguished Adjunct Professor, Birla Institute of Technology (BITS), Pilani, 2020-Contd.
- Elected Fellow of IEEE for “contributions to theory and applications of computer networks,” 1999-2017.
- Life Fellow of IEEE, 2018-Ever.
- Distinguished Engineer of ACM, 2006. Requires at least 15 years of professional experience who have achieved significant accomplishments or have made a significant impact on the computing field.

- Elected Fellow of AAAS for “distinguished contributions to the theory and practice of dependable computing and networking systems, including design, development, implementation, and building experimentation platforms,” 2012.
- Eminent Engineer, Tau Beta Pi, 2013- Contd.
- Department Leadership Award, Iowa State University, 2008.
- Mervin S. Coover Distinguished Service Award, Electrical and Computer Engineering, ISU, 2010.
- Warren B. Boast, Undergraduate Teaching Awards, Electrical and Computer Engineering, ISU, 2006.
- Best Teacher Award, Student Association, ISU, 1999.
- Dean’s Honor list at McGill University 1985 (Ph.D.). Reserved for top few dissertation.
- Dean’s Honor list at McGill University 1983 (M.Eng). Reserved for top few theses.
- IEEE Communication Society Distinguished Visitor (2009-2013).
- IEEE Distinguished Visitor (2000-2002).
- IEEE Distinguished Tutorial Speaker (2000-2002).
- Keynote and Banquet speaker at many conferences.
- Have won several best/top paper awards.
- Recipient of Commonwealth Scholarship, Canada 1982-1985
- Recipient of National Scholarship, India 1967-73.
- Listed in several volumes of Who’s Who.

5. Teaching Activities: Have taught a variety of courses listed below.

- Introduction to Digital Logic Design. A standard course on introduction and application of digital logic design and combinational and sequential circuits for various applications. I developed and introduced a new laboratory in the course that uses FPGA-based logic design boards for rapid prototyping and laboratory experimentation.
- Introduction to Micro Processors. This is a standard course on architecture and applications of Micro processors for various application, including input/output, direct memory access and interrupt programming. I supervised a senior design team to design and implement a PowerPC based system to be used in microcontroller-based system and application design laboratory.
- Computer Organization and Design/Computer Architecture and Structure. I have developed and taught various versions this course. I have revised it regularly to introduce new state-of-art tools and laboratory components in the course. Initially, it used a microprogramming based engine in the laboratory where student designed and implemented an instruction set architecture as part of the course. In the next reorganization, the laboratory included various microprogramming engines such as HP 3000 and Texas Instruments EVM-16 board (16-bit data path) to achieve the same goals. Subsequently, I introduced Verilog simulation engine in the same course taught as EE471 and CSE471) at the University of Washington (UW) and Cpre305 at ISU. In the follow on version courses uses both Verilog and FPGA based engines and system simulation tools.
- Vertical Integration of Engineering Education (VIE) sequence on Introduction to Digital Logic Design, Microprocessor Applications and Computer Organization and Architecture. This curriculum of two experimental instructional and two laboratory classes over a two semester period covered logic design, microcontroller applications and computer architecture, organization, and design in an integrated fashions. The 12-semester credits course sequence was taught for two academic years, 2004-05 and 2005-06. In each year a controlled group of 20 students (representative of student population) were as selected and were taught the material typically covered by a 3-course 4-credit sequence as a 4-course 2-semester sequence. The result showed that student learning improved significantly. This material was then then adopted as a regular sequence in computer engineering curriculum at Iowa State University as CprE281/CprE381 sequence.

- VLSI Testing. A conventional course of VLSI testing techniques. Co-taught it with Dr. Mani Soma at the University of Washington.
- Advanced Computer Architecture. An advanced standard course on computer architecture suitable for entering graduate students at the University of Washington.
- Fault-Tolerant Computer Systems. Developed a new graduate course on Fault-Tolerant Computer Systems design. First offering was in 1986. Boeing Company found the course contents very useful and bought the entire course on video cassettes for their training center. The course was a regular course in curriculum at UW and is now a regular course at ISU. Also, set up a new laboratory for research in fault tolerant computing area, which is equipped with state-of-art computing equipment and tools for simulations and evaluations. I also have developed analysis tools and techniques that are now used by industry.
- Parallel Computer Systems. Revised and upgraded the contents of the course on Parallel Computer Systems to reflect the state of art in parallel computer systems. In particular, when I designed and built the Proteus multi-computer system at US, we used this system for parallel and distributed programming.
- VLSI ARRAY Processors. Developed a course in using large scale VLSI systems on a chip for various regular applications in 1988. It was a timely course and included material on how to explore an algorithm for parallelization, how to express them in data and signal flow forms, and map them on regular VLSI structures on a chip.
- FPGA-Based Adaptive Computing Systems. Jointly developed this timely new graduate-level course on using reconfigurable components such as Field Programmable Gate Arrays to map algorithms directly onto the hardware in 1998. The course is a regular course in ISU curriculum now.

6. Research Activity:

6.a. Research Area:

- **A. Design of Fault-Tolerant and High Integrity Systems.** Microprocessor design, computer interconnection network, and performance and reliability analysis methodologies, techniques, and tools. We have developed architectural solutions for reliable and aggressive overclocking for power, performance, energy, and reliability tradeoffs and application of them in security application.
- **B. Parallel and High Performance Computing Systems.** Designed and implemented a large parallel computer system, *Proteus*, for machine vision applications. We have also developed application of high performance computing based on multi-core and GPU and other accelerator-based machines for a variety of applications.
- **C. Reconfigurable/Balance Computing.** High-performance adaptive balanced computing systems deploying reconfigurable and memory lookup-based computing techniques.
- **D. Wavelength Division Multiplexing-based Optical Networking.** We have addressed issues in architecture and algorithms for design, routing, role of wavelength conversion, and dependability issues in WDM-based local and wide-area optical networks.
- **E. Wireless and Sensor Applications.** We have also performed research in the area of medium access protocols, robust load-balanced location management and protocol issues, fairness in channel utilization, and dependability in ad-hoc and structured wireless and mobile computing.
- **F. Image/Vision Processing and Applications.** Development of visual sensors and development of framework for meta image navigation augmenters (MINA) for GPS denied environment and application of this along with other sensors for real-time navigation and asset monitoring.

6.b. Contributions: Have made the following significant research contributions.

- **A1. System-Level Diagnosis.** Made fundamental and significant contribution in developing a generalized theory for system-level diagnosable system in the presence of an arbitrary fault set in a multi-computer system. We characterized such diagnosable systems in terms of their testing requirement under various model of test result interpretation and faults scenarios where multiple faults occur sequentially or simultaneously. We have also developed distributed fault diagnosis algorithms for multi-processor systems that exploit the regularity and symmetry of interconnection topology and allow fault sets in size much larger than that is possible using the prevalent classical theory. The work led to development of several probabilistic and deterministic fault diagnosis approaches. These models allow design of practical systems.
- **A2. Fault Tolerant Computer System.** Developed a new fault tolerant computer system architecture, called MESHKIN, based on distributed fault diagnosis and reconfiguration approach to tolerate multiple faults while minimizing the hardware complexity and performance penalty while maintaining very high reliability. The Boeing company implemented a fault tolerant computer system based on this work.
- **A3. Reliability Analysis Tools and Techniques.** Developed techniques and tools to analyze reliability of complex systems that operate in multiple phases with different requirements and follow complex maintenance schedules. Examples include commercial and military aircraft systems, and NASAs shuttle systems. The tools, EHARP (Enhanced Hybrid Automated Reliability Predictor) and HIMAP (Hierarchical Modelling and Analysis Package) were developed for the Boeing Company, who uses them regularly. Several other companies such as Boeing (various divisions), Singapore Defense, Honeywell, GE Locomotive division, Lucent, and the University of Massachusetts, University of Arizona, University of Texas at Dallas, and ISU, also use these tools for analysis and education
- **A4. Managing Soft Faults.** Dependability of computer systems in the presence of transient and soft faults is a major concern in current and future processor and memory system designs. We studied the error propagation characteristics due to transient faults in processor registers, logic, and cache memories. Developed low-overhead techniques such as shadow caching for multi-bit error correction in (cache) memory system and both circuit and logic level error detection and correction in processor systems to make them more robust. Also developed a novel concept of reconfigurable caches/functional units integrated in micro architecture to achieve a balance processor and memory bandwidths.
- **A5. Performance and Reliability of Processor Systems.** To improve the performance and reliability of processor systems we have developed a design methodology to overcome the clock rates upper bound that is determined using the worst case timing paths to avoid timing errors. Process, Voltage and Temperature (PVT) variations also force designers to fix clock-times of embedded processors and system-on-chips at much higher value than what is typically required. In practice, most applications running in a given operating environment do not exert the critical path every cycle, leaving room for significant performance improvements that can be achieved through dynamically adjusting clock frequency at run time beyond worst case limits. We have developed a framework to make a balance between clock speeds, performance, power consumption, and thermal management on a chip.
- **B1. VLSI dictionary machine.** Developed novel architectures for an efficient dictionary machine for VLSI. This is a direct implementation of a data structure in a large scale VLSI system chip using a simpler control structure that is easy to implementable.
- **B2. Proteus Multi-Computer System.** Developed, designed and implemented Proteus multi-computer system – a fully reconfigurable high performance computer system – for computer vision applications using mathematical morphology for Coastal Navy. This system used a large grain message passing network model at high level and used shared memory multiprocessor node at the lowest level with software controlled cache coherency architecture. Several ideas to optimize cache design for this application, which can be generalized for parallel processing, were developed and deployed. The system architecture allowed to include spare capacity for fault detection, diagnosis, and reconfiguration. A 46-node system prototype was built and experimented with at the University of Washington. A patent was issued for the novel ideas in this architecture. Several programming approaches and methodologies were developed and deployed the Proteus machines. The network deployed time-slotted circuit-switched connection structure with separate data and control plane.

