

DAVID HUNG-CHANG DU

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Bio

Dr. Du is currently the Qwest Chair Professor of Computer Science and Engineering at University of Minnesota, Minneapolis. He is the Center Director of the NSF multi-university I/UCRC Center of Research in Intelligent Storage (CRIS). In addition to NSF, CRIS is currently sponsored with 9 companies with 15 sponsored memberships including Intel, IBM, HPE, Dell/EMC, Seagate, Veritas, Samsung, Huawei and Salesforce. He was a Program Director (IPA) at National Science Foundation CISE/CNS Division from March 2006 to August 2008. At NSF, he was responsible for NeTS (Networking Research cluster) NOSS (Networks of Sensor Systems) Program and worked with two other colleagues, Karl Levitt and Ralph Wachter, on Cyber Trust (Internet Security) Program. In 2008 he was also assigned to CSR (Computer System Research) Cluster for handling research in computer systems. Dr. Du receives a B.S degree in Mathematics from National Tsing-Hua University (Taiwan) in 1974 and an M.S. and Ph.D. degrees from University of Washington (Seattle) in 1980 and 1981 respectively. He joined University of Minnesota as a faculty since 1981. Dr. Du also has been a visiting professor in Germany, Korea, Singapore, Hong Kong and Taiwan.

Research Expertise: Dr. Du's current research focuses on intelligent storage systems, sensor/vehicular networks and cyber physical systems. He has had research in high-speed networking, database design, multimedia computing and CAD for VLSI circuits. He has authored and co-authored over 300 technical papers including 130 referred journal publications in these research areas. He has graduated 60 Ph.D. and 100+ M.S. students in the last 30 years. His research in intelligent storage systems focus on new storage technologies/architectures, that can handle semantic data and adaptive to long-term data preservation, and efficient power management for data centers. His research in sensor/vehicular networks and cyber physical systems focuses on vehicle-to-vehicle communications, future intelligent transportation systems, next generation air-transportation systems and security and privacy issues for cyber physical systems. His research in CAD includes physical layout, timing verification and delay fault testing for high-speed and very large scale circuits. His research in high-speed networking includes heterogeneous high-performance computing over high-speed networks, quality of service, parallel data archive for high-performance computing, and optical networks.

Professional Activities and Awards: Dr. Du is an IEEE Fellow (since 1998) and a Fellow of the Minnesota Supercomputer Institute. He is currently a member of Advisory Committee to Institute of Information Science and Research Center for Information Technology Innovation, Academic Sinica in Taiwan and a member of International Advisory Board to Korean Journal of Computer Science and Engineering. He was an Editor of IEEE Transactions on Computers from 1993 to 1998. He was the US WEST Chair Professor at the University of Minnesota from 1994 to 2000. He is currently serving on the Editorial Boards of several international journals including IEEE Transactions on Vehicle Technology. He has also served as Conference Chair and Program Committee Chair for several conferences in multimedia, networking security and database areas. Most recently, he is the General Chair for IEEE Security and Privacy Symposium (Oakland, California) 2009, Program Committee Co-Chair for International Conference on Parallel

Processing 2009, and Workshop Co-Chair and the General Chair for IEEE International Conference on Distributed Computing Systems 2010 and 2011 respectively. General, Co-Chair of ACM International Conference on Underwater Networks and Systems 2013 and General Chair of International Conference on Parallel Processing (ICPP) 2014. He also serves as the Chair of Steering Committee for ICPP.

He has had research grants from the National Science Foundation, DARPA, ONR, DOE and companies like 3M, Northern Telecom, Unisys, IBM, Seagate Technology, US WEST, Honeywell, Sun Micro, Intel, Cisco, HPE, NetApp, Dell/EMC, ETRI (Korea), ITRI (Taiwan) and etc.

Industrial Experiences: Dr. Du has served as a consultant to a number of companies in the past, including: Honeywell, NCR, Unisys, 3M and IXMICRO. In 1996, he spent 6 months in the Computer Communications Lab (CCL) of the Industrial Technology Research Institute (ITRI) in Taiwan. His major function at CCL/ITRI was to plan several long term (5-year) R&D projects funded by the Ministry of Economic Affairs. He has served as a member of Technical Advisory Committee for CCL/ITRI from 1995 to 2010. In 1998, he joined IXMICRO as the Vice President of Research and Development for one year. He led a team of 30+ engineers to develop products such as ATM network interface cards, ATM switches, Fast Ethernet switches, wireless mice, ADSL modems, and streaming video servers. He has co-founded a startup company called Streaming21 and also helped to establish another startup company called Baynacre with his former students. Baynacre was later acquired by Apache Design Solutions. He has served as Chairman and CEO for Streaming21 in 2000 and 2001. During this period, he helped to raise \$18M funds from VCs for Streaming21 and managed 60+ employees. Streaming21 was focused on developing streaming video products for carrier and entertainment markets. Baynacre was focused on static timing analysis software tools for nano-technology.

EDUCATIONAL BACKGROUND:

Degree	Institution	Year Completed
Ph.D. in Computer Science	University of Washington (Seattle)	1981
M.S. in Computer Science	University of Washington (Seattle)	1980
B.S. in Mathematics	National Tsing-Hua University (Taiwan)	1974

PROFESSIONAL EMPLOYMENT:

Position	Employer	Period
Program Director	National Science Foundation CISE/CNS	March 2006 – August 2008

Qwest Chair Professor Professor	University of Minnesota	2007-Present 1991 - Present
Chairman and CEO	Streaming21	2000 - 2001
US WEST Chair Professor	University of Minnesota	1994 - 2000
Vice President of Engineering	3CX, San Jose, California	Jan. 1998 – Dec. 1998
Associate Professor	University of Minnesota	1987 - 1991
Assistant Professor	University of Minnesota	1981 - 1986

RESEARCH INTERESTS

Intelligent Storage Systems, Multimedia Computing, Cyber Physical Systems, Sensor/Vehicular Networks, Cyber Security, High-Speed Networks, Distance Education, Database Design, Parallel/Distributed Architectures/Systems, CAD for VLSI Circuits.

Awards and Honors:

IEEE Fellow since 1998

Fellow, Minnesota Supercomputer Institute

Center Director, National Science Foundation I/UCRC Center on Intelligent Storage since 2009

National Science Foundation, Director's Award for Collaborative Integration, September 8, 2008

ACM Recognition of Service Award, 2013

IEEE Certificate of Appreciation, 2012 for contributing to the growth of the communications industry and the society as a loyal communications society member

IEEE Certificate of Appreciation, 2007

Member of Technical Review Committee, Information Communication Lab at Industry Technology Research Institute, Taiwan, 2008, 2010, and 2013

Member of Advisory Committee for Innovation and Advanced Research, Institute of Information Industry, Taiwan, 2016-present

Member of International Advisory Committee, Research Center for Information Technology Innovation, Academic Sinica, Taiwan, 2011-present

Member of International Advisory Committee, Institute of Information Science, Academic Sinica, Taiwan, 2008-2016

Member of International Advisory Board of the Journal of Computer Science and Engineering, Korea, 2007-present

Invited member of visiting committee of Chinese University of Hong Kong for reviewing Departments of Biomedical Engineering, Computer Science and Engineering, Electronic Engineering, Information Engineering, Mechanical and Automation Engineering, and Systems Engineering and Engineering Management 2018

Invited Speaker at Salesforce, February 2018, San Francisco

Invited Plenary Speaker at IEEE ICNC (International Conference on Computing, Networking and Communications) 2017, San Jose, CA

Invited Keynote Speaker at the 6th IEEE Non-Volatile Memory Systems and Applications Symposium (NVMSA) 2017, Hsin-Chu, Taiwan

Invited Speaker at Huawei Strategy and Technology Workshop 2016, Shenzhen, China, May 2016

Invited Speaker at National Taiwan University, 9/7/2016

Invited Speaker at Industrial Technology and Research Institute, Taiwan, 9/9/2016

Invited Speaker at Asia University, Taiwan, 9/13/2016

Invited Speaker at National Central University, Taiwan, 9/21/2016

Invited Distinguished Speaker at Huawei Storage Summit, Shenzhen, China, November, 2015

Invited Speaker, University of Central Florida, October, 2015

Invited Speaker Distinguished Industrial Lecture Series in ICT for 2020 - Storage Systems Research Trends in Big Data Era at CITI (Center for Information and Technology Innovation), Academic Sinica, Taiwan August 2014

Invited Keynote Speaker, the 16th IEEE International Conference on Communication Technology, Nov. 2014, Shenzhen, China

Invited Keynote Speaker, the 15th IEEE International Conference on Communication Technology, Nov. 2013, Guilin, China

Invited Keynote Speaker, IEEE 2nd International Conference on Cloud Computing and Intelligence Systems, Oct. 30 to November 1, 2012, Hangzhou, China