- **B3. Beyond Arithmetic Carry Chain:** Logic Chain for Architecture. We have developed new architectural concepts to enhance the performance of look-up table based FPGAs. Our solution, called ChainMap, is a polynomial-time delay-optimal technology mapping algorithm for the creation of generic logic chains. By using the carry chain as a generic, near zero-delay adjacent cell interconnection structure for 4/5/6-LUTs, average speedups of between 1.4x-1.7x can be realized with an average LUT utilization penalty of 1.00-1.24x. Using this we make a case for generalization of CarryChain in FPGA to a LogicChain based design.
- **B4. Data Shaping.** GPS is a critical sensor for Unmanned Aircraft Systems (UASs) due to its accuracy, global coverage and small hardware footprint, but is subject to denial due to signal blockage or RF interference. When GPS is unavailable, position, velocity and attitude (PVA) performance from other inertial and air data sensors is not sufficient, especially for small UASs. We have developed a novel, automated approach called MINA (Meta Image Navigation Augmenters), which is a synergy of machine-vision and machine-learning algorithms for map aided navigation. MINA utilizes publicly available collection of discrete landmarks and open source geo-referenced vector map data, such as OpenStreetMap, in conjunction with real-time optical imagery from an on-board, monocular camera to augment the UAV navigation computer when GPS is not available, as well as generate a vector and EXIF based 3D aeronautical chart in real time. The MINA approach has been experimentally validated with both actual UAV flight data, and flight simulation data.
- **B5. Scalability and Efficiency of Data Management in All-Pairs Interactions.** We address the memory bottleneck in a class of application where a large amount of data is involved. The data consists of data elements, which need to interact with each other as in a cross product. Two choices are to store data in a single nodes memory and compute the cross product. Alternately data can be distributed among multiple computing nodes and be moved as needed. The latter however creates a large data movement affecting the performance of the algorithm. Our method allows distributing data efficiently initially and then remove the need for any further communication of data among nodes. We accomplish by it using cyclic quorum theory The same basic scheme can be deployed in establishing communication paths between all pairs in a communication network by embedding multiple rings in the network topology, one ring for each quorum set. This then provides a path from any node to any other nodes without any further routing algorithm. The scheme has been extended to provide redundant paths between any pair of nodes for fault tolerant routing algorithm.
- **C1. Network Topologies.** Interconnection topologies play important role in development of parallel and distributed multi-computer systems. We have developed Enhanced Hypercube (EHC), Generalized Folding Cube (GFC), and Helical Binary-cube (HBC) interconnection topologies that are universal structures for embedding any arbitrary permutation routing requests in circuit switched mode. Also developed Extra stage and Reduced stage multi-stage interconnection structures for robust and fault tolerant operation to interconnect multi-computer systems.
- **C2. Reconfigurable Architectures.** Have investigated developing reconfigurable architectures that are based on FPGA-like memory lookup-based computing techniques. In particular, developed architectures that can trade cache memory to become functional units in a general purpose computing system. This adaptive balanced computing system allows efficient use of resources in a dynamic computing environment.
- **C3. Peer-to-Peer (P2P) Networks.** These are flexible distributed systems that allow nodes (called peers) to act as both clients and servers. P2P is a powerful emerging networking paradigm as it permits sharing of virtually unlimited data and computational resources in a completely distributed, fault-tolerant, scalable and flexible manner. The current research in P2P systems is based on a cooperative network model. The network designers need to take into account the independence and selfishness of P2P users to make the future systems reliable and robust. Our research efforts are focused on harnessing idle processing resources in P2P networks taking into account the selfishness of the nodes. In this context we have developed CompuP2P, which is architecture for distributed computation that facilitates trading of computing power using an incentive driven economic model.
- **D1. Fiber-Optics Based Optical Networks.** Have made significant research contribution in design and operation of fiber optics based optical networks. The most prominent component of this research in this area is characterization of role of wavelength converters in optical WDM (wavelength division

multiplexing)-based network and algorithms for placement of convertors. Follow on work focused on development of alternate architectures that employ no wavelength conversion, but use multiple fiber, with fewer wavelengths on each fiber (a very practical approach and a very cost-effective solution)

- **D2. Traffic Grooming.** We have developed several mechanisms and traffic grooming algorithms; traffic grooming architectures; and algorithms for resource allocation for efficient traffic grooming.
- **D3. Fault and Attack Management in WDM networks.** We have developed dependable routing and connection management methods; investigated techniques and methods to detect and diagnose attacks in WDM-based fiber optic networks; and created simulation environment to analyze the effectiveness of the techniques. Several effective full and partial survivability techniques using resource sharing approaches have been developed.
- **E1. Location Management.** Developed an efficient fault tolerant distributed database system to manage location information of mobile devices. This scheme distribute the location update and search workload on multiple distributed database systems to optimize the search and update time and and load balance the workload of involved servers.
- **E2. Sensors-Assisted Power Grid Protection.** Conventional control and protection mechanisms on power transmission networks are blind-sided in recognizing and responding to physical threats to the power system including but not limited to sabotage, and acts of nature. These safety mechanisms are based purely on electrical quantities and the operator will not have knowledge of attacks on the system that physically alter the transmission path, which is common occurrence. We have developed a theoretical and experimental program to carry out inspection and fault detection technology for power grid and other assets monitoring using wireless sensor network.
- **E3. Assets Monitoring.** Integrated miniature air vehicles (MAVs) for persistent intelligence, reconnaissance, maintenance and surveillance for obscured or logistically challenging assets in non-urban environments have been developed. The system converges towards an error-free state with self stabilization, and has an ability to fall back to a safe mode.
- **F1. GPS-Denied Navigation and Augmentation.** Future of intelligence, surveillance and reconnaissance missions involve GPS-denied environments. GPS spoofing and jamming are immediate threats. Our research focus on vision Guided Navigation of Unmanned Air Vehicles.
- **F2. Image-Based Navigation.** This research finds use of GPS denied environments and vision guidance in other applications on diverse platforms. One goal is to develop a self-calibrating image-navigation system. In this process we have develop methods to establish and verify current location based on man made and natural landmarks characteristics from available data bases and available imagery from camera systems.
- **F3. Characterization of Mountain Signature.** We extend the GPS-denied missions in mountain areas, with no assumption of human-made geographic objects. We leverage the analogy between mountain drainage patterns, human arteriogram, and human fingerprints, to match local drainage patterns to parallax occlusion maps of geo-registered radar returns.

6.b. Student Research Supervision:

6.b.1. Post-Doctoral Fellows and Visitors:

1. Dr. Ofer Peleg, Post Doctoral Fellow, Israel, (1994-95)
2. Dr. Siva Ram Murthy, Visiting Faculty, IIT India (1996-97)
3. Dr. G. Mohan, Post Doctoral Fellow, IIT India (1999-2000)
4. Dr. Ashwin Gumaste, Visiting Faculty, IIT Bombay, India (2007-2008)
5. Dr. Z. Le, Visiting Faculty, China, (2008)
6. Koray Celik (Spring 2013- Spring 2015)
7. Mayank Mishra (Nov 2015-June 2017)

6.b.2. PhD Student Supervision:

1. SangBang Choi (Sum 90), "Hypercube Architectures to Embed Arbitrary Permutations." Committee members: Professors James S. Meditch(EE), M. Soma (EE), Robert J. Marks(EE), and J. Baer (CSE). Currently a Professor at the Inha University, Korea.
2. Garrison Greenwood (Sum 92), "A Methodology for Mapping Pipelined Algorithms onto Hypercube Array." Committee members: Professors G. Borriello (CSE), M. Soma (EE), L. Shapiro (CSE/EE), V. Klee (Mathematics), J. Hwang (EE). Currently at Portland State University, Portland OR.
3. Craig Wittenbrink (Spr 93), "Designing Optimal Parallel Volume Rendering Algorithms." Committee members: Professors T. Derose (CSE), R. Haralick (EE), L. Shapiro (CSE/EE), M. Gantor (ME). Currently at the nVideo Labs.
4. C. Chen (Sum 93), "High-Performance High-Integrity System design: Architectural Tradeoff Methodology and A Cache Error Recovery Protocol." Committee members: Professors J. Baer (CSE), L. Shapiro (CSE/EE), M. Soma (EE). Currently an Associate Professor at the National Yunlin Institute of Technology, Touliu, Yunlin, ROC of Taiwan.
5. Kisang Song (Sum 94), "Fault Tolerant ATM Backbone Network Design and Resource Management of LAN/MAN Interworking." Committee members: Professors J. Meditch (EE), G. Zick (EE), E. Riskin (EE), Grad School Rep. He is going to join Electronics and Telecommunication Research Institute (ETRI) at Taejeon Science Town, Korea.
6. David Fura (Aut 94), "Abstract Interpreter Modeling and Verification Methods for Dependable Embedded Hardware Systems." Committee members: Professors G. Borriello (CSE), M. Soma (EE), L. Shapiro (CSE/EE), A. Shaw (CSE). Has his own small scale business based on his dissertation work.
7. Tushar Sarnaik (Passed Qualifying and General Examinations, did not complete the final defence due to job situation), "HUV Concept: Applications and Performance." Committee members: Professors J. Baer (EE), M. Soma (EE), W. Moritz (EE).
8. Suresh Subramaniam (Sum 1997), "Role of Wavelength Converters in all-optical networks." Committee Members: Professors J.S. Meditch, M. Azizoglu, Richard Ladner, E. Riskin. Currently working as an Associate Professor at George Washington University.
9. Govindrajan Krishnamurthy (Sum 1999), "Location management and fault Tolerance Issues in Mobile Networks." Committee Members: Professors Soma Chaudhari, Doug Jacobson, Julie Dickerson. Works for Nokia Research, Boston. Received Research Excellence Award.
10. Li Ling (Spring 2000), "Dynamic Wavelength Routing in Multifiber WDM Networks." Committee Members: Professors Satish Udpa, Jim Davis, G. Manimaran. Works for CIENNA, Boston. Received Research Award.
11. Raed Al-Omari (Sum 2001), "Controlling Schedulability-REliability Trade-Offs in REal Time Systems." Committee Members: Professors G. Manimaran, Murti Salapaka, S. Chaudhuri. Works for IBM Research, Austin. Received Research Excellence Award.
12. Huesung Kim (Sum 2001), "Towards Adaptive Balanced Computing (ABC) using Reconfigurable Caches (RFC)." Committee Members: Professors G. Manimaran, A. Tyagi, G. H. Lee, S. Kothari. Works for Intel, Austin. Received Research Excellence Award.
13. Sashisekaran Thiagarajan (Fall 2001) "Traffic Grooming and Wavelength Conversion in Optical Networks." Committee Members: Professors G. Manimaran, A. Kamal, S. Chaudhuri, R. Weber. Works for Cienna Research, Baltimore. Received Research Excellence Award.
14. Seongwoo Kim (Fall 2001) "Integrity Monitoring in Microprocessor." Committee Members: Professors A. Tyagi, G. Lee. S. Kothari. Works for Intel, Portland. Received Research Excellence Award.
15. S. Ramasubramanian (Sum 2002) "A Generalized Framework for Analyzing Time-Space Switched Optical Networks." Committee: Professors G. Manimaran, A. Kamal. R. Weber, and S. Sethuraman. Faculty member at University of Arizona. Received Research Excellence Award.

16. M. Sridharan (Sum 2002) “Design and Operation of Mesh-Restorable WDM Networks.” Committee: Professors G. Manimaran, M. Salapaka, A. Kamal, and S. Chaudhuri Works for Microsoft, Seattle, WA.
17. Rama Sangireddy (Sum 2003) “On-Chip Adaptive Components for Balanced Computing.” Committee: Professors A. Tyagi, S. Kothari, M. Chang, and D. Fernandez-Baca. Faculty member at University of Texas, Dallas. Received Research Excellence Award.
18. Tao Wu (Sum 2003) “Attack Monitoring & Localization in All-Optical Network.” Committee Member: Professors A. Kamal, B. Ramamoorthy, D. Jacobson, S. Chaudhury, G. Mainmaran. Works for Microsoft, Seattle, WA. Received Research Excellence Award.
19. Jing Fang (Fall 2004) “Traffic Grooming in IP over WDM Optical Networks.” Committee Member: Professors A. Kamal, S. Chaudhury, G. Mainmaran, M. Mina. Works for Agnomy department, Iowa State University. Received Research Excellence Award.
20. Pallab Datta (Sum 2005) “Survivability Approaches for Multiple Failures in WDM Optical Networks.” Committee Member: Professors A. Kamal, S. Chaudhury, G. Mainmaran, M. Mina. Works for Sandia National Research Laboratory. Received Research Excellence Award.
21. Rohit Gupta (Sum 2005) “Protocols for Sharing Computing Resources and Dealing with Nodes’ Selfishness in Peer-to-Peer Networks.” Committee Members: Professors A. Tyagi, T. Daniels, D. Jacobsons, S. Tirathapura, J. Wang. Works for Amazon Company. Received Research Excellence Award.
22. Wensheng He (Sum 2006) “Survivable design in WDM mesh networks.” Committee Members: A. Kamal, G. Mainmaran, D. Jacobson, and L. Ruan. Works for software industry.
23. Nathan Vanderhorn (Spring 2007) “Fiber Optic Networks: Access Controls, Fairness and Prototyping.” Committee Members: A. Kamal, M. Mina, R. Weber, and C. Bergman. Works for Rockwell Collins, Cedar Rapids, IA.
24. Srivatsan Balasubramaniam (Spring 2007) “Design and Protection Algorithms for Path Level Aggregation of Traffic in WDM Metro Optical Networks.” Committee Members: A. Kamal, L. Ruan, R. Weber, D. Fernandez Baca. Works for CISCO, San Francisco.
25. Michael Frederick (Spring 2008) “Beyond the Arithmetic Constraint: Depth-Optimal Mapping of Logic Chains in LUT-based FPGAs.” Committee Members: A. Tyagi, D. Rover, J. Zambreno, S. Aluru, and D. Fernandez-Baca.
26. Viswanathan Subramaniam (Fall 2009) “Timing Speculation and Adaptive Reliable Overclocking Techniques for Aggressive Computer Systems.” Committee Members: A. Tyagi, R. L. Geiger, J. A. Zambreno, D. Fernandez-Baca, S. K. Gadia.
27. Prem Kumar Ramesh (Spring 2011) “Aggressive and Reliable High-Performance Architectures - Techniques for Thermal Control, Energy Efficiency, and Performance Augmentation.” Committee Members: Akhilesh Tyagi, David Fernandez-Baca, Zhao Zhang, and Joseph Zambreno.
28. Jinxu Ding (Fall 2012) “Policy Driven Capacity Expansion Planning of Energy Infrastructure: Modeling and Solutions using High Performance Computing.” Committee Members: Nicola Elia, James McCalley, Peter Sherman, and Zhao Zhang. Received Research Excellence Award.
29. Prasad Avirneni (Fall 2012) “RAKSHA:Reliable and Aggressive framewoRK for System design using High-integrity Approaches.” Committee Members Akhilesh Tyagi, Joseph Zambreno, Phillip Jones, David Fernandez-Baca, and Zhao Zhang. Received Research Excellence Award.
30. Lizandro Damian (Fall 2012) “Parallelization and checkpointing of GPU applications through program transformationParalleli.” Committee Members: Brett Bode, Akhilesh Tyagi, Zhao Zhang, Shashi Gadia.
31. Koray Celik (Fall 2012) “Vision Guided Navigation.” Committee Members: Steve Holland, Namrata Vaswani, Akhilesh Tyagi, Peter Sherman, and Zhao Zhang. Received Research Excellence Award.

32. Pavan Gorti (Spring 2014) "Application aware performance, power consumption, and reliability trade-off." Committee Members: Akhilesh Tyagi, Joseph Zambreno, Philip Jones, and David Fernandez Baca.
33. David Lastine (Summer 2014) "Efficient communication using multiple cycles and multiple channels." Committee Members: James Cochran, Ahmed El-sayed Kamal, Mani Mina, Robert J Weber.
34. Cory Kleinheksel (Spring 2016), "Efficient Computation and Communication Management for All-Pairs Interactions." Committee Members: Shashi Gadia, Manimaran Govindarasu, Suresh Kothari, and Srikanta Tirthapura.
35. Teng Wang (Summer 2016) "Augmented navigation in GPS denied terrain environments using synthetic vision." Committee Members: Joseph Zambreno, Nicola Elia, Namrata Vaswani, and Peter Sherman. Received Research Excellence Award.
36. Parijat Shukla (Fall 2017) "Efficient Similarity Computation for Semi-structured Data using Data Shaping." Committee Members: Akhilesh Tyagi, Joseph Zambreno, Zhao Zhang, and Siggı Olafson.
37. Pratik Mishra (Spring 2018) "Host managed storage solutions for Big Data," Committee Members: Akhilesh Tyagi, Anuj Sharma, Chinmay Hegde, and Siggı Olafson.
38. Piyush Lakhawat (Fall 2018) "Knowledge discovery techniques for Transactional data model," Committee Members: Jack H. Lutz, Joseph Zambreno, Phillip H. Jones, Yong Guan, Zhengdao Wang.
39. Ravikiran Yeleswarapu (Spring 2020), "Addressing multi-bit errors in DRAM/memory subsystem," Committee Members: Zhao Zhang, Akhilesh Tyagi, Phillip H. Jones, and Sigurdur Olafsson.
40. Krishna Teja Chitty-Venkata, started in Fall 2017 (passed Qualifying Examination).
41. Yiming Bian, started in Spring 2020, (will take Qualifying Examination in Fall 2020).

6.b.3. MSEE/MSCS Students Supervision:

1. SangBang Choi (Aut 87), "Performance and Reliability Analysis of Some Fault-Tolerant Multistage Interconnection Networks."
2. Glen Fujimori (Win 88), "Logical Decomposition of System-Level Requirements, Potential Problems and Some Design Solutions for Fault Tolerant Distributed Computing Systems."
3. Saurabh Sonawala (Win 88) "An Echo-Back Bus Protocol for Fault-Tolerant Computer Systems."
4. Phyllis Li (Spr 88), "Comparison of the Hypercube-based Compact Neural Network With Other Artificial Neural Networks."
5. Steven Yee (Sum 88), "Interpolated Character Generation."
6. Narong Penla (Sum 88), "Reduced Interconnection Neural Networks and a Simulation Environment to Study Them."
7. Merat Bagha (Aut 88), "Meshkin: A Distributed Fault Tolerant Computer Architecture."
8. Godfrey D'Souza (Aut 88), "Diagnosis and Consensus in Distributed Systems"
9. Duane Koehler (Aut 88), "STEED - A Testability Enhancement Expert Design System."
10. Joseph Ho (Win 89), "Specification and Process Scheduling for Real-Time Computing."
11. Derek J. Van Alen (Spr 89), "An All Digital Phase Locked loop Implementation of a Fault Tolerant Clock."
12. Bert Sullam (Spr 89), "Implementation Issues in a Mesh-Based Fault Tolerant Computer Architecture."
13. Ho Shyan Lin (Sum 89), "High-Performance Comparison-Based Cache-Aided Rollback Recovery Computing Systems."

14. Katherine Buhler (Sum 89), "Design of Dependable Broadband Switching Architectures."
15. Min Lee (Aut 89), "A Comparative Study of Synchronous and Non-Synchronous Transmission Algorithm on a Replicated Token Bus Network."
16. Anatoly Menn (Aut 89), "An Efficient Sorting Algorithm for the Star Graph Interconnection Network."
17. Sanjay Thatte (Wint 90) , "Helical Hypercube."
18. Virgil Bourassa (Spr 90), "The MaRFT and RPM - Massively Redundant and Reconfigurable Architectures for Fault-Tolerant/Parallel Computing."
19. Glenn Yu (Spr 90), "An Incremental Distributed Diagnosis Algorithm for Multiprocessor Systems."
20. H. Stephen Au (Sum 90), "Phased Mission Reliability Analysis."
21. Alex Bobotek (Sum 90), "An Inherent-Testability-Analysis Technique for Digital Design."
22. Craig Wittenbrink (Sum 90), "Directed Data Cache for High Performance Image and Graphics Processing."
23. Tushar Sarnaik (Aut 90) "Analysis and Comparison of Two Fault Tolerant Computer Architectures."
24. D.D. Nguyen (Aut 90) "Achieving Fault in Memory-Processor Communication."
25. Tuan Le (Win 91), "A design and Analysis of Fault Tolerant Digital Autonomous Terminal Access Communication."
26. Mike A. Csoppensky (Sum 91) "Efficient Distributed Routing Algorithms for a Synchronous Circuit-Switched Hypercube."
27. Linda Bender (Sum 91) "A Performance Comparison of the MIPS R4000 and Intel i860."
28. Jay Choi (Aut 91) "Linear Chains Allocation in Hypercubes."
29. Theodore Yeung (Aut 91) "ARINC 629 Buses in A Fault Tolerant Integrated Modular Avionics Systems."
30. Mike Harrington (Aut 91) "Synchronizing Distributed Networks in the Presence of Faults."
31. Farid Mamaghani (Win 92) "Parallel Algorithms and Pipelined Architectures for Determination of Line of Sight Visibility."
32. Han K. Gim (Win 92) "Software Fault Tolerance: Research and Applications."
33. Samir Palnitkar (Spr 92) "Reliability Modeling of latent and Blind Failures in Scheduled Maintenance Systems Using Markov Chains."
34. J. Wang (Spr 92) "Probabilistic Diagnosis in Wafer Scale Systems."
35. TianMing Zhang (Spr 92) "Achieving Almost-Free Fault Tolerance in Dilated Banyan Networks."
36. Tuan Phan (Wint 93) "Programming Vision Algorithms on Proteus."
37. Upender Reddy (Sum 93) "Exploring Idle Capacity for Fault Diagnosis in Multiprocessor Systems."
38. Alok Gupta (Win 94) "Transient fault Detection in Computer Network using SNMP Protocol."
39. Benjamin Sklar (Spr 94) "Ray Tracing: Parallelization via Image Decomposition and Performance Impact."
40. Kevin Simonson (Aut 94) "Sorting Machines."
41. Girija Govind (Win 96) "Simulation and Analysis of Fault-Tolerant Caching Schemes."
42. Allen Sansano (Win 96) "Minimizing Overhead in Parallel Algorithms Through Overlapping Communication/Computation and Its Implementation on the Proteus Parallel Computer."