Invited Speaker, Old Dominion University, Norfolk, Virginia, February 2012

Invited Keynote Speaker, the 17th IEEE Conference on Parallel and Distributed Systems (ICPADS), December 7-9, 2011, Tainan, Taiwan

Invited Speaker, NEC Research, Princeton, New Jersey, December 2011

Invited Speaker, Department of Computer Science and Engineering, University of Alabama, Tuscaloosa, Alabama, November 2011

Invited Speaker, IBM Almaden, San Jose, California, March 2011

Invited Speaker, Samsung Electronics Research, San Jose, California, March 2011

Invited Keynote Speaker, the 16th International Conference on Distributed Multimedia Systems, October 14-16, Chicago, 2010

Invited Plenary Speaker, Cyber Physical System Summit (organized by Taiwan Government Executive Yuan Strategy Research Board), September 2010, Taipei, Taiwan

Invited Plenary Speaker, Globecom 2010 on “Future Generation Networks”, Dec. 2010

Invited President Distinguished Speaker, Haungzhou Electronic University, China, March 2010

Invited Speaker, Institute of Computing Technology, Chinese Academic of Sciences, February 2010

Invited Keynote Speaker, the 2nd International workshop on Critical Infrastructure Protection, December 2009, Taipei, Taiwan

Invited Keynote Speaker, 10th International Symposium on Pervasive Systems, Algorithms and Networks, Taiwan, Dec. 2009

Invited Keynote Speaker, 5th International Conference on Mobile Ad-Hoc and Sensor Networks (MSN 2009), Wu Yi Mountain, China

Invited Distinguished Speaker, William and Mary College, November 2008

Invited Keynote Speaker, D2D Workshop, October 25, 2008, Shenzhen, China

Invited Keynote Speaker, SNAPI08, Workshop on Storage Network Architecture and Parallel I/Os, September 2008, Baltimore, Maryland

Invited Keynote Speaker, IFIP International Conference on Network and Parallel Computing, Oct. 18, 2008, Shanghai, China

Invited Keynote Speaker, International Workshop on Wireless Security and Privacy, June 20, 2008, Beijing, China

Invited Keynote Speaker, Workshop on Mission Critical Networks, April 18, 2008, Phoenix, Arizona

Invited A* Visiting Professor, Data Storage Institute, Singapore, January 2009

Invited Speaker, Symantec, Mountain View, California, April 2008

Invited Keynote Speaker, International Conference on Wireless Algorithms, Systems and Applications, August 2007

Invited Keynote Speaker, Korean Computer Congress (KCC), June 2007

Invited Sensor Network Panel Organizer at Infocom, May 2007

Invited Speaker, Boeing, Seattle, May 2007

Invited Keynote Speaker at IEEE International Conference on Service-Oriented Computing and Applications, June 2007, Newport Beach, California

Invited Speaker at Boeing, March 2007

Invited Plenary Speaker at Navy Undersea Distributed Networked Systems Conference in Newport, RI, February 13-15, 2007

Invited Keynote Speaker at NASA Earth Science Web Meeting in San Diego, February 13-14, 2007

Invited Keynote speaker at Trusted Computing Group Annual Meeting, January 2007, Atlanta

Invited Speaker at DOE Salishan High Speed Computing Conference, April 2006

Invited Speaker at Cisco Fast Router Symposium, August 2006

Invited Speaker at Distinguished Lecture Series at Michigan State University, November 2006

Invited Keynote Speaker at GENI Great Plains Network Workshop, Nov. 2006, Kansas State University

Invited keynote Speaker, the 9th IASTED Conference on Internet and Multimedia Systems and Applications, August 2005, Honolulu, Hawaii

Invited Plenary Speaker, the IEEE Conference on Next Generation Web Services and Practices, Seoul, Korea 2005

Digital Technology Center, Outstanding Service Award, 2004

Invited Korea IT Promotion Agency Distributed Visiting Professor at Chung-An University,

Invited Speaker, Han-Wha S&C, Seoul Korea, June 17th, 2003

Invited Keynote Speaker at Digital Convergence Workshop, June 18th, 2003

Invited Speaker at KAIST (Korea Advanced Institute for Science and Technology), June 20th, 2003

Invited Speaker, Seoul National University, June 25th, 2003

Invited Keynote Speaker at Korea Electronic Conference, July 9th, 2003

Invited Speaker at Samsung Electronics, July 15th, 2003

Invited Speaker at HanYang University, July 16th, 2003

Invited Speaker at Samsung Advanced Institute of Technology, July 25th, 2003

Invited Keynote Speaker, Workshop on Architectural and OS Support for Multimedia Applications, Minneapolis, August 1998

Invited Keynote Speaker, International Conference on Internet Technology, 1998

Invited Keynote Speaker, Pacific Workshop on Distributed Multimedia Systems, Taipei, Taiwan, July 1998

Invited Keynote Speaker, 11th International Conference on Computer Applications in Industry and Engineering, Las Vegas, Nevada, Nov. 11-13, 1998

Certificate of Appreciation from IBM, 1997

Invited Distinguished Visitor, National University of Singapore, 1996

Best Paper Award, International Conference on Computer Design, Austin, Texas 1998, "Finding the Longest Simple Path in Cyclic Combinatorial Circuits," (with Y.C. Hsu and S.Z. Sun)

"On the General False Path Problem," Proc. of Design Automation Conference 1989, pp. 555-560 (with H.C. Yen). *This paper has been nominated for the best paper award.*

PROFESSIONAL ACTIVITIES

Member of International Advisory Board, Journal of Computing Science and Engineering, 2006-2012

Co-Editor, IEEE JSAC Special Issue on Mission Critical Networking, 2009

Associate Editor, IEEE Transactions on Vehicle Technology since 2013

Editor, Journal of Information Science and Engineering, 2002 -2012

Editor, IEEE Trans. on Computers, 1992 to 1997

Editor, Parallel and Distributed Computing Practices, 1997-present

Editor, International Journal on Cluster Computing, 1998 –present

Editor, International Journal of Contemporary Computing, 2010-present

Editor, International Journal of Computer Science and Applications, 2004-present

Guest Editor, Journal of Communications Special Issue on Recent Advances on Controlling Unwanted Internet Traffic 2010

Guest Editor, IEEE JSAC (Journal Selected Area of Communications) Special Issue of Mission Critical Networks, 2009

Guest Editor, Special Issue of IEEE Computer on “Continuous Media on Demand”, September 2001

Guest Editor, Special Issue of Communications of ACM on
"Experiments and Experiences with ATM Networks" published in Feb. 1995.

General Co-Chair, IEEE Conference on Computer Communication Security (CNS) 2015, Florence, Italy

General Chair, the 43rd International Conference on Parallel Processing, Minneapolis, Sept. 2014

General Co-Chair, the 6th International Workshop on Sensor Networks (SN 2013), July 30th-August 2, 2013, Nassau, Bahama

General Co-Chair, the 8th ACM International Conference on Underwater Networks and Systems, Kaohsiung, Taiwan, Nov. 11th-13th, 2013

General Co-Chair, the 15th International Conference on Communication Technology, Guilin, China, Nov. 17th-19th, 2013

PC Vice Chair, the International Conference on Distributed Computing Systems (ICDCS), Philadelphia, June 2013

PC Co-Vice Chair, the 4th International Conference on Emerging Data and Web Technologies (EIDWT), 2013

General Co-Chair, the 5th International Workshop on Sensor Networks (SN 2012), July 30-August 2, 2012, Munich, Germany

Conference General Co-Chair, the 5th International Conference on Networking, Architecture and Software (NAS), Dalian, China, July 2011

Workshop Co-Chair, the 30th International Conference on Distributed Computing Systems, Genova Italy, June 2010

General Chair, The 31st IEEE International Conference on Distributed Computing Systems, Minneapolis Minnesota, June 2011

Program Committee Chair, International Conference on Parallel Processing, Vienna Austria, September 2009

General Chair, The 30th IEEE Security and Privacy Symposium, May 2009, Oakland, California

General co-chair, 4th International Conference on Next Generation of Web Services, Seoul, Korea, October 2008

Program Committee Vice-Chair, IEEE International Conference on Distributed Computing Systems (ICDCS), 2008

Treasurer, IEEE Privacy and Security Symposium, 2008

Member of Steering Committee, ACM Workshop on Underwater Networks (WUWNet), 2007-2009

General Co-Chair, ACM Workshop on Underwater Networks (WUWNet), 2008

Member of International Program Committee, SIGMAP (International Conference on Signal Processing and Multimedia Applications), 2007

Member of Program Committee, ACM Conference on Computer and Communications Security, 2007

Conference Co-General Chair, IEEE International Conference on Next Generation Web Services, August 2005, Seoul, Korea

Program Committee Vice Chair, IEEE International Conference on Distributed Computing Systems (ICDCS), 2005

Conference Co-Organizer: Intelligent Storage Workshop, 2003 to 2006

Program Committee Co-Chair: Intelligent Storage Workshop 2004

Invited Panelist, Storage Workshop, Supercomputing 2004

International Program Committee Member of IASTED (International Association of Science and Technology Development), 2004 and 2005

Program Committee Member, IEEE ICME 2001-2006

Program Area Committee Chair, IEEE ICME 2002

Program Committee Member, SPIE Conference on Multimedia Computing and Networking (MMCN), 2004-2008

Program Committee Member, Distributed Multimedia Systems, 1996-2005

Workshop Co-Organizer : NSF IMA Workshop on “Digital Library: Asset Management” Feb. 2001

Program Committee Vice Chair, IEEE International Conference on Distributed Computing, 2000

Invited Panelist, "Storage Architecture and Multimedia", IEEE International Conference on Multimedia Computing Systems, 1999

Principal Organizer, Internet2 Day at University of Minnesota, 1999

General Chair, International Conference on Parallel Processing, Minneapolis, 1998

Program Committee Member of IEEE Workshop on Communication and Architectural Support for Network-Based Parallel Computing 1997

Program Committee Member of 1997 and 1998 Pacific Workshop on Distributed Multimedia Systems

Program Committee Member of IEEE Local Computer Conference, 1997 and 1998

Program Committee Co-Chair of 1996 Pacific Workshop on Distributed Multimedia Systems

Steering Committee Member of High Performance Computing- Asia 1995 and 96 (HPC-ASIA'95 and '96)

Steering Committee Member of International Computer Symposium 1996

Program Committee member of IEEE International Conference on Distributed Computing Systems, 1995

Program Committee member of 1995 Pacific Workshop on Distributed Multimedia Systems

Program Committee member of Workshop on High-Speed Network Computing (HiNet'95 and HiNet'96)

Program Committee member of Third IEEE Workshop on the Architecture and Implementation of High Performance Communication Subsystems (HPCS'95)

General Chairman, International Conference on Management of Data (SIGMOD), 1994

Invited Visiting Professor, University of Essen, Germany for 2 months 1994

Program Committee member of International Conference on Parallel and Distributed Systems 1994

Program committee member of the International Conference on Computer Designs, 1992-1993,

Program committee member of GLOBECOM, 1993

Invited Visiting Professor at National Singapore University for 3 months 1991

Program committee member of the International Conference on Data Engineering 1986-1989

Award committee chairman of the International Conference on Data Engineering 1989

Program committee member of the International Conference on Local Area Network, 1989-2000

Program committee member of the International Conference on Very Large Databases, 1989

Session chairs of various conferences

Invited Speaks at many companies including IBM, Intel, Cisco, Dell Computer, etc.

Reviewer and panelist for NSF, various journals and conferences

Major University Committees and Contributions:

Founder of National Science Foundation I/UCRC Center on Intelligent Storage, 2009- present

Chair, Institute of Technology Honors and Awards Committee, 2005

Assisted in establishing a joint computer engineering degree in ECE and CSE Departments

Assisted in establishing a joint Bachelor Degree in Information Technology in Networking between North Hennepin Community College and the University

Founder of Intelligent Storage Consortium in Digital Technology Center

Served on Internet2 Ad Hoc Committee to assist CIO from 1996 to 1999

University Distance Learning Committee, 1997

Institute of Technology Promotion and Tenure Committee, 1996-1998

Institute of Technology Honors and Awards Committee, 2003 – 2005

Elected to University of Senate, 3-year term, 2003-2005

Participated and Chaired several search committees; served on ADC Chair Search Committee and was the Chair of the ADC Chair Search Committee from 2002 to 2005

GRANTS Awarded :

MEIS DASE, 1983

MEIS Small Grant, 1984

Graduate School Faculty Summer Research Grant, 1984

NSF Equipment Grant, \$82,500 1984

CDC/Honeywell/Sperry Research Grant, "Database Management for ECAD" \$30,000, Sept. 1984- Dec. 1984 and \$90,000 for 1985 (with V. Berzins and S. March)

NSF Research Grant, Grant No. DCR-8405498, "Studies in Associative Retrieval," \$80,552, Sept. 1984- Feb. 1987

Northern Telecom Inc. Research Grant, "Local Area Networks for Office Automation," \$60,000, 1985 (with K. Maly)

NSF CER Research Grant DCR-8420935, "Experimental Research in Computer Algorithms", \$3,622,190 (participating with S. Sahni as PI), 1985-1990

Northern Telecom Research Grant, "Local Area Network for Office Automation", \$60,000 for 1986-1988

HP Equipment Grant, "Studies in Distributed Systems", \$198,778 for 1986 (with A. Tripathi)

MEIS Research Grant, "Computer-Aided-Design for VLSI", \$270,000 for 1986-1989 (with G. Sobelman)

NSF Research Grant MIP-8605297, "Studies in Layout Problems", \$80,116 for 1986-1989

NCR Comten Research Grant, "Studies in Computer Networking", \$25,000 for 1989-1990

Computer-Integrated-Manufacturing Consortium, Productivity Center
Principal Investigator for Network and Database Projects, 1990-1994

"Performance-Driven Layout," \$74,920, National Science Foundation MIP-9007168, 1991-1993

"Collaborative Research in Networking," \$100,000 IBM Rochester 1992-1993; A set of research equipment including one AS/400, 2 PS/2 and 6 Terminals are also provided

"Heterogeneous Computing in High Speed Networks", \$30,000, 1993, Bellcore

Broadband ISDN Compass Testbed, US West, 1992-1995

Founder of the Distributed Multimedia Research Center at University of Minnesota, 1994-1997, Industrial Sponsors: US WEST, Honeywell, Computing Devices International, Network Systems and IVI Publishing; Each industrial sponsor contributes \$50,000/year

"Real Time and Multimedia Network Services for Distributed Control Applications," \$61,858, ARPA (Joined with Honeywell; the total project budget \$701,000) from June 1994 to December 1995

"High-Performance Computing over A Cluster of IBM RS/6000 Workstations"
Equipment Grant from IBM, \$979,000 (with Co-PI Don Riley), 1995

"Advanced Multimedia Communications," \$89,000, 3M, 1993-1994, \$45,000 from 3M, 1995-1996

"Applications over High-Speed Networks : A Pilot Project for the NII"

NSF CISE Research Infrastructure Grant 1995-2000, \$1,500,000 with \$600,000 matching from University of Minnesota and \$800,000 matching from IBM (with P. Woodward, V. Kumar and P.C. Yew as co-PIs)

"Research in Distance Learning" IBM Research Partnership Grant \$120,000 from 1995 to 1997.

"High-Performance Computing Using Clusters of Workstations," IBM SUR Project, Equipment Grant from IBM, \$800,000 in 1997 and \$600,000 in 1998

"Performance Evaluation of Fibre Channel - Arbitrated Loop" Computing Devices International, \$25,976 from June 1995 to June 1996.

"Transaction Processing Using Internet Web", \$27,000 from United Health Inc, 1997

NSF vBNS connection to Minnesota, NSF \$350,000 1996-1997 (with Don Riley, et al. as co-PI)

"Video IP Project" \$25,000 from NYSERnet

"Design and Performance Study of Serial Storage Interface Technology", \$68,000 from Seagate Technology, 1997-1998

"Performance Evaluation of Future Serial Storage Interface," \$72,000 from IBM Storage Systems Division, 1998-1999

"Collaborative Research Activities over the VBNS," \$124,000, NSF, April 1, 1999- March 31, 2000

"Internet Integrated Services over ATM Networks," \$105K, National Sandia Labs, 2000-2003

"Research in Multimedia Computing," \$3,000, Dell Computer, 2000

"A System for Multi-Axial Subassemblage Testing (MAST),"

\$6.47M NSF Grant CMS-0086602 and \$6M matching by the University and the State, January 1, 2001 to December 31, 2004 (with Kathy French as PI, and Carol Shield, Douglas Ernie, Jerry Hajjar and Arturo Schultz as co-PIs)

"Research in Emerging Network Infrastructure and Server Technology,"

\$50,000 from International Simulation and Training Systems, January 1, 2002 to December 31, 2002

"Efficient Shared File Systems for iSCSI," \$100K gift from Intel, June 1, 2002 to May 31, 2004

"Collaborative Research Resources: Collaborative Data Analysis and Visualization," \$500,000, NSF CNS-0224424, Sept. 15, 2002 to Sept. 14, 2005 (with Paul Woodward as PI, and Jon Weissman, et. al. as co-PIs)

"Intelligent Storage Consortium," \$250,000 in 2002 and \$150,000 in 2003, Digital Technology Center, University of Minnesota, (with Jon Weissman, Ahmed Tewfik, David Lilja, Yongdae Kim, and Zhi-Li Zhang)

“Intelligent Storage Consortium,” \$165,000, StorageTek, Nov. 15, 2002 to Nov. 14, 2005

“Performance and Efficient Accesses for Future Storage Area Networks,” \$75,000, gift from Cisco, Sept. 2003- August 2004