43. Seongwoo Kim (Aut 96) "Shadow Caching for Cache Fault Tolerance."
44. A. Anand (Spr 97) "Hierarchical Analysis of Fault Trees with Dependencies, Using Decomposition."
45. T. Sakaguchi (Spr 97) "Hierarchical Stochastic Reward Net."
46. M. Bhaskar (Win 98) "Performance Improvement for TCP During Interference in Mobile Computing."
47. D. Deshpande (Fall 98) "Configuration Scheduling Schemes for Striped FPGAs."
48. Wei Zhao (Sum 1999) "Hierarchical Petrinet Description Methods."
49. Indu Peddibothala (Sum 1999) "Experimental Verification of IRTCP."
50. Sudheer Matta (Spr 2000) "Mobile Aware IRTCP."
51. Jim Ng (Spr 2000) "A Heuristic Approach to Variable Ordering in Binary Decision Diagrams."
52. Joel Nickel (Fall 2000) "REESE: A Method of Soft Error Detection in Microprocessors."
53. Zulfiqar Hussain Sarosh (Fall 2000) "Configuration cache-Management systems for Striped FPGAs."
54. Liang Zhang (Spr 2001) "A Real Time Music Recognition and Display System."
55. Jian-Wei Zhou (Sum 2001), "A New Localize Approach to Distributed Fair Scheduling in Multihop Wireless Networks." s for Intermediate Processing at Routers in the Internet."
56. Sonal Pandey (Fall 2001), "Mechanisms and protocols for intermediate processing at routers in the Internet."
57. Dazhi Zhang (Sum 2002), "Fairness and Fairness, An Interpretation and Application in Ad-Hoc Wireless Networks."
58. Aaron Cordes (Sum 2002), "Parallelization of Image Processing Applications."
59. Nathan Vanderhorn (Fall 2002), "RDF network: A high-speed option for Metropolitan Area Networks."
60. Wheng-Sheng He (Fall 2002), "Capacity Optimization for Surviving Double-Link Failures in Mesh-Restorable Optical Networks."
61. Mike Frederick (Fall 2002), "A Single FAULT Recovery Strategy for Optical Networks Using Subgraph Routing."
62. Adeel Israr (Fall 2002), "CBCA: Balanced Cache Checkpointing for Superscalar Processors."
63. Rakesh Raghavan (Spring 2003), ICEI TCP: Implit Congestion and Explicit Interference Detection in TCP."
64. Jinran Chen (Spring 2003), "Fairness in Wireless Ad-Hoc Network in the Presence of Channel Errors."
65. Nitin Jose (Sum 2003), "Connection rerouting for network reconfiguration."
66. Yana Ong (Sum 2005), "Iowa State Optical Simulator (ISTOS): Design, Architectures and Features."
67. V. Sekhri (Sum 2005), "CompuP2P: A Light-Weight Architecture for Internet Computing."
68. G. Subramaniam (Spring 2006), "Control Caching: A fault-tolerant architecture for SEU mitigation in microprocessor control logic."
69. M. Bezdek (Sum 2006), "Utilizing timing error detection and recovery to dynamically improve super-scalar processor performance."
70. D. Lastine (Spring 2007), "An examination of single link failure in an optical network with full grooming."
71. Kamna Jain (Fall 2007), "D-RDF: Dynamic Resource Description Framework."

72. Zachary Schmid (Sum 2009) started with thesis graduated with M. Eng.
73. Kritanjali Balakrishanan (Sum 2009) started with thesis graduated with M. Eng.
74. Nishant Reddy (Sum 2009) “Network coding in Wireless Networks.”
75. Somya Gupta (Fall 2009) started with thesis graduated with M. Eng.
76. Harini Sundararaman (Fall 2010) started with thesis graduated with M. Eng.
77. Mani Ganesh (Fall 2010), “Complex Event Processing Models.”
78. Suresh Shankaran (Summer 2011) “Impairment Aware Cycle Based Routing Algorithm (IACBRA).”
79. Ashish Daga (Fall 2013) “Schedulability Modeling & Verification & Using Model Checking in Uppaal.”
80. Joy Shukla (Fall 2014), “Hybrid Drive Design: An Economics-Workload Based Approach.”
81. Haoyuan Lin (Summer 2015), “Foreign object detection (FOD) using multi-class classifier with single camera vs. distance map with stereo configuration.”
82. Karthik Subramanya (Summer 2016), “Predicting Customer attrition for an e-retailer through the power of Big Data.”
83. Rashmi Girmala (Spring 2017), “LowLEAC: Low Leakage Energy Architecture for Caches.”
84. Venkata-Kasi Yeleswarapu, (Summer 2017), “Efficient Parallel All-Pairs Computation Framework: using Computation - Communication Overlap.”
85. Sai-Abhyudhayreddy Ravula, (Fall 2017), started with thesis graduated with M. Eng.
86. Yiming Bian, (Spring 2020), “A Systematic Approach to All Cyclic Quorum Sets Computation.”
87. Md. Jawad Mashrur, Rahman, started Fall 2019.

6.b.4. Undergraduate Students Supervision: Regularly supervise a group of 4-6 students’ project every year as senior design or research experience for undergraduate.

6.c. Research Proposals or Grants:

6.c.1. Current and Pending Sponsored Research:

1. Iowa Economic Development Agency, “Enabling COVID-19 research activities via HPC infrastructure,” 11/1/20-3/31/2021, Total funding \$150,000 (PI, co-PI B. Ganapathysubramanian).
2. NSF, “NSF: MRI: Acquisition of a Shared High-Performance Computing System for Cyber-Enabled System Design,” 10/1/20-9/30/2023, Total funding \$600,000(PI, co-PIs B. Ganapathysubramanian, A. Sharma, C. Lawrence-Dill, S. Ryan, 35% effort). Being funded at \$600,000 with a match of \$257,200.
3. NSF, “CC* Integration: End-to-End Software-Defined Cyberinfrastructure for Smart Agriculture and Transportation,” 10/1/18-9/30/2021, Total funding \$9999,919(co-PI with PI Zhang and co-PIs Kamal, Sharma, Schnable, 15% effort).
4. NSF, “SHF: Small: Enhancing Memory System Dependability by Integrity Checking,” 7/1/16-6/31/21, Total funding \$438,500, (lead PI with Drs. Zhang 50% effort).
5. Virginia and Philip Sproul Professor, ISU, Approximately \$40,000/year from ECPE department, 2014-2024.

6.c.2. Completed Sponsored Research:

1. NSF, “MRI: Acquisition of a HPC System: Computing for Sustainability,” 8/16/17-8/15/19, Total funding \$678,216 from the NSF, with a matching of \$290,663 from ISU (lead PI, co-PIs Dr. A. Passalacqua, B. Ganapathysubramanian, C. Lawrence-Dill, and H. Rajan, 40% effort).

2. NSF, "MRI: Acquisition of a HPC System for Data-Driven Discovery in Science and Engineering," 8/16/12-8/15/16, Total funding \$1,841,346, with a matching of \$789,149 from ISU (lead PI with Drs. Aluru, Gordon, Fox, and Takle, 40% effort).
3. NSF, "II-NEW: Distributed Computing Laboratory for Large Scale System Modeling and Analysis," 8/16/12-8/15/16, Total funding \$350,000, (Lead PI with Drs. J. McCalley and S. Tirthapura, 60% effort).
4. Vermeer Corporation, "Foreign Object Detection," 5/16/13-6/30/15, Total funding \$300,000, (Co-PI with Dr. Raj Aggrawal, 50.00% effort).
5. Jerry R. Junkins Chair, ISU, Approximately \$75,000/year from ECPE department, 2002-2014.
6. NSF, "EFRI-RESIN: 21st Century National Energy and Transportation Infrastructures: Balancing Sustainability, Costs, and Resiliency (NETSCORE-21)," 9/16/08-9/15/14, Total funding \$1,983,226, (Co-PI with Drs. J. McCalley (lead PI), K. Gkritza, L. Wang, and D. Aliprantis, 16.67% effort).
7. NSF, "CSR-DMSS, SM: Design and Evaluation of a Scalable Meta-Event Dissemination System," 9/1/08-9/1/13, Total funding \$432,000, (Co-PI with Dr. S. Tirthapura, 50% effort).
8. Rockwell Collins, "Refined Map-Aided Navigation for Aerial Platforms," 11/21/12-9/30/13, Total funding \$75,000.
9. Rockwell Collins, "Aerial Image Navigation using Geo-Referenced Landmarks," 1/1/11-10/31/12, Total funding \$50,000.
10. Rockwell Collins, "On-the-fly Lens Calibration for Image Navigation and Map-aided Navigation," 10/1/10-9/30/11, Total funding \$100,000.
11. Dept. of Education, "Graduate Assistantship in the Area of National Needs (GAANN)," 8/16/06-8/15/11, Total funding \$520,000.
12. ISU, "ICUBE: Information Infrastructure Institute," A Presidential initiative at ISU funded to support a faculty position and research support, (PI with Co-PIs Drs. V. Vittal and S. Kothari), 8/16/02-8/15/11, \$400,000. Additional support of \$100,000 per year.
13. NSF, "NeTS-NBD: Survivable Multipoint Traffic Grooming in Optical Networks," 8/1/06-8/1/11, Total funding \$318,000, (Co-PI with Dr A. Kamal).
14. NSF, "CRI: IAD Acquisition of a cluster and high performance storage for data-intensive applications in Materials Science, Power Systems and Systems Biology," 4/1/08-4/1/11, Total funding \$719,000 + match of \$400,000 from ISU sources, (Co-PI with Drs. Aluru (lead PI). J. McCalley, and M. Aluru).
15. NSF, "CSR: Small: Meta Analysis Directed Execution," 9/1/09-12/31/10, Seed funding \$100,000, (Co-PI with Drs. A. Tyagi and S. Gadia). Received additional funding for REU \$16,000.
16. Rockwell Collins, "Real-Time Image Navigation and Mapping," 10/1/09-9/30/10, Total funding \$100,000.
17. NSF, "NeTS-NR: Evolutionary architectures for ultra-broadband access networks," 9/01/04-8/31/09, Total funding \$450,000, ISU Funding \$162,075. (PI from ISU in collaboration with Co-PI S. Subramaniam of GWU and S. Ramasubramaniam of UA). Additional REU support of \$12,000.
18. NSF, "SST-Sensor Network Design For A Secure National Electric Energy Infrastructure," 9/01/04-8/31/09, Total funding \$400,000. (PI, Co-PIs Vijay Vittal, Zhendao Wang, G. Manimaran, and M. Salapaka). Additional REU support of \$6,000.
19. Rockwell Collins, "Enhancement of Microcode Development Tools," 8/1/07-12/31/08, Total funding \$39,000.
20. Rockwell Collins, "3-D Localization and Optical sensor)," 8/1/07-12/31/08, Total funding \$49,000.
21. NSF, "Integrity Monitoring and Recovery Techniques for Next Generation Submicron Microprocessors," 8/01/03-10/31/08, Total funding \$240,200, (sole PI). Additional REU support of \$18,000.

22. NSF, "MRI: Acquisition of a 512-node BlueGene/L Supercomputer for Large-Scale Applications in Genomics and Systems Biology," 8/1/05-8/1/08, Total funding \$600,000 + match of \$300,000 and additional match of \$720,000 from ISU sources, (Co-PI with Drs. Aluru (lead PI). R. Jernigan, and P. Schnable).
23. NSF, "High Speed System Engineering," (Co-PI with Drs. M. Mina and R. Weber), 8/25/03-8/15/07, Total funding \$512,096. Additional REU support of \$12,000.
24. NSF, "NR: Collaborative Research: Wavelength Sharing Mesh-Restorable Optical Networks," (PI from ISU in collaboration with Dr. K. Sivalingham, 9/1/03-8/31/07, Total funding \$371,000, ISU Funding, \$197,000, First Two Year Funding \$131,471. (PI from ISU). Additional REU support of \$12,000.
25. NSF, "Routing, Wavelength Assignment, Dimensioning and Performance of Optical Networks with Multicast Service," (Co-PI with Dr. A. Kamal), 8/15/2001 - 8/15/2006, \$236,000. Additional REU support of \$12,000.
26. Lockheed Martin Company, "Developing an Innovative Software Engineering Education Program," (Co-PI with Dr. S. Kothari), 02/01/02-01/31/07, \$165,000.
27. ITN Corporation, "Subsystem Fault Detection in Sensor Networks," Subcontract from an NSF SBIR grant, (sole PI) , 07/01/05-07/12/05, \$14,000.
28. Lockheed Martin Company, "Optical Networking," \$50,000, 1/1/03-12/31/05. (sole PI)
29. NSF, " Exploring Architectures and Algorithms for Optical Networks (Collaborator Dr. S. Subramaniam of GWU)," 8/16/99 - 8/15/04, \$333,553 for ISU's work (total \$510,000).
30. DARPA (subcontract from GWU), "FAMOS: Fault and Attack Management in Optical Networks," 5/15/00 - 11/14/03, \$471,000 for ISU work. (Total including GWU funding is \$ 2.4 Million).
31. NSF, "Adaptive Balanced Computing Architectures (With Dr. A. Tyagi)," 8/16/99 - 8/15/03, \$350,000.
32. NSF, "REU Program," 8/16/99-8/15/03, \$60,000 (6 grants of \$10,000 each).
33. NSF, "Robust Resource Management in Real-Time Systems with Feedback," (Co-PI with Drs. G. Manimaran and M. Salapaka), 3/1/2001 - 2/28/03, \$110,000.
34. Nicholas Professorship, ISU, \$35,000/year + \$40,000/year from ECPE department, 1997-2202.
35. Lockheed Martin Company, "Real-Time Software for CAVE (common Avionics Vehicle Environment) Multiprocessor System," (Co-PIs Drs. S. Kothari and G. Manimaran), 02/01/00-01/31/01, \$50,000.
36. Craver Trust, "Reliability of Future Processors," 7/1/00 - 6/30/01, \$10,750.
37. NSF, "Extent and Effects of Error Propagation and Recovery Mechanisms in Cache Memory Systems (PI)," 9/16/96 - 8/15/00, \$180,000.
38. NSF, "Issues in Design of Lightwave Networks with Sparse Wavelength Conversion (Co-PI M. Azizoglu)," 9/16/96 - 8/15/00, \$338,395.
39. Innovative Medical Devices, "Music Artists' Assistant Design of a Music Display/Follow System," 6/1/99 - 5/31/00, \$113,000.
40. Craver Trust, "ABC:Adaptive Balanced Computing," 7/1/98-6/30/99, \$25,000 (Co-PI Dr. A. Tyagi).
41. Boeing, "Development of Markov Modeling Tools for Analysis of Fault Tolerant Systems (PI)," 1/1/91 - 12/31/98, \$475,000 (\$75,000 for 1997, \$50,000 for 1998).
42. Allied Signal, "Analysis Techniques for Integrated Avionics Systems (PI)," 6/16/97 - 9/15/98, \$95,000.
43. NSF, "Error Detection and Recovery in High Performance Fault Tolerant Processor Systems Employing Caches (PI)," 7/1/93 - 12/31/96, \$159,332.
44. Royalty Research Funds, UW, "Management of Remote Connectionless Multimedia Service through ATM Network (PI)," March 16, 1995 - June 15, 1996, \$20,700.

45. NSF, "Congestion Control and Fault Tolerance in Broadband-ISDN computing (PI with Professor James S. Meditch)," 8/16/91 - 7/15/95, \$461,620.
46. Boeing Advance Systems, "Cash gift," 1990 - 1994, \$10,000.
47. NASA Headquarters, "A study of Parallel Architectures and Algorithms for Volume Rendering," 7/1/91 - 6/30/93, \$44,000.
48. WTC, "Design of high integrity systems (PI)," 7/1/91 - 6/30/93, \$50,000.
49. Navy Coastal System Center, "Automatic classification hardware development," Investigators with G. Harkins, L. Shapiro, J. Hwang, T. Phillips, PI: Robert M. Haralick, 1/1/90 - 12/31/93, \$2,179,750.
50. Novell Inc., "Fault management in local area network (PI)," 2/1/91 - 9/15/91, \$20,365 (Cash), \$19,380 (Software and Hardware gifts).
51. WTC, "Design of high integrity systems (PI with Mani Soma), 7/1/88-6/30/91, \$135,400.
52. Intel Corp., "Processor pipeline architecture using i860 (PI)," 7/1/90 - 6/30/91, \$35,750 (H/W).
53. Boeing Aerospace Co., "Reliability analysis and modeling methodology (PI)," 3/16/88 - 9/30/90, \$80,320.
54. Boeing Electronics Co., "Methodology and design of an architecture for fault tolerant embedded systems (PI)," 11/1/86 - 9/30/89, \$113,642.
55. Boeing Aerospace Co., "Architectural Analysis of a fault tolerant architecture for embedded systems (PI)," 1/16/88 - 9/30/89, \$40,947.
56. Texas Instruments, "Microprogramming laboratory development (PI)," 9/1/88 - 6/30/89, \$18,478 (H/W).
57. Boeing Electronics Co., "Analysis and application of neural networks," Co-investigator with PIs: Robert Marks and Les Atlas, \$75,000 (1986), \$50,000 (1987).
58. University of Washington, "Equipment grants," \$10,000 (Graduate School), \$10,000 (College of Engineering), \$10,000 (Department of Electrical Engineering).
59. ASEE Career Advancement Opportunity Grant, "\$2,000 to attend Digital Signal Processing course (G. Tech) 1987," and "\$1,500 to attend VLSI System Design course (MIT), 1988."

7. Service Activities:

7.a. Professional Societies and Editorship:

- Member of IPSJ/IEEE-CS Joint Award Committee Member, 2019 and 2020.
- Fellow AAAS, elected for "distinguished contributions to the theory and practice of dependable computing and networking systems, including design, development, implementation, and building experimentation platforms," 2012.
- Fellow IEEE, elected for "contributions to theory and applications of computer networks," 1999.
- ACM Distinguished Engineer, 2006. ACM Member since 1986.
- Member (Fellow) IEEE Computer Society, 1986-Contd.
- Member (Fellow) IEEE Communication Society, 1995-Contd.
- IEEE Communication Society Distinguished Lecturer 2009-13.
- IEEE Distinguished Speaker 2000-02.
- IEEE Distinguished Tutorial Speaker 2000-02.

- ABET Evaluator, 2003-Contd.
- Eminent Engineer, Tau Beta Phi, 2013- Contd.
- Member Golden Key International Honor Society.
- Steering Committee, Optical Network Technical Group, SPIE.
- Editor Electronic New Letter, IEEE Technical Committee on Fault Tolerant Computing, 1992-97.
- Editor of Special Issue of IEEE Computer Magazine on Fault Tolerance, April 1997.
- co-Editor of Special Issue of IEEE Network Magazine on Optical Networking, 2000.
- co-Editor of Special Issue of Optical Networks Magazine on Wavelength Conversion, 2000.
- co-Editor of Special Issue of MONET, 2000.
- Editor of Elsevier Microprocessor and Micro-systems Journal, January 1996 - December 2006.
- Associate Editor of IEEE Transactions on Computers, 1997-2002, 2012-2016.
- Associate Editor of IEEE/ACM Transactions on Networking, 2003-2009.
- Associate Editor of Elsevier Computer Networks Journal, 2003-2016.
- Associate Editor of Elsevier Optical Switching and Networking (OSN), 2004-Contd.
- Member Editorial Advisory Board, Journal of Pervasive Computing and Communications, 2005-2015.
- Editorial Board, International Scholarly Research Network (ISRN) Communications and Networking Journal, Hindawi Publishing Corporation, 2010-2014.

7.b. Organization Activities of International Conferences and Forums:

- General Chair, SSICC-2019, Second International Conference on Smart IOT Systems: Innovations in Computing, Jaipur, India January 2019.
- General Chair, SSICC-2017, Smart Systems, Innovation, and Computing Conference, Jaipur, India April 2017.
- Technical Program Chair, IEEE/ICC 2014, Optical Networks and Systems Symposium.
- General Chair, IEEE EIT 2008, held at Ames, IA, May 2008.
- General Chair, Broadnets 2005, held at Boston MA, October 2005.
- General Chair, IEEE FTCS-27, held in Seattle WA, June 1997.
- Technical Program Co-Chair, RNDM 2016.
- Technical Program Chair, IEEE/SPIE OPTICOMM 2003.
- Technical Program Chair, IEEE ICCCN 1999.
- Technical Program Chair, Advances in Computing (India) December 1997.
- Technical Program Chair, IEEE Workshop on Mixed Signal Testing, 1991.
- Tutorial Chair, IEEE FTCS, 1999.
- Tutorial Chair, IEEE ICC, 1995.
- Track Chair: Networking at IEEE PCCC, Phoenix, AZ, March 1992, 1994.
- Session Chair at several conferences.

- Program Committee Member: Fault tolerant computing symposium, 1991, 1994, 1996, 1997, 1998, 1999, Dependable Systems and Networks, 2003, 2004, 2014, 2015, 2016, 2017, 2018, Performance and Dependability Symposium, 2004-2013 (every year), Performance and Reliability 2002, Workshop on fault Tolerant Parallel and Distributed Computing, Amherst, 1992, 1994, EURO Parallel and Distributed Computing, 1998, Defect and Fault Tolerance in VLSI Systems, 1992, 1993, IEEE Phoenix Conference on Computers and Communications, 1992-2008 (every year), Heterogeneous Parallel and Distributed Computing, 1993, Asian Test Symposium, Tokyo, Japan, 1994, Reconfigurable Bus Architecture Workshop, 1994, 1995, 1996, Pacific Rim Fault Tolerant Computing Conference, 1995 - 2013 (every year), IEEE ICCCN, 1995, 1998 to 2009 (every year), IEEE INFOCOM, 1996, 1997, 1999, 2001, 2003, 2006-2017 (every year), IEEE ICC 2004-2018 (every Year), IEEE Globecom 2005-2017 (every year), SPIE Opticomm 2000, 2001, 2002, IPDS, 1996, 2003, 2004, HiPC, 1996, IPDS, 1998, Intl. Conf. On Comp. Sci. and Informatics (CS&I 2000), Australasian Computer Architecture Conference (ACAC-2000), HPSR 2004, 2005, IEEE HASE 2005, ONDM 2003, 2004, 2005, DRCN 2003, 2005, 2009, 2015, 2016, European Dependable Computing Conference, 2006, DISC 2007, Broadnets 2006-2009, IEEE LAN 2008, IEEE RNDM 2009-2018(every year), IEEE ANTS 2012-2018 (every year), IPCC 2012-2017 (every year), several others in India in 2016, 2017, and 2018.
- Panel Member
 - Reliability and Maintainability symposium, January 1994, Los Angeles, CA.
 - Hot Topics: Free Performance and Fault Tolerance, Sigmetrics, 1995.
 - Reliability and Maintainability symposium, January 1996, Las Vegas, NV.
 - Grooming in Switched Multilayer Transport Networks, ONDM 2003, Budapest, Hungary, 2003.
 - Optical Networking Research: Decline or Resurgence? - Broadnets 2006, San Jose, 2006.