“Intelligent Storage Consortium,” \$135K, Veritas, May 2003 to May 2006

“Intelligent Storage Consortium,” \$110K, LSI Logic (Engenio), March 2004-March 2006

“A Parallel Archive System Using Object-based Storage Targets and Lustre,” \$50K, 2004, DOE

“Intelligent Storage Consortium”, \$55K, Sun Micro, 2004

“SIMON: SIMulation and MOdeling for SAN,” ONR STTR Phase 1 Grant, \$75,000 with ATC Corp, 2004-2005 (with Yongdae Kim); Phase 2 funding for \$500,000 from 2005-2007

“Development of A System for Interactive Analysis and Visualization”, NSF CNS-0421423, \$300,000 from 7/15/04 to 7/14/06 (with Paul Woodward as PI)

“Intelligent Storage Consortium”, \$55K, ETRI/Korea, September 2004 to September 2005

“Designing OSD-Based File Systems”, \$20K, ETRI/Korea, 9/1/04-12/31/04 (with Yongdae Kim)

“Intelligent Storage Support to Micro-Array Data”, NIH Equipment Grant \$222,000 (participating researcher with Chris Chute from Mayo Clinic as PI), 2005

“Intelligent Storage Consortium,” \$55K, ITRI/Taiwan, December 2005 to December 2006

“Parallel Archive System Using Object-Based Storage Target and Lustre File System”, \$155,000 from Los Alamos National Lab, March 2006- January 2009

“Database Applications with Intelligent Storage System”, \$60,000 from ETRI/Korea, April 2006 to April 2007, and \$100,000 each year in 2007-2010

“Integrated Infrastructure for Secure and Efficient Long-Term Data Management,” (was PI for the project with co-PIs Yongdae Kim and David Lilja; Due to my appointment at NSF, Andrew Odlyzko has substituted as the PI), NSF CCF-0621462, \$696,999 from 9/15/06-9/14/09

“Global Time-Synchronized Delivery Architecture to Support Mission-Critical Traffic on the Internet” \$55,000, gift from Cisco, May 2007-April 2008

NSF I/UCRC Center on Intelligent Storage (joint with UC Santa Cruz), \$10K for planning in 2008

“Travel Support for IEEE Symposium on Security and Privacy 2009,” \$15K from NSF, \$10K from ARO and \$10K from ONR

“Efficient Datadeuplication with Consideration of Data Chunk Frequency,” NSF \$300,000 9/1/09-8/31/2012

“Collaborative Research: Predictable Delivery for Large-Scale Real-Time Applications”,
NSF CNS-1016350, \$268,522 9/1/10-8/31/2013

“Collaborative Research : A Multi-University I/UCRC Center on Intelligent Storage,”
NSF IIP-0934396, \$400,000, 8/1/09-7/31/2014

NSF I/UCRC Center Membership

- \$200,000 from Xyratex 2010-2014
- \$450K from Seagate, 2010-2018
- \$100K from Los Alamos National Lab 2010-2012
- \$100K 2010-2012 and \$300K 2013-2016 from Symantec
- \$150K from Veritas 2016-1018
- \$150K from NEC-Labs 2012-2015
- \$500K from NetApp 2012-2017
- \$250K from Dell/Compellent 2013-2018
- \$500K from HPE 2013-2018
- \$50K from Hitachi Global Storage Systems 2013-2014
- \$100K from LSI 2012-2014
- \$150K from SGI 2013-2016
- \$100K from FedCentric 2013-2015
- \$100K from SK-Telecom 2014-2016
- \$100K from Cray 2014-2016
- \$100K from IBM 2015-2017
- \$150K from Intel 2015-2018
- \$100K from Huawei 2016-2018

“Efficient Buffer Management in FTL for High Performance Solid State Drives,”
NSF CNS-115471 \$130,000, 2011-2012

“Integrating Flash and Phase Change Memory into Memory/Storage Hierarchies for
Enhancing High-End and Data Intensive Computing”
NSF IIP-1127829 \$199,428, 2011-2012

“Information Dissemination in Vehicular Networks for Reduced Traffic Congestion,”
NSF award CNS-1217572, \$420K from August 16, 2012 to August 15, 2015

“Prediction-Based Data Placement for New Memory and Storage Hierarchies,” NSF
award CNS-1217569, \$450K from Sept. 1, 2012 to August 31, 2015

“One Cloud Does Not Fit: Minnesota Integrated Cloud Systems Research Testbed,” NSF
award II-New 1305237, \$350K from Sept. 1, 2013 to August 31, 2016 (with Jon
Weissman, Abhishek Chandra and Zhili Zhang as co-PIs)

“Travel Support for the 43rd Annual International Conference on Parallel Processing,”
NSF Award CNS-1438816, \$10K from 3/28/2014 to 2/21/2015

“CSR:Small:Collaborative Research: Software Defined Energy Adaption in Large Scale Data Centers,” NSF Award CNS-1421913, \$250K from 8/26/2014 to 1/14/2017

“NSF I/UCRC Phase II: Center on Intelligent Storage,” NSF Award IIP-1439622, \$631,800 from 9/15/2014 to 3/04/2019

“CSR:Small: Efficient Usage of Shingle Magnetic Recording Drives,” NSF Award CNS-1525617, \$494,971 from 8/18/2015 to 01/13/2018

“I/UCRC Innovative Managing Director: Center on Intelligent Storage,” NSF Award IIP-1536477, \$454,247 from 9/11/2015 to 9/10/2017

“Research on Kinetic and SMR Drives,” \$70K from ETRI/Korea, 9/1/2015 to 1/31/2016

“Heterogeneous Storage Systems with Emerging Technologies for Solving Big Data Problems,” \$499,100 NSF Award CNS-1812537, 7/15/2018-7/14/202021

OTHER RESEARCH ACCOMPLISHMENTS

A U.S. patent was received on December 8, 1992.

Patent No. 5,170,482 for "Improved Hypercube Topology for Multiprocessor Computer Systems" (with R.Shu)

U.S. patent pending

"Weighted Striping for Multimedia Servers with Heterogeneous Types of Disks" (with Yuewei Wang)

U.S. patent pending

“Reducing Bandwidth Requirement for Delivering Video over Wide Area Networks with Proxy Servers” (with Wei-hsiu Ma)

PUBLICATIONS

Books:

Scalable Network Monitoring in High Speed Networks, Choi, Baek-Young, Zhili Zhang and David Du, 1st Edition 2011, Springer

Edited Books :

Proceeding of the Workshops ICDCS (International Conference on Distributed Computing Systems), 2010

Proceeding of the 37th International Conference on Parallel Processing, 2009

Proceeding of the Second Workshop on Underwater Networks, WUWNET 2007, Montreal, Quebec, Canada, September 14, 2007 ACM 2007

Proceeding of the Pacific Workshop on Distributed Multimedia Systems 1996 (with Olivia Sheng).

Chapters in Books :

"Timing Verification for Large VLSI Designs," Progress in Computer Aided VLSI Design, Vol. 2 (with H.C. Yen)

"On Gate Matrix Layout Folding Techniques," Progress in VLSI Design, Vol. 3 (with I.C. Lin)

"High Performance Computing over Switched-Based High-Speed Networks," Lecture Notes in Control and Information Sciences, Springer-Verlag, 1997

Journals and Conference Proceedings (all refereed and some journal publications are also presented in conference proceedings) :

Parallel/Distributed Processing and Storage Systems (Journals):

1. "TDDFS: A Tier-aware Data Deduplication-based File System," to appear in ACM Transactions on Storage (with Zhichao Cao, Hao Wen, Xiongzi Ge, and Jingwei Ma), 2018
2. "NetStorage: A Synchronized Trace-Driven Replayer for Network-Storage System Evaluation," to appear in Journal of Performance Evaluation (with Bingzhe Li, Clark Anderson, Bernard King-Smith, David Lilja, Farnaz Toussi, and Hao Wen), 2018
3. "On Improving the Write Responsiveness for Host-Aware SMR Drives," to appear in IEEE Transactions on Computers (with Ming-Chang Yang, Yuan-Hao Chang, Fenggang Wu, and Tei-Wei Kuo), 2018
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5. "Performance Evaluation of Host Aware Shingled Magnetic Recording (HA-SMR) Drives," IEEE Transactions on Computer, Vol. 66, No. 11, November 2017 (with Fenggang Wu, Ziqi Fan, Ming-Chang Yang, Baoquan Zhang, and Xiongzi Ge)
6. "Extending SSD Lifespan with Cooperative Non-Volatile Memory-based Write Buffers," *ACM Transactions on Storage (TOS)*, March 2017 (with Ziqi Fan and Dongchul Park)
7. "Multiple Bloom Filters-based Hot Data Identification: Block-level Decision vs. I/O Request-level Decision," *Journal of Computer Science and Technology (JCST)*, Volume 33, No. 1, January 2018 (with Dongchul Park, and Weiping He)
8. "A Lookahead Read Cache: Improving Read Performance for Deduplication Backup Storage," *Journal of Computer Science and Technology* 32 (1): 26-40 January 2017 (with Dongchul Park, Ziqi Fan, and Young Jin Nam)

9. "A Dynamic Switching Flash Translation Layer Based on Page-Level Mapping," IEICE Transactions on Information and Systems 01/2016; E99.D(6): 1502-1511 (with Dongchul Park and Biplob Debnath)
10. "Par-BF: A Parallel Partitioned Bloom Filter for Dynamic Data Sets," to appear in Journal of High Performance Computing, 2015 (with Yi Liu, Xiongzi Ge and Xiaoxia Huang)
11. "SSD as a Cloud Cache? Carefully Design about It," Journal of Computers, 2015 (with Yi Liu, Xiongzi Ge and Xiaoxia Huang)
12. "MOLAR: A High Performance, Cost-Efficient SSD-based Hybrid Storage Cache," Computer Journal 2015 (accepted with Yi Liu, **Xiongzi Ge**, Xiaoxia Huang)
13. "Reliability Enhancement of Flash-Memory Storage Systems: An Efficient Version-Based Design," IEEE Transactions on Computers, Vol. 62, No. 12, pp. 2503-2515, December 2013 (with Y.H. Chang, P.C. Huang, P.H. Hsu, L.J. Lee and T.W. Kuo)
14. "An On-Line Hot Data Identification for Flash-based Storage Using Sampling Mechanism," ACMngchul Applied Computing Review, Vol. 13, No. 1, March 2013 (with Dongchul Park, Biplob Debanth, Young Jin Nam, Youngkyun Kim and Youngchul Kim)
15. "Energy Adaption for Multitiered Datacenter Applications," Special Issue of "Sustainable Intelligent Systems" in Intel Technology Journal, Vol. 6, Issue 3, 2012 (with M. Murugan and K. Kant)
16. "DiscPOP: Power-Aware Buffer Management for Disk Accesses," Sustainable Computing: Informatics and Systems, Elsevier Press, 2012 (with Xiongzi Ge and Dan Feng)
17. "On the Interconnect Energy Efficiency of High-End Computing Systems," Sustainable Computing: Informatics and Systems, Elsevier Press, 2012 (with Muthukumar Murugan and Krishna Kant)
18. "Enhancing Data Center Sustainability Through Energy Adaptive Computing," ACM Journal of Emerging Technologies, April 2012 (with Muthukumar Murugan and Krishna Kant)
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20. "An Efficient Algorithm for Delay Buffer Minimization," Journal of Combinatorial Optimization, 4(2), pp. 217-233, 2000 (with Guoliang Xue, Shangzhi Sun, et. Al.)
21. "Interface Comparison: SSA versus FC-AL", IEEE Concurrency, Vol. 6, No. 2, April-June 1998, pp. 55-70 (with J.W. Hsieh et al)
22. "Distributed Algorithms for Maximum Cliques," Journal of Information and Optimization Sciences, Vol. 17, 1996, No. 3, pp. 569-583 (with C.T. Wu and A. Lim).

23. "Performance Characteristic of the Connection Machine Hyper-tree Network" Journal of Parallel and Distributed Computing 19, pp. 245-254, 1993 (with M.J. Lin et al)
24. "On the Performance of Synchronous Multiprocessors," IEEE Trans. on Computers, vol. C-34, May 1985, pp. 462-466 ; a short version also appeared in Proc. of International Conference on Parallel Processing, 1983, pp. 429-436 (with J.L. Baer).
25. "Binary Search in a Multiprocessing Environment," IEEE Trans. Computers, vol. C-32, no. 7, July 1983, pp. 667-677 (with J.L. Baer and R. Ladner).

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26. "ChewAnalyzer: Workload-Aware Data Management Across Differential Storage Pools," Proc. of MASCOTS 2018 (the 26th IEEE International Symposium on the Modeling, Analysis, and Simulation of Computer and Telecommunication Systems) (with Xiongzi Ge, Xuchao Xie, Pradeep Ganesan and Dennis Hahn)
27. "JoINS: Meeting Latency SLO with Integrated Control for Networked Storage," Proc. of MASCOTS 2018 (the 26th IEEE International Symposium on the Modeling, Analysis, and Simulation of Computer and Telecommunication Systems) (with Hao Wen, Zhichao Cao, Yang Zhang, Xiang Cao, Zhiqi Fan and Doug Voigt)
28. "Data Management Design for Interlaced Magnetic Recording," Proc. of HotStorage 2018, Boston (with Fenggang Wu, Baoquan Zhang, Zhichao Cao, Hao Wen, Bingzhe Li, Jim Diehl and Guohua Wang)
29. "Improving Data Integrity in Linux Software RAID with Protection Information (T10-PI)", Proc. of the first International Workshop on Advances in High-Performance Algorithms Middleware and Applications (AHPAMA 2018) in conjunction with CCGRID 2018, Washington DC, 2018 (with Baoquan Zhang, Raghunath Raja Chandrasekar, Alireza Haghdooost, Lance Evans)
30. "CDBB: An NVRAM-based Burst Buffer Coordination System for Parallel File Systems," High Performance Computing Conference (HPC) 2018 (with Ziqi Fan, Fenggang Wu, Jim Diehl, and Doug Voigt)
31. "ALACC: Accelerating Restore Performance of Data Deduplication Systems Using Adaptive Look-Ahead Window Assisted Chunk Caching," to appear in the Proc. of the 16th Usenix Conference on Files and Storage Technologies (FAST) 2018 (with Zhichao Cao, Hao Wen and Fenggang Wu)

32. “Kinetic Action: Performance Analysis of Integrated Key-Value Storage Devices vs. LevelDB Servers,” Proc. of IEEE 23rd International Conference on Parallel and Distributed Systems (IEEE ICPADS 2017) (with Manas Minglani, Jim Diehl, Xiang Cao, Bingzhe Li, Dongchul Park, David J. Lilja)
33. “TraceRAR: An I/O Performance Evaluation Tool for Replaying, Analyzing, and Regenerating Traces,” Proc. of the International Conference on Networking, Architecture and Storage (NAS 2017), Shenzhen, China, August 7 -8, 2017 (with Bingzhe Li, Farnaz Toussi, Clark Anderson, David Lilja)
34. “Virtual Persistent Cache: Remedy the Long Latency Behavior of Host-Aware Shingled Magnetic Recordin Drives,” Proc. of IEEE ICCAD 2017 (with Ming-Chang Yang, Yuan-Hao Chang, Fenggang Wu, and Tei-Wei Kuo)
35. “Hibachi: A Cooperative Hybrid Cache with NVRAM and DRAM for Storage Arrays,” Proc. of the 33rd IEEE International Conference on Massive Storage Systems and Technology (MSST), Santa Clara, CA, 2017(with Ziqi Fan, Fenggang Wu, Dongchul Park, Jim Diehl, Doug Voigt)
36. “SMaRT: An Approach to Shingled Magnetic Recording Translation,” Proc. of the 15th Usenix Conference on Files and Storage Technologies (FAST) 2017 (with Weiping He)
37. “On the Accuracy and Scalability of Intensive I/O Workload Replay,” Proc. of the 15th Usenix Conference on Files and Storage Technologies (FAST) 2017 (with Alireza Haghdoost, Weiping He, and Jerry Fredin)
38. “*Data Allocation of Large-scale Key-Value Store System using Kinetic Drives*”. In Proc. of the third IEEE International Conference on Big Data Computing Service and Applications (BigDataService 2017), San Francisco Bay, CA, USA, April 6-9, 2017 (with Xinag Cao and Manas Minglani)
39. “Band for the Buck—Guaranteed, Modeling VDI Applications with Guaranteed Quality of Services,” Proceeding of International Conference on Parallel Processing (ICPP), Philadelphia, PA, August 2016 (with Hao Wen, Milan Shetti and Doug Voigt)
40. “Evaluating Host Aware SMR Drives”, In HotStorage’16: 8th USENIX Workshop on Hot Topics in Storage and File Systems (with Fenggang Wu, Ming-Chang Yang, Ziqi Fan, Baoquan Zhang and Xiongzi) .
41. “Accelerating Data Shuffling in MapReduce Framework with A Scale Up NUMA Computing Architecture,” Proc. of the 24th High Performance Computing Symposium (HPC) 2016, Pasadena, California (with Xiang Cao and Kewal Keshaoao)