7.c. Referee:

- **Funding Agencies:** National Science Foundation, 1990-2016; Qatar National Research Fund (QNRF), Qatar Foundation, 2008, 2009; HongKong Research Foundation, 2008; Natural Sciences and Engineering Research Council of Canada (NSERC), 2008-11, Korea-U.S. Science Cooperation Center, 2011-13.
- **Journals:** ACM Computing Surveys, IEEE Computers magazine,, IEEE Computer Network magazine, IEEE Software magazine, IEEE Transactions on Computers, IEEE Transactions on Embedded Computer Systems, IEEE Transactions on Dependable and Secure Computing, IEEE/ACM transactions on Networking, IEEE Transactions on Parallel and Distributed Computing, IEEE Transactions on Circuits and Systems, IEEE Transactions on Computer Aided Design, IEEE Transactions on Reliability, IEEE Transaction on Electronic Testing, Elsevier Transactions on Computer Communication, Elsevier Transactions on Computer Networks, Elsevier Transactions on Microprocessors and Microsystems, Journal of Parallel and Distributed Processing, SPIE Journal of Lightwave Technology, SPIE Journal of Networking, Theory and Applications, Progress in Neural Network, Journal of Algorithms, Journal of Computer Vision, Graphics and Image Processing, Journal of Parallel Computing, IEEE Proceeding.
- **Conferences:** Intl. Conf. on Parallel Processing, Symposium of Fault Tolerant Computing, International Parallel Processing Symposium, IEEE Phoenix Conference on Computers and Communications, International Symposium on Computer Architecture, International Conference on Computer Aided Design, Software Technology and Theoretical Computer Science, India, IEEE Symposium on Parallel and Distributed Computing, Sigmetrics, Hawaii International Conference, Defect and Fault Tolerance Workshop, High Performance Distributed Computing, International Conference on Parallel Computing, International Parallel Processing Symposium, High-Performance Computing, European Parallel and Distributed Computing, Optical Network Design and Modelling, Design of Reliable Communication Networks, High Performance Switching and Routing, European Dependable Computing Conference.

7.d. University Committees:

- ISU: Advisory Board Member, Iowa Energy Center, 2013-2016.

- ISU: Advisory Board Member, SP@ISU, 2013-Contd.
- ISU: Associate Dean for Graduate Education Committee, 2013-Contd.
- ISU: Graduate Council, Graduate College, 2012-2015.
- ISU: Chair of HPC@ISU, a university wide Steering committee to manage HPC, 2011-2015.
- ISU: Member of Vice President for Research Search Committee, 2013.
- ISU: Member of In-Trans Director Search Committee, 2011-12, 2012-13.
- ISU: Member of Chair's cabinet, 2005-2010.
- ISU: Member of Budget Model Review and Implementation Committee, 2006-2007.
- ISU: Member of Chief Information Officer Search Committee, 2003.
- ISU: Member of Computer Science Chair Search Committee, 2001.
- ISU: Information Science and Technology Task Force, 2000.
- ISU: Member of Committee on Academic Computing (CAC) 1999, 2000.
- UW: Special Committee on Minority Faculty Affairs (1989-93), Chair (1992-93).
- UW: Member of Royalty Research Fund Proposal Evaluation Committee (1993-95).

7.e. College Committees:

- ISU: COE: Associate Dean for Research and Graduate Education, 2013-Contd.
- ISU: COE: Chair of Search Committee to search for President High Impact Hires in Big Data area in CoE, 2013-14, 2014-15.
- ISU: COE: Chair of Search Committee to search for President High Impact Hires in Translational Health area in COE, 2013-14, 2014-15.
- ISU: Chair, Aerospace Department Chair Search Committee, 2009-2010. Search was successful.
- ISU: Member, College of Engineering, Engineering Fee Task Force (EFTF) 1998-2003.
- ISU: Member, Research Grant Evaluation Committee 1998-2001. Review of internal research proposals.
- ISU: Chair, EFTF Allocation Review Committee 1998-1999. Developed a simplified policy for proportional allocation of EFTF resources.
- UW: Member, ENGR Course Development Committee (1991-93).
- UW: Member, Student Affairs Committee (1993-94, 1995-1996).
- UW: Alternate Member, College Promotion and Tenure Committee, 1996-97)

7.f. ISU Departmental Committees:

- ISU: Chair of ECpE Promotion and Tenure Committee, 2012-2013.
- ISU: Member of ECpE Promotion and Tenure Committee, 2011-2012.
- ISU: Member of ECpE Research Committee, 2011-2013.
- ISU: Chair, ECpE, May 16-2003 - Sept 30, 2010.
- ISU: Director of Information Infrastructure Institute, 2002-Contd.
- ISU: Associate Chair for resources 2000-2003.

- ISU: Chair, Promotion and Tenure Committee 2000-02.
- ISU: Chair, Computer Usage Committee 1998-2003.
- ISU: Member, Computer Usage Committee 1997-98.
- ISU: Member, Governance Document Revision Committee 1998-99.
- ISU: Member, Promotion and Tenure Committee 1998-03.
- ISU: Member, Faculty Search Committee 1997-99, 2002-2003.
- UW: Member, Support Services Committee (1985-87).
- UW: Member, Admission Appeals Committee (1988-89).
- UW: Member, EE Faculty Search Committee (1988-89, 1990-91, 1993-94).
- UW: Chair EE Faculty Search Committee (1995-96).
- UW: Member, CSE Admissions Committee (1990-91, 1991-92).
- UW: Member, CSE Cheating Committee (1990-94, 1995-96).
- UW: Member, EE Graduate Study Committee (1990-91).
- UW: Member, EE Graduate Admissions Committee (1990-91).
- UW: Member, CSE Undergraduate Computer Architecture Course Committee (1990-91, 1991-92).
- UW: Member, EE Advisory Committee (1991-92, 1992-93).
- UW: Group Chair, Electronics and Computers Group in EE (1991-92).
- UW: Member, EE Computer Resources Committee (1991-92, 1992-93, 1993-94, 1995-96).
- UW: Member, CSE Curriculum Committee (1992-93).
- UW: In-charge, CSE 519 seminar series (1993-94).
- UW: Member, CSE/EE Building Committee (1995-1996).
- UW: Member, EE Promotion and Tenure Review Committee (1995-97).
- UW: Chair, CSE Graduate Student Review of Progress Committee (1995-96).
- UW: Member, CSE Qualifying Evaluation Committee (1996-97).
- UW: Group Chair for EE Digital Systems (1996-97).

7.g. Outside University:

- Executive Committee Member (2014-2019) for Digital Manufacturing and Design Innovation Institute representing Iowa State University as Tier I partner. DMDII was funded at \$70M by federal government with a promised \$140M industrial and partner cost share as part of NNMI - National Network for Manufacturing Innovation program.
- Executive Committee Member (2018-22) for REMADE Institute representing Iowa State University as Tier I partner. REMADE has been funded at \$70M by federal government with a promised \$140M industrial and partner cost share as part of NNMI - National Network for Manufacturing Innovation program.
- Member of Board of Trustees, Hindu Temple and Cultural Center (HTCC), 1991-997.
- Served as Treasurer (1990-92), Vice Chairperson (1992-93) and Chairperson of the Board of Trustees, HTCC, Seattle, 1993-95.

- Member of the Executive Committee of India Association of Western Washington (IAWW), 1993.
- Member of Board of Trustees, Hindu Temple and Cultural Center of Iowa (HTCC-CI)1999-2014.
- Treasurer, HTCC-CI, 1999-2005.
- Vice President and Member of Executive Board of Indian Cultural Association, Ames, Iowa, 2006-2007.
- Member of Executive Board of Indian Cultural Association, Ames, Iowa, 2017-2018.

8. Invited Lectures and Seminars:

- Panel Member, Reliability and Maintainability Symposium, January 1994, Los Angeles, CA.
- Panel Member, Reliability and Maintainability Symposium, January 1996, Los Angeles, CA.
- “WDM and Wavelength Conversion,” at Washington State University, July 1996.
- “Design decision in Proteus system,” at
 - University of California, Irvine, April 1993
 - Wollongong University, Wollongong, Australia, December 1993;
 - University of Newcastle, Newcastle, Australia December 1993.
 - University of Illinois, Urbana-Champaign, April 1994;
 - NASA Lewis Research Center, Cleveland, OHIO, July 1994;
 - NASA Langley Research Center, Norfolk, VA, July 1994;
 - Monash University, Melbourne, Australia, June 1995,
 - Flinders University, Adelaide, Australia, June 1995;
 - Australian National University, Canberra, Australia, June 1995;
 - University of N.S.W., Sydney, Australia, June 1995;
 - Queensland University, Brisbane, Australia, June 1995;
 - Old Dominion University, Norfolk, VA., October 1995;
 - Texas A & M, College Station, TX, May 1996; and
 - INPG, Granoble, France, March 2001.
- “Using Spare Capacity for Fault Detection in Multiprocessor Systems,” at
 - University of Arizona, Tucson, AZ, April 1994; (ii) IIT, New Delhi, Jan. 1995.
- “Performance for Nothing,” at
 - The University of Newcastle, Australia, March 1995;
 - The University of Tasmania, Hobart, Australia, June 1995.
- “RFDB: A Cache Protocol for Fault Tolerant Systems,” at IIT, New Delhi, Jan. 1995.
- “Issues in Design of High Performance Fault Tolerant Systems,” at IIT, New Delhi, India, Jan. 1995.
- “Recovery in Mobile Environments: Design and Trade-Off Analysis,” at FTCS-26, Sandai, Japan, June 25, 1996 (substitute Speaker).
- Organized a panel on hardware/software issue in high-performance computing at the second round table conference, ICASE, Hampton, VA, October 1996.
- “Role of Wavelength Conversion in all Optical Network,” at
 - University of Washington, Dept. of Computer Science Lecture Series., January 1997;
 - Iowa State University, Computer Science Lecture Series., October 1997;
 - Massachusetts Institute of Technology, Cambridge, MA, October 1999;
 - Texas A & M, College Station, TX, April 26, 2000.
- “Cache Fault Tolerance,” at Iowa State University, February 1997.

- “Issues in Optical Interconnection of LANs,” at
 - (i) Departmental seminar at Suny Buffalo, November 1997;
 - (ii) Departmental seminar at the George Washington University, November 1997;
 - (iii) Departmental seminar at University of Iowa, Iowa City, December 1997;
 - (iv) Aerospace Corporation, Los Angeles, February 1998;
 - (v) National Plasma Physics Institute, Ahmadabad, India, June 1999;
 - (vi) Western Australian University, Perth July 1999.
- “Parallel Computing and Role of Overlapped Computing and Communication,” Iowa State University Energy Group Seminar, 1999.
- “Mobility: Optimal Location Management Algorithms and Fault Tolerance,” at
 - (i) Ohio State University, April 1999;
 - (ii) University of Cincinnati, OH, SUNY Buffalo, NY, November 1999.
- “Complex System Analysis and Introduction to HIMAP,” Lucent Inc, Naperville, IL, January 2000, Illinois Institute of Technology, January 2000.
- “Traffic Grooming in WDM Nets,” IP Over WDM Workshop, Paris, Nov. 2000.
- “Optical Network and Wavelength Division Multiplexing,” at
 - (i) National Plasma Physics Institute, Ahmadabad, India, January 2001;
 - (ii) Ohio State University, May 2001.
- “Role of Wavelength Conversion and Alternatives,” a 4-hour tutorial at
 - (i) OPTICOMM-2000 conference, October 2000;
 - (ii) IEEE Student Branch, Bombay Chapter, January 2001;
 - (iii) Costa Rica University, San Jose, Costa Rica, March 2001;
 - (iv) IEEE Student Branch, San Jose, Costa Rica, March 2001;
 - (v) IEEE Student Branch, San Salvador, El Salvador, March 2001;
 - (vi) IEEE Student Branch, Guatemala City, Guatemala, March 2001; and
 - (vii) Broadband Fiber Optical Technology Conference, North Maharashtra University, Jalgaon, India, December 2001.
- “Beyond SONET and SDH,”
 - (i) Keynote Speech at Beyond SONET/SDH workshop, IP Over WDM Workshop Paris, April 2001;
 - (ii) Indian Institute of Bombay, December 7, 2001.
- “Monitor Placement Algorithm,” High-Speed Networking Workshop, April 2001.
- “Survivable Traffic Grooming Networks,”
 - (i) Keynote Speech at Broadband Fiber Optical Technology Conference, North Maharashtra University, Jalgaon, India, December 2, 2001;
 - (ii) Department of Electrical and Computer Engineering, University of Houston, March 15, 2002;
 - (iii) Keynote Speech , IEEE Section Conference, San Jose, Costa Rica, May 29, 2002.
- “Advances in Optical Networks,” after dinner speaker at the Symposium Banquet the 21st Biennial Symposium, Kingston, Ontario, Canada, June 3, 2002.
- “Challenges in 2nd Generation Optical Network,” Key note Speeches at HSN 2002, New York, June 23, 2002, and SCI 2002, Orlando, FL, July 15, 2002.
- Panel Coordinator and Speaker, ”Traffic Grooming in Optical Networks: Challenges and Issues,” ONDM Conference, Budapest, Feb 4, 2003.
- “Advances in Optical Networks,” A four hour tutorial talk at ADCOMP-2003 held at PSG College of Technology, Coimbatore, India, December 17, 2003.
- “Grooming and Survivability Issues in Traffic Management in WDM Optical Networks,” Key note Speeches at ADCOMP-2003 held at PSG College of Technology, Coimbatore, India, December 18, 2003.

- “Survivability and Traffic Grooming in Optical Networking,”
 - (i) Key note Speech at ONDM-2005, February 7, 2005;
 - (ii) Distinguished Lecture, University of Texas, Dallas, January 27, 2006.
- “Architectural Issues in Optical Networking,” NSF-EU Workshop on Future of Optical Networking, Brussels, Belgium, June 27-28, 2005.
- “Achieving High Performance in Distributed Computing Grids,” Key note Speeches at PDCS 2005, November 14, 2005.
- Panel Member on panel discussing Future of Optical Networking at Broadnets 2006, San Jose, October 2006.
- “Protection of Power Grid and Use of Sensor Technology,” Departmental Seminar, ECE, University of North Carolina, Charlotte, NC, November 3, 2006.
- “A Premier on WDM Optical Networks,” Invited Talk at PHOTONICS 2006, Hyderabad, India, December 15, 2006.
- “Net Centric Computing: The Future of Computers & Networking,” 3rd Intl. Conf. on Distributed Computing and Internet Technology, Bhubaneswar, India, December 20, 2006.
- “Monitoring the US Power Grid Via Wireless Sensor Networks,” a presentation to the EPRI group at San Francisco, February 13, 2007.
- “Capacity Balanced Efficient Protection and Grooming Architecture for Optical Networks,”
 - (i) Keynote Speech at Broadnets 2007, Raleigh/Durham, NC, September 11, 2007;
 - (ii) 12th MC meeting of COST 293, Bartinoro, Italy, May 8, 2008.
- “Fault Tolerant Multicast-Couple Hop Routing over Light-Trails,” at the 2008 IEEE ANTS Conference, IIT/Mumbai, Dec 15, 2008.
- “An Efficient Superscheduler Architecture and Job Migration Algorithm for Computational Grids over Light-trail WDM Networks,” at Broadnets 2009, Madrid Spain, Sept. 2009.
- “Autonomous Aero-Visual and Sensor Based Inspection Network for Asset Monitoring,” at the 7th International Workshop on the Design of Reliable Communication Networks (DRCN 2009), Washington DC, October, 2009.
- “Efficient Protection and Grooming Architectures for Future Optical Networks,”
 - (i) Invited Talk, Duke University, Raleigh/Durham, NC, September 2007;
 - (ii) Tutorial talk at Asia Communication and Photonics Conference (APC) 2009, Shanghai, China;
 - (iii) IEEE Comm. Society Distinguished Lecture at National Singapore University (NSU), Singapore;
 - (iv) IEEE Comm. Society Distinguished Lecture at Nanyang Technology University (NTU), Singapore, March 9, 2010;
 - (v) IEEE Comm. Society Distinguished Lecture at Indian Institute of Technology, Delhi, November 2010;
 - (vi) IEEE Comm. Society Distinguished Lecture at XiDan University, Xian, China, June 13, 2011;
 - (vii) IEEE Comm. Society Distinguished Lecture at Lima (Peru), Aug 11, 2011;
 - (viii) IEEE Comm. Society Distinguished Lecture at Montreal, Canada, Sept 19, 2011;
 - (ix) IEEE Comm. Society Distinguished Lecture at Quebec City, Canada, Sept 21, 2011.
- “Autonomous Aero-Visual and Sensor Based Inspection Network for Asset Monitoring,”
 - (i) IEEE Comm. Society Distinguished Lecture at NCKU Tainan, Taiwan, on March 12, 2010;
 - (ii) IEEE Comm. Society Distinguished Lecture at National Taiwan University, Taipei, Taiwan, March 15, 2010;
 - (iii) IEEE Comm. Society Distinguished Lecture at IEEE Region Coastal South Carolina, May 10, 2010;
 - (iv) IEEE Comm. Society Distinguished Lecture at IEEE Region Atlanta GA, May 11, 2010;
 - (v) IEEE Comm. Society Distinguished Lecture at IEEE Region Huntsville AL, May 12, 2010;
 - (vi) IEEE Comm. Society Distinguished Lecture at IEEE Ecuador, Aug 15, 2011;
 - (vii) IEEE Comm. Society Distinguished Lecture at New Brunswick, Canada, Sept 20, 2011;

- (viii) IEEE Comm. Society Distinguished Lecture at Ottawa, Sept 22, 2011;
 - (ix) IEEE Comm. Society Distinguished Lecture at Fort Worth, October 25, 2011;
 - (x) IEEE Comm. Society Distinguished Lecture at Austin, October 26, 2011;
 - (xi) IEEE Comm. Society Distinguished Lecture at San Antonio, October 27, 2011;
 - (xii) Distinguished speech at IEEE RWW2012 Conference, Santa Clara, CA, Jan 16, 2012;
 - (xiii) IEEE Comm. Society Distinguished Lecture at Orange County, CA, Jan 16, 2012;
 - (xiv) IEEE Comm. Society Distinguished Lecture at Woodland Hills, CA, Jan 17, 2012;
 - (xv) IEEE Comm. Society Distinguished Lecture at San Fernando Valley, CA, Jan 18, 2012;
 - (xvi) IEEE Comm. Society Distinguished Lecture at Foothill, CA, Jan 18, 2012;
 - (xvii) IEEE Comm. Society Distinguished Lecture at San Diego, CA, Jan 19, 2012;
 - (xviii) IEEE Comm. Society Distinguished Lecture at ROCK RIVER VALLEY LIFE MEMBER AFFINITY GROUP, Northern Illinois University, Dekalb, Illinois, Nov 29, 2012.
- “Multi-point to Multi-point Connections Using Complex Cycles: Cycle Finding Algorithm,” IEEE ANTS, Indian Institute of Technology, Bombay, Mumbai, Dec 17, 2010.
 - “RAKSHA: Reliable and Aggressive framewoK for System design using High-integrity Approaches,” at
 - (i) Indian Institute of Technology, Delhi, New Delhi, India, January 7, 2011;
 - (ii) IEEE RASDAT workshop, Indian Institute of Technology, Chennai, India, January 8, 2011;
 - (iii) Indian Institute of Science, Bangalaoe, India, April 22, 2011;
 - (iv) Keynote speech at 2011 2nd World Congress on Computer Science and Information Engineering (CSIE 2011), held at Changchun, China, June 17, 2011;
 - “Sustainable Software Architectures,” opening talk for the session organized at The 7th International Conference on Distributed Computing and Internet Technologies, Bhubaneswar, February, 9, 2011.
 - “Emerging Computer-Communications Architectures,” NSF-ECEDHA Energy & Power Summer Program, Atlanta, July 11, 2011.
 - “Creating Information Infrastructure for Research Collaboration,” at the Merrill Advanced Studies Center Workshop, Nebraska City, NE, July 19, 2012.
 - “Understanding, Evaluating and Reporting Research Productivity and Impact,” at the Merrill Advanced Studies Center Workshop, Nebraska City, NE, July 18, 2013.
 - “Mechanisms for International Collaborations,” PES, Bangalore, India, May 2014.
 - “Data Driven Optical Networks,” IEEE CCW Workshop, Blue Bells, PA, Nov. 6-7, 2014.
 - “Research Methodology, a half day workshop for 250 PhD students,” Gujarat Technological University, June 2015.
 - “UAS Navigation in GPS-Denied Terrain Environments and Synthetic Vision,” Gujarat Technological University, March 2016.
 - “Big Data in Context Panel,” The midwest Big Data Summer School, Iowa State University, June 20-24, 2016.
 - “Memory Efficient Computation Management for All-to-All Big Data Interaction,” Gujarat Technological University, March 2017.
 - “Storage and Memory Efficient Computation Management for Big Data Computations,” Keynote talk at Smart Systems, Innovation, and Computing Conference, Jaipur, India April 14, 2017.
 - “Simple Problem Complex Solutions in Networking and Computing,”
 - (i) keynote talk at Confluence-2018 conference, held at Amity University Noida, India, January 12, 2018.
 - (ii) Invited talk at BITS Pilani, India, January 31, 2018.
 - (iii) keynote talk at ICETCE (International Conference on Emerging Technology in Computer Engineering) 2018, Held at Jaipur February 2, 2018.

- “Managed Storage Solutions for Big Data,” Keynote talk at Smart Systems, Innovation, and Computing Conference, Jaipur, India, January 2019.
- “Knowledge Discovery Techniques for Transactional Data,” keynote talk at ICETCE (International Conference on Emerging Technology in Computer Engineering) 2019, Held at Jaipur February 2019.
- “Introduction to College of Engineering Research,” presentation to various ISU Foundation organized events on Jan 6, 2021, Feb 4, 2021, March 16, 2021.
- “Hardware System Architectures and Efficient DNN Inference,” Keynote talk at Smart Systems, Innovation, and Computing Conference, Jaipur, India, January 23, 2021.
- “Effectiveness of Computing Platforms on Optimized Deep Learning Neural Network Models,” Keynote talk at Confluence-2021 conference, held at Amity University Noida, India, January 28, 2021.
- “A Study of Effectiveness of Computing Platforms on Optimized Deep Learning Neural Network Models,” Gujarat Technological University, a workshop held for 200 PhD students, January 29, 2021.
- “Computation Organization of Optimized Deep Learning Neural Networks” keynote talk at ICETCE (International Conference on Emerging Technology in Computer Engineering) 2019, Jaipur, India, February 3-4, 2021.