42. "OWBP: Flash-Aware Offline Write Buffer Policy," Proc. of the Workshop on Emerging Parallel and Distributed Runtime Systems and Middleware (IPDRM) 2016 (with Alireza Haghdoost), Chicago, IL
43. "I/O Cache: A Non-Volatile Memory Based Buffer Cache Policy to Improve Storage Performance," Proceed. of IEEE 23rd Symposium on Modeling, Analysis and Simulation of Computer and Telecommunication Systems, Atlanta, GA, 2015 (with Ziqi Fan and Alireza Haghdoost)
44. "Novel Address Mapping for Shingled Write Disks," HotStorage Workshop 2014, Philadelphia, Pennsylvania (with Weiping He)
45. "H-ARC: A Non-Volatile Memory Based Cache Policy for Solid State Drives," Proceedings of MSST (Massive Storage Systems and Technology) 2014, Santa Clara, California (with Ziqi Fan and Doug Voigt)
46. "Group based energy adaptation for storage systems", 9th International Workshop on Feedback Computing (USENIX Association), 2014, Philadelphia, USA (with M. Murugan, K. Kant, and A. Raghavan)
47. "FlexStore: A software defined, energy adaptive distributed storage framework", IEEE 22nd International Symposium On Modeling, Analysis and Simulation Of Computer And Telecommunication Systems (MASCOTS 2014), Paris, France (with M. Murugan, K. Kant, and A. Raghavan)
48. "OneStore: Integrating Local and Cloud Storage with Access Hints," In the Poster Session of 2014 ACM Symposium on Cloud Computing. November 3-5, 2014, Seattle, WA (with Xiongzi Ge, Zhichao Cao, Pradeep Ganesan, and Dennis Hahn)
49. "PIONEER: A Solution to Parallel I/O Workload Characterization and Generation," *CCGrid 2015* (with Weiping He and S.B. Narasimhamurthy)
50. "Par-BF: a Parallel Partitioned Bloom Filter for Dynamic Data Sets," Proceedings of workshop on Data-Intensive Scalable Computing Systems (DISCS), in conjunction with SC'14. November 16th, 2014, New Orleans LA, USA (with Yi Liu, Xiongzi Ge, and Xiaoxia Huang)
51. "OpenANFV: Accelerating Network Function Virtualization with a Consolidated Framework in OpenStack," A demo in ACM SIGCOMM'14, August 2014, Chicago, Illinois (with **Xiongzi Ge**, Yi Liu, Liang Zhang, Hongguang Guan, Jian Chen, Yuping Zhao and Xinyu Hu)
52. "Assuring Demand Read Performance of Data Deduplication Storage with Backup Datasets," Proc. of IEEE MASCOTS 2012 (with Youngjin Nam and Dongchul Park)
53. "Hybrot: Towards Improved Performance in Hybrid SLC-MLC Devices," Proc. of IEEE MASCOTS 2012 (with Muthukumar Murugan)

54. "H-SWD: Incorporating Hot Data Identification into Shingled Write Disks," Proc. of IEEE MASCOTS 2012 (with Chung-I Lin, Dongchul Park, and Weiping He)
55. "Virtual USB Drive: A Key Component for Smart Home Storage Architecture," Proc. of IEEE International Conference on Consumer Electronics (ICCE), January 2012 (with Youngjin Nam and Dongchul Park)
56. "HotDataTrap: A Sampling-based Hot Data Identification Scheme for Flash Memory," ACM Symposium on Applied Computing (SAC), March 2012 (with Dongchul Park, Biplob Denath and Youngjin Nam)
57. "Chunk Fragmentation Level: An Effective Indicator for Read Performance Degradation in Deduplication Storage," IEEE International Symposium of Advances on High Performance Computing and Networking (HPCC/AHPCN), September 2011 (with Youngjin Nam, Guanlin Lu, Nohhyun Park, and Weijun Xiao)
58. "Pantheon: Exascale File System Search for Scientific Computing" (Short Paper). In Proceedings of the International Conference on Scientific and Statistical Database Management (SSDBM), Portland, OR, July 2011 (with Joseph L. Naps and Mohamed F. Mokbel)
59. "Reliability-Aware Deduplication Storage: Assuring Chunk Reliability and Chunk Loss Severity," The First International Workshop on Energy Consumption and Reliability of Storage Systems (IGCC/ERSS), July 2011 (with Youngjin Nam, and Guanlin Lu)
60. "A Workload-Aware Adaptive Hybrid Flash Translation Layer with an Efficient Caching Strategy," In Proceedings of the 19th IEEE International Symposium on Modeling, Analysis and Simulations of Computer and Telecommunication Systems (MASCOTS 2011), Singapore, July 2011 (with Dongchul Park and Biplob Debnath)
61. "A Version-based Strategy for Reliability Enhancement of Flash File Systems", in Proc. of Design Automation Conference 2011 (with Pei Han Hsu, Yuan-Hao Chang, P0-Chung Huang, and Tei-Wei Kuo)
62. "Hot Data Identification for Flash Memory using Multiple Bloom Filters," Proceedings of the 27th IEEE Symposium on Massive Storage Systems and Technologies, May 2011 (with Dongchul Park)
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64. "Rejuvenator: A Static Wear Leveling Algorithm for Flash memory" Proceedings of the 27th IEEE Symposium on Massive Storage Systems and Technologies, May 2011 (with Muthukumar Murugan)

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66. "Sampling-based Metadata Management for Flash Storage," Proceedings of the 27th IEEE Symposium on Massive Storage Systems and Technologies, May 2011 (with Biplob Debnath, Srinivasan Krishnan, Weijun Xiao, and David J. Lilja)
151. "Willow: A Control System for Energy and Thermal Adaptive Computing," Proceedings of IEEE IPDPS 2011 (with Krishna Kant and Muthukumar Murgan)
152. "Frequency Based Chunking Algorithm for Data Deduplication," Proceedings of the 18th IEEE International Symposium on Modeling, Analysis and Simulation of Computer and Telecommunication Systems, Miami Florida, August 2010 (with G. Lu and Y. Jin)
153. "CFTL: A New Flash Translation Layer Design Considering Data Access Patterns," accepted as a poster paper in SIGMETRICS 2010 (with D. Park and B. Debnath)
154. "Deferred Updates for Flash-Based Storage," Proceedings of MSST (Conference on Massive Storage Systems and Technology), 2010 (with B. Debnath, M. Mokbel, and D. Lilja)
67. "Large Block Clock (LB-CLOCK): A Write Caching Algorithm for NAND Flash Based Solid State Disks," Proceeding of 17th Annual Meeting of the IEEE International Symposium on Modelling, Analysis and Simulation of Computer and Telecommunication Systems, Sept. 2009 (with Biplob Debnath, Sunil Kumar, and David Lilja)
68. "ADMAD: Application-Driven Metadata Aware De-duplication Archival Storage System", Proc. of SNAPI08 Workshop on Storage Network Architecture and Parallel I/Os, Oct. 2008, Baltimore, Maryland (with Chuanyi Liu, Yingping Lu, Guanlin Lu, and Dong-Sheng Wang)
69. "Design and Implementation of A Network Aware Object-Based Tape Device," Proc. of IEEE Mass Storage Systems and Technology Conference 2007 (with Dingshan He and Nagapramod Mandagere)
70. "GreenStor: Application-Aided Energy-Efficient Storage," Proc. of IEEE Mass Storage Systems and Technology 2007 (with Naapramod Mandagere and Jim Diehl)
71. "HPTFS: High Performance Tape File System", Proc. of IEEE Mass Storage Systems and Technology 2006 (with X.B. Zhang, Jim Hughes, and Ravi Kavuri)
72. "Experiences on Building An Object-Based Storage System Based on T10 Standard," Proc. of IEEE Mass Storage Systems and Technology Conference 2006 (with D.S. He, et al)
73. "Coordinating Parallel Hierarchical Storage Management in Object-Based Cluster File Systems," Proc. of IEEE Mass Storage Systems and Technology Conference 2006 (with D.S. He, X.B. Zhang and Gary Grider)

74. "Object Placement in Parallel Tape Storage Systems," Proc. of International Conference on Parallel Processing, pp. 101-108, 2006 (with Xianbo Zhang, D.S. He and Y.P. Lu)
75. "Multi-Axial Subassemblage Testing (MAST) System," Proc. of NSF NEES Workshop, 2005, Portugal (with Cathy French, et. al.)
76. "QoS Provisioning Framework for OSD-based Storage System ", Proc. of IEEE Mass Storage Systems Technology Conference, 2005 (with Yingping Lu and Tom Ruwart)
77. "A Novel Update Propagation Module for the Data Provenance Problem: A Contemplating Vision on Realizing Data Provenance from Modules to Storage", Proc. of IEEE Mass Storage Systems Technology Conference, 2005 (with Abed Lawabni, Changjin Hong and Ahmed Tewfik)
78. "Performance Impact of Mechanical Vibration of ATA and SCSI Disks " (with Tom Ruwart, Vijay Lenka and Yingping Lu) Proc. of IEEE Mass Storage Systems Symposium, 2005
79. "Simulation Based iSCSI Storage Systems," Proc. of IEEE Mass Storage Systems Symposium, 2004 (with Yingping Lu)
80. "An Efficient Data Sharing Schemes for iSCSI Based File Systems," Proc. of IEEE Mass Storage Systems Symposium, 2004 (with Dingshan He)
81. "Intelligent Storage Device: An Answer to Data Explosion Problem?", invited paper to the Storage Workshop of Supercomputing 2003
82. "Performance Study of Software-Based iSCSI Security," Proc. of the first International IEEE Security in Storage Workshop, 2002 (with S. Tang and Y.P. Lu)
83. "A System for Multi-Axial Subassemblage Testing (MAST); Design Concepts and Capabilities," Proc. Of the Seventh World Congress on Earthquake Engineering, Boston, Massachusetts, July 2002 (with C. French, et al)
84. "A System for Multi-Axial Subassemblage Testing (MAST): Initial Developments," Proc. Of the American Society of Civil Engineers Structures Congress, April 2002, Denver, Colorado (with J. Hajjar, et al).
85. "Efficient RAID Disk Scheduling on Smart Disks," Proc. of IEEE Mass Storage Conference, 2002 (with Tai-Sheng Chang)
86. "Active Disk File System: A Distributed Scalable File System," Proc. Of IEE Mass Storage Symposium, 2001 (with H.R. Lim, Vikram Kapoor, and Chirag Wighe)
87. "The Design of RAID with XOR Engines on Disks for Mass Storage Systems," Proc. of the Sixth NASA Goddard Conference on Mass Storage Systems and Technologies in cooperation with the Fifteenth IEEE Symposium on Mass Storage Systems, March 22-24, pp. 181-186, 1998 (with T. Chang, et al)