9. Publications:

Books and Book Chapters:

1. A. K. Somani, “Reliability of Redundant Fault Tolerant Systems,” J. Webster (ed.), Wiley Encyclopedia of Electrical and Electronics Engineering. John Wiley & Sons, Inc, 2019, DOI: 10.1002/047134608X.W6413.pub2. 18 double column IEEE journal format.
2. Somani, A.K., Shekhawat, R.S., Mundra, A., Srivastava, S., Verma, V.K. (Eds.), “Smart Systems and IoT: Innovations in Computing, Proceeding of SSIC 2019,” ISBN 978-981-13-8405-9, December 2019.
3. Somani, A.K., Srivastava, S., Mundra, A., Rawat, S. (Eds.), “Proceedings of First International Conference on Smart System, Innovations and Computing SSIC 2017, Jaipur, India, ISBN 978-981-10-5828-8, 2017.
4. Mayank Mishra and A. K. Somani, “On-Disk Data Processing: Issues and Future Directions,” arXiv preprint arXiv:1709.02718.
5. Mayank Mishra, Pratik Mishra, and A. K. Somani, “Understanding the Data Science behind Business Analytics,” in the edited book ”Big Data Analytics: Tools and Technology for Effective Planning” ISBN 9781498784368, 2017.
6. Piyush Lakhawat and A. K. Somani, “Big Data Cluster Analysis: A Study of Existing Techniques and Future Directions,” in the edited book ”Big Data Analytics: Tools and Technology for Effective Planning” ISBN 9781498784368, 2017.
7. Karthik B. Subramanya and A. K. Somani, “Enhanced Feature Mining and Classifier Models to Predict Customer Churn for an e-Retailer,” in the edited book ”Big Data Analytics: Tools and Technology for Effective Planning” ISBN 9781498784368, 2017.
8. Pratik Mishra, Mayank Mishra, A. K. Somani, “Application of Hadoop Ecosystem Tools,” in the edited book ”NoSQL: Database for Storage and Retrieval of Data in Cloud” ISBN 9781138032392, 2016.
9. Parijat Shukla and A. K. Somani, “A Scalable Record Linkage Technique for NoSQL Databases using GPGPUs,” in the edited book ”NoSQL: Database for Storage and Retrieval of Data in Cloud” ISBN 9781138032392, 2016.

10. A. K. Somani, "Network Design: Algorithms and Examples," In Wiley Encyclopedia of Electrical and Electronics Engineering (John Webster, ed.) Hoboken: John Wiley & Sons, Inc., March 2016, 31 pages.
11. JinWei Tioh, M. Mina, R. J. Weber and Arun K. Somani, "Fiber Optic Network Components," in Instrument Engineers Handbook: Process Software and Digital Networks, Fourth Edition, Taylor & Francis Group, edited by Halit Eren, 2011.
12. A. K. Somani, "Protection approaches for survivable traffic grooming," a book chapter in Traffic Grooming for Optical Networks: Foundations and Techniques, coedited by R. Duta, A. Kamal, and G. Rouskas, published by Springer in 2008.
13. A. K. Somani and Tao Wu, "Monitoring and Detecting Attacks in an All Optical Networks," a book chapter in Information Assurance: Survivability and Security in Networked Systems coedited by David Tipper, published by Morgan Kaufmann/Elsevier in 2007.
14. A. K. Somani, "Network Design: Algorithms and Examples," In Wiley Encyclopedia of Electrical and Electronics Engineering (John Webster, ed.) Hoboken: John Wiley & Sons, Inc., March 2007.
15. A. K. Somani, "Survivability and Traffic Grooming in Optical Networks," **Cambridge Press Book**, 436 pages, 2006.
16. A. K. Somani, "System Level Diagnosis and Implications in Current Context," a book chapter on Dependable Computing Systems: Paradigms, Performance Issues, and Applications, Edited by Hassan B. Diab and Albert Y. Zomaya, published by Wiley Series on Parallel and Distributed Computing, 2005 (37 pages).
17. A. K. Somani, "Tradeoffs and comparison of restoration strategies in WDM networks," a book chapter in Emerging Optical Network Technologies, by Krishna Sivalingam and Suresh Subramaniam, 2005, pp. 333-355 (21 pages).
18. L. Li and A. K. Somani, "Multifiber WDM Networks," a book chapter in book edited by Lu Ruan and Ding-Zhu Du, published by Springer, 2001, pp. 123-150 (28 pages).
19. L. Li and A. K. Somani, "Dynamic Wavelength Routing Techniques And Their Performance Analysis," book chapter in book edited by K. M. Sivalingam and S. Subramaniam, Kluwer Academic Publishers, 2000, pp. 247-272 (26 pages).
20. A. K. Somani, "Network Design," invited paper in Wiley Encyclopedia of Electrical and Electronics Engineering, 1998, pp. 132-153 (22 pages).
21. S. B. Choi and A. K. Somani, "A Parallel Algorithm for Embedding Complete Binary Trees in Faulty Hypercubes," Fault Tolerant Parallel and Distributed Computing, edited by D. Avresky and D. R. Kaeli, Kluwer Academic Publishers, 1998, pp. 249-265 (17 pages).
22. P. Rostykus and A. K. Somani, "Biological Basis for Compact Neural Networks," in Vol 2, Progress in Neural Networks, Ablex Publishing Company, Norwood, New Jersey, Editor Prof. O. Omidvar, 1993, pp. 109-128 (20 pages).
23. A. K. Somani and O. Peleg, "New Approaches in System-Level Diagnosis," Frontiers of Computing Systems Research, Essays on Emerging Technologies, Architectures and Theories, Volume 2, Plenum Publishing Corp, New York, NY USA, 1991, pp. 251-305 (55 pages).
24. A. K. Somani and P. Rostykus, "Hypercube-based Compact Neural Networks and Their Comparison with Other Artificial Neural Networks," in Vol. 1, Progress in Neural Networks, Ablex Publishing Company, Norwood, New Jersey, Editor Prof. O. Omidvar, 1991, pp. 57-85 (pages 29 pages).
25. A. K. Somani and P. Narong, "Reduced Interconnection Neural Networks," was accepted for publication as a book chapter (edited by Dr. Bruce Shriver). The book was to be published by Computer Society Press but had been since withdrawn by the editor as it could not be published in a timely manner, October 1989.

Archival Journal Articles:

26. R. Yelaswarapu and A. K. Somani, "Addressing multiple bit/symbol errors in DRAM" in PeerJ Computer Science journal 7:e359. Jan 2021, <https://doi.org/10.7717/peerj-cs.359>.
27. Teng Wang, Ye Zhao, Jiawei Wang, Arun K. Somani, Changyin Sun, "Attention-Based Road Registration for GPS-Denied UAS Navigation," IEEE Transactions on Neural Networks and Learning Systems, Print ISSN: 2162-237X Online ISSN: 2162-2388 Digital Object Identifier: 10.1109/TNNLS.2020.3015660
28. T. Wang and A.K. Somani, "Aerial-DEM Geolocalization for GPS-Denied UAS Navigation," Machine Vision and Applications, 2019, 31, 3 (2020) doi:10.1007/s00138-019-01052-6.
29. Parijat Shukla and Arun K. Somani, "Tree Matching on Parallel Machines using Data Shaping," in Proc. of Services Transactions on Big Data (STBD, ISSN: 2326-442X), 2018.
30. C. J. Kleinheksel and A. K. Somani, "Enhancing Fault Tolerance and Resource Utilization in Unidirectional Quorum-based Cycle Routing," in IEEE/ACM Transactions on Networking, 2018, DOI: 10.1109/TNET.2018.2811386, 14 pages, March 2018.
31. T. Wang, K. Gopalakrishnan, O. Smadi, A.K. Somani, "Automated shape-based pavement crack detection approach," Transport 33 (3), pp. 598-608, 2018.
32. Pratik Mishra and A. K. Somani, "Host Managed Contention Avoidance Storage Solutions for Big Data," in Journal of Big Data Systems, Springer Nature, 2017, 4:18. DOI 10.1186/s40537-017-0080-9.
33. V. K. V. Yelaswarapu and A. K. Somani, "A Memory Efficient Parallel All-Pairs Computation Framework: Computation Communication Overlap," in: Wyrzykowski R., Dongarra J., Deelman E., Karczewski K. (eds) Parallel Processing and Applied Mathematics, PPAM 2017. Lecture Notes in Computer Science, vol 10777. Springer, pp 443-458. DOI: <https://doi.org/10.1007/978-3-319-78024-5-39>.
34. C. J. Kleinheksel and A. K. Somani, "Efficient Distributed All-Pairs Algorithms: Management using Optimal Cyclic Quorums," in IEEE Transactions on Parallel and Distributed Systems, 2017, Volume 29, Issue 2, pp. 391-404, DOI:10.1109/TPDS.2017.2707417.
35. N. D. P. Avirneni, Prem Kumar, and A. K. Somani, "Managing contamination delay to improve Timing Speculation architectures," PeerJ Computer Science 2:e79 <https://doi.org/10.7717/peerj-cs.79>, August 2016.
36. C. J. Kleinheksel and A. K. Somani, "Optical quorum cycles for efficient communication," in The Photonic Network Communications, April 2016, Volume 31, Issue 2, pp 196-205.
37. N. D. P. Avirneni, P. K. Ramesh, and A. K. Somani, "Utilization aware Power Management in Reliable and Aggressive Chip Multi Processors," in IEEE Transactions on Computers, Volume: 65, Issue: 3, March 1 2016, pp. 979-991. DOI: 10.1109/TC.2015.2439277.
38. Teng Wang, Koray Celik, and Arun K. Somani, "Characterization of mountain drainage patterns for GPS-denied UAS navigation augmentation," Machine Vision and Applications, January 2016, Volume 27, Issue 1, pp 87-101, DOI: 10.1007/s00138-015-0723-9.
39. Sarvesh Bidkar, Ashwin Gumaste, Puneet Ghodasara, Annirudha Kushwaha, Jianping Wang, and Arun Somani, "Scalable Segment Routing A New Paradigm for Efficient Service Provider Networking Using Carrier Ethernet Advances," Journal of Optical Communications and Networking, Vol. 7, Issue 5, pp. 445-460, 2015. doi: 10.1364/JOCN.7.000445
40. N. D. P. Avirneni and A. K. Somani, "Countering power analysis attacks using Reliable and Aggressive Designs," IEEE Transactions on Computers, pp. 1408-1420, accepted Jan. 2013. Volume: 63, Issue: 6, June 2014, DOI: 10.1109/TC.2013.9.
41. N. Pavan Kumar Gorti and Arun K. Somani, "Reliability aware dynamic voltage and frequency scaling for improved microprocessor lifetime," ACM SIGOPS Operating Systems Review, Vol. 47, No. 3, December 2013, pp. 10-17. doi:10.1145/2553070.2553073.

42. Siddhartha Kumar Khaitan, James. A. McCally, and Arun K. Somani, "Proactive Task scheduling and stealing in master-slave based load balancing for parallel contingency analysis," Elsevier Journal of Electric Power Systems Research, Volume 12, Issue 1-2, October 2013.
43. Koray Celik and Arun K. Somani, "Monocular Vision SLAM for Indoor Aerial Vehicles," Journal of Electrical and Computer Engineering, Volume 2013 (2013), Article ID 374165, 15 pages.
44. E. Ibanez, Steve Lavrenz, Diego Meja, Venkat Krishnan, Konstantina Gkritza, James McCalley, Arun K. Somani, "Resiliency and robustness in long-term planning of the national energy and transportation system, International Journal of Critical Infrastructures, Volume 12, Issue 1-2, 2013.
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