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89. "Enhanced PVM Communications Over A HIPPI Local Area Network," Proc. of HiNet'96 (with J.W. Hsieh).
90. "Performance of High-Speed Network I/O Subsystems : Case Study of A Fibre Channel Network," Proc. of Supercomputing'94 (with M.J. Lin et al)
91. "The CM-2 Data Transposition Problem," Proc. of International Parallel Processing Symp., 1993. (with R. Vetter and A. Kleitz)
92. "Hierarchical Uni-Directional Hypercubes," Proc. of International Conference on Parallel Processing, 1991 (with H.S. Chou)
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94. "On Subcube Allocation and Relinquishment Schemes for Hypercube Connected Multiprocessors," Proc. of International Conference on Parallel Processing (1990) (with S.H. Tan)
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96. "STMAC: Spatio-Temporal Coordination-Based MAC Protocol for Driving Safety in Urban Vehicular Networks", to appear in IEEE Transactions on Intelligent Transportation Systems, 2017 (with Jaehoon Jeong; Yiwen Shen Sangsoo Jeong; Sejun Lee; Hwanseok Jeong; Tae Oh; Taejoon Park; Muhammad Ilyas; and Sang Son)
97. "Two-Way Traffic Link Delay Modeling in Vehicular Networks," Elsevier Computer Networks, Vol. 110, December 2016 (with Jinho Lee and Jaehoon Jeong)
98. "PTMAC: A Prediction Based TDMA MAC Protocol for Reducing Packet Collisions in VANET," IEEE Transactions on Vehicular Technology, Vol. 65, No. 11 2016, pp.9209-9223 (with Xiaoxiao Jiang)
99. "SAINT: Self-Adaptive Interactive Navigation Tool for Cloud-Based Vehicular Traffic Optimization," IEEE Transactions on Vehicular Technology, Vol. 65, No. 6, June 2016, pp. 4053-4067 (with Jaehoon Jeong, Hohyeon Jeong, Eunseok Lee, and Tae Oh)
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101. "Achieving Asymmetric Sensing Coverage for Duty Cycled Wireless Sensor Networks," IEEE Transactions on Parallel and Distributed Systems, Vol. 25, No. 12, December 2014, pp. 3076-3087 (with Yu Gu, Long Cheng, Jianwei Niu, and Tian He)
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109. "Virtual Scanning Algorithm for Road Network Surveillance," IEEE Transactions on Parallel and Distributed Systems, March 2010 (with J. Jeong, Y. Gu and Tian He)
110. "In-Situ Key Establishment in Large-Scale Sensor Networks," EURASIP Journal on Wireless Communications and Networking, Volume 2009 (2009), Article ID 427492, 12 pages. (with Y. Xiang, F. Liu and X. Cheng)
111. "Topology Inference in Wireless Sensor Networks," Lecture Notes in Computer Science, Springer Berlin/Heidelberg, Volume 5682/2009 (with K. Xing, Xiuzhen Cheng, and Dechang Chen)
112. "Silent Positioning in Underwater Acoustic Sensor Networks" IEEE Transactions Vehicular Technology, May 2008 (with Xiuzhen Cheng, Haining Shu, and Qilian Liang)
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125. "Enhanced PVM Communications Over A High-Speed Local Area Network," *IEEE Parallel and Distributed Technology*, Vol. 3, No. 3, Fall 1995, pp. 20-32 (with S.L. Chang, et al).
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127. "High Performance Computing Over Switch-Based Local Area Networks," appeared in the special issue on High-Performance Computing of *Integrated Computer-Aided Engineering Journal*, 1995 (with M.J. Lin)

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130. "Cycle Compensation Protocol : A Completely Fair Protocol for the Uni-Directional Twin-Bus Architecture," A short version appeared in the Proc. of the Conference on Local Computer Networks, 1990 and also appeared in IEEE Trans. on Computers, Vol. 43, No. 1, January 1994, pp. 1-12 (with Y.S. Leu).
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133. "Embedded Uni-Directional Incomplete Hypercube for Optical Networks, "Proc. of International Conference on Parallel Processing, 1991 ; also appeared in IEEE Trans. on Communications, Vol. 41, No. 9, pp. 1284-1289, Sept. 1993 (with S.H. Tan)
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138. "MA-TDMA: A Migration-based Adaptive TDMA MAC for Reducing Packet Collisions in VANET," Proc. of VTC-Spring 2016 (with Xiaoxiao Jiang)
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297. "Dynamic File Structure for Partial Match Retrieval Based on Overflow Bucket Sharing," IEEE Trans. Software Engineering, Vol. SE-12, No. 8, August 1986, pp. 801-810. (with T.S. Yuen).
298. "Disk Allocation Methods for Binary Cartesian Product Files," BIT, 26 (1986), pp. 138-147.
299. "On the File Design Problem for Partial Match Retrieval," IEEE Trans. on Software Engineering, vol. SE-11, no. 2, Feb. 1985, pp. 213-222.
300. "Distributing a Database for Parallel Processing is NP-hard," SIGMOD RECORD, vol. 14, no. 1, March 1984, pp. 55-60.
301. "Symbolic Gray Code as a Multi-key Hashing Function," IEEE Trans. Pattern Analysis and Machine Intelligence, vol. PAMI-2, no.1, pp. 83-90, January 1980. (with R.C.T. Lee)
302. "Disk Allocation for Cartesian Product Files on Multiple-Disk Systems," ACM Trans. Database Systems, vol. 7, no.1, March 1982, pp. 82-101 (with J.S. Sobolewski)
303. "Common Properties of Some Multi-attribute File Systems," IEEE Trans. Software Engineering, vol. SE-5, March 1979, pp. 160-174 (with W.C. Lin and R.C.T. Lee)

Database and File Systems/Design (Conferences)

304. "Towards Efficient Search on Unstructured Data : An Intelligent-Storage Approach", *ACM Sixteenth Conference on Information and Knowledge Management*, (2007), CIKM 2007, pp. 951-954 (with Aravindan Raghuveer; Meera Jindal; Mohamed Mokbel; Biplob Debnath)
305. "Some Properties of Cartesian Product Files," *ACM SIGMOD Conference Proceedings*, 1980, pp. 157-168 (with W.C. Lin and R.C.T. Lee)

Ph.D. Students (61 graduated):

1. Tak-Sun Yuen (finished August 1985)
Thesis Title : Hashing Based Dynamic File Structures for Associative Retrieval
Initial Employer : Pace University
2. Kou-Chuan Chang (finished June 1986)
Thesis Title : On Via Minimization and Layer Assignment Problems,
Initial Employer : Boeing Electronics Company
3. Fernando Naveda (joint with Professor Ibarra ; finished June 1986)
Thesis Title : On the Routing Problem for Printed Circuit Boards
Initial Employer : University of Kansas
4. Suzanne Sharrock (finished March 1987)
Thesis Title : Voice/Data/Video Integration on Local Area Networks
Initial Employer : Network Architecture Company
5. Richard Enbody (finished June 1987)
Thesis Title : On Multiple Layer Channel Routing Problems
Initial Employer : Michigan State University
6. Lee-Chin Liu (finished March 1989)
Thesis Title : Routing Problems for VLSI Designs
Initial Employer : IBM, Rochester, Minnesota
7. Ren-Ben Shu (finished June 1989)
Thesis Title : Efficient and Reliable Architectures for Massively Connected Multiprocessors
Initial Employer : National Singapore University
8. Hung-Chuan Yen (finished June 1989)
Thesis Title : Timing Analysis for VLSI
Initial Employer : Cadence Co.
9. Shu-Ping Chang (finished December 1989)
Thesis Title : Multiple Packet Multiple Channel Local Area Networks
Initial Employer : IBM T.J. Watson Research Center
10. Yean-Shiang Leu (finished by March 1990)
Thesis Title : Network Architectures for High-Speed Communications
Initial Employer : IBM, San Jose, California

11. Ichiang Lin (finished June 1990)
Thesis Title : New Techniques for Performance Driven Layout
Initial Employer : IBM, Kingston, New York
12. Chih-Hsiang Chou (finished Dec. 1990)
Thesis Title : Network Architectures for Metropolitan Area Networks
Initial Employer : IBM, Rochester, Minnesota
13. Ching-Tin Wu (finished September 1991)
Thesis Title : Performance-Driven Layout and Wafer Packing Problems for VLSI
Initial Employer : 3M, Minnesota
14. Swie Tsing Tan (finished July 1991)
Thesis Title : Distributed Processor Allocation for Hypercube Multiprocessors and Embedded Virtual Incomplete Hypercubes for High-Speed Optical Networks
Initial Employer : AT&T Bell Lab
15. Lee-Ren Liu (Finished August 1991)
Thesis Title : Efficient Algorithms for Timing Verification and Delay Fault Testing
Initial Employer : Actel, California
16. Hsi-Chuan Chen (Finished Jan. 1992)
Thesis Title : Study of Timing Verification and Timing Optimization of Combinational Circuits
Initial Employer : AT&T Bell Lab
17. Ron Vetter (finished June 1992)
Thesis Title : Network Architectures for High Performance Computing Environment
Initial Employer : Moorhead State University, Moorhead, Minnesota
18. Kent Williams (finished August 1992)
Thesis Title : Study of Design Issues for High-Speed Optical Passive Star Networks
Initial Employer : North Carolina A&T University
19. Keumog Ahn (finished June 1993; joint with S. Sahni)
Thesis Title : Study of VLSI Circuits Layout Design Issues
Initial Employer : AT&T Bell Labs
20. Sanghyun Ahn (finished January 1994),
Thesis Title : ATM Network VP Layout Design and Multicasting Group Communication Problems
Initial Employer : Seoul City University (Korea)
21. Sheau-Ru Tong (finished March 1994)
Thesis Title : Hot-Spot Problem for Interconnection Networks and High Performance Computing on Passive Star Networks
Initial Employer : Industrial Technology Research Center (Taiwan)
22. Meng-Jou Lin (finished September 1994)

Thesis Title : Distributed Network Computing Over Switch-Based High-Speed Local Area Networks

Initial Employer : Apple Computer

23. Rose Tsang (finished Sept. 1995)

Thesis Title : High Speed Network Support for Multimedia Traffic

Initial Employer : National Sandia Lab

24. James Schnepf (finished Sept. 1995)

Thesis Title : Multimedia Support for Distance Education

Initial Employer : St. John's University, Minnesota

25. Juho Kim (finished Sept. 1995)

Thesis Title : Timing Analysis of CMOS VLSI and Performance Optimization

Initial Employer : Cadence Corp.

26. Shang-Zhi Sun (finished Nov. 1995)

Thesis Title : Studies on Timing Analysis, Clock Period Optimization and Testability

Initial Employer : Lattice Semiconductor

27. Mohamad Rooholamini (finished May 1996; joint with V. Cherkassky)

Thesis Title : ATM as the System Interconnect of a Multimedia Server

Initial Employer : Dell Computer

28. Yaun-Chung Hsu (finished in June 1996)

Thesis Title : Study on Timing Analysis and Clocking Problems of Logic Circuits

Initial Employer : IBM Rochester

29. Ching-Liang Liu (finished in June 1996)

Thesis Title : Efficient Design of Video on Demand Server

Initial Employer : Washington State University

30. Ren-Wei Hsieh (finished in June 1997)

Thesis Title: High-Speed Network Support for High-Performance Network and Multimedia Communications

Initial Employer: Dell Computer

31. Sangyup Shim (finished in July 1997)

Thesis Title: Supporting I/O Intensive Applications in A High Performance Storage System

Initial Employer: San Jose State University

32. Yuewei Wang (finished in September 1997)

Thesis Title: Video Allocation Schemes for Video-on Demand Services

Initial Employer: IxMicro Inc., California

33. A. Pavan (finished in March 1998)

Thesis Title: Topological Issues in Time and Wavelength Division Multiplexed Multihop Lightwave Networks

Initial Employer: Honeywell Technology Center

34. Yen-Jen Lee (finished in February 2000)

Thesis Title: Scalable Architectures for Multimedia Communications in Education and Entertainment

Initial Employer : Streaming21, San Jose, California³⁶.

35. Wei-Hsiu Ma (finished in June 2000)
Thesis Title: Video Delivery and Caching with Proxy Servers for Reducing Bandwidth Requirement over Wide Area Networks
Initial Employer: Streaming21, San Jose, California
36. Seijun Song (Joint with Zhi-Li Zhang; finished in August 2000)
Thesis Title: A Software-Based Approach to Scalable Fault-Tolerant Real-Time Ethernet for Networked Control Systems
Initial Employer: Cisco
37. Srihari Nelakuditi (Joint with Zhi-Li Zhang; finished in October 2001)
Thesis Title: Localized Approach to Providing Quality-of-Service
Initial Employer: University of South Carolina
38. Tai-Sheng Chang (finished in December 2002)
Thesis Title: On Several Design Issues of Intelligent High-Performance Storage Systems
Initial Employer: General Electric Medical Imaging Division
39. Zhenhai Duan (joint with Zhi-Li Zhang; finished in July 2003)
Thesis Title: On Scalable Support of Quality of Services in the Internet
Initial Employer: University of Florida State
40. Yingfei Dong (Joint with Zhi-Li Zhang; finished in July 2003)
Thesis Title: Efficient Resource Management in Multimedia Network Systems
Initial Employer: University of Hawaii at Manoa
41. Bae Young Choi (Joint with Zhi-Li Zhang; finished in August 2003)
Thesis Title: Scalable Network Monitoring in High-Speed Large Networks
Initial Employer: US Sprint
42. Ewa Kusmieriek (Joint with Zhi-Li Zhang; finished in May 2004)
Thesis Title: Adaptive Streaming Techniques for Large Scale Video Delivery
Initial Employer: Poznan Supercomputer Center (Poland)
43. Dan Edeen (finished in May 2005)
Thesis Title: An Model for ADSL Link Aggregation with Qualify of Service Support
Initial Employer: Qwest Communications
44. Ying-Ping Lu (finished in November 2005)
Thesis Title: Design Issues in Networked Intelligent Storage Systems : Performance and Quality of Service
Initial Employer: Silicon Graphics Inc.
45. James Beyer (finished in March 2006)
Thesis Title: Control Algorithms for Observation Systems
Initial Employer: CRAY Research

46. Dingshen He (finished in August 2006)
Thesis Title: Data Management in Intelligent Storage Systems
Initial Employer: Microsoft
47. Xiaobo Zhang (finished in July 2006)
Thesis Title: Tape Storage Solutions: Meeting Growing Data Demands
Initial Employer: Symantec
48. Hyeran Lim (finished in September 2006)
Thesis Title: Designing Fair, Efficient and Scalable Storage Systems Based on Emerging Storage Technologies
Initial Employer: Samsung Electronics (Korea)
49. Aravindan Raghuvier (finished in January 2008)
Thesis Title: Techniques for Streaming, Storage and Search of Video
Initial Employer: Yahoo India
50. Jaehoon Jeong (finished in December 2009)
Thesis Title: Wireless Sensor Networking for Intelligent Transportation Systems
Initial Employer: Brocade
51. Guanlin Lu (finished in December 2011)
Thesis Title: Efficient Data Deduplication
Initial Employer: EMC Corp. San Jose
52. Dongchul Park (finished in July 2012)
Thesis Title: Hot and Cold Data Identification: Applications to Storage Systems
Initial Employer: Samsung Electronic Research Center, San Jose
53. Sarah Sharafkandi (finishing date: May 2013)
Thesis Title: On QoS Provisioning for Vehicular Safety Communication
Initial Employer: Qualcomm
54. Muthukumar Murgan (finishing date: June 2013)
Thesis Title: Towards A Flexible and Energy Adaptive Datacenter Infrastructure
Initial Employer: HP
55. Xiaoxiao Jiang (finishing date: July 2015)
Thesis Title: Improving the Reliability and Efficiency of Data Transmission in Ad-Hoc Vehicle Networks
Initial Employer: Verizon
56. Weiping He (finishing date: July 2015)
Thesis Title: The Applications of Workload Characterization in the World of Massive Data Storage
Initial Employer: Dell
57. Nagapramod Mandagere (finishing date: October 2015)
Thesis: Techniques for Optimizing Cost of Enterprise Data Management
Initial Employer: IBM Almaden Research Center

58. Ziqi Fan (finishing date: May 2017)
Thesis Title: Improving Storage Performance with Non-Volatile Memory-based Caching Systems
Initial Employer: Samsung Electronics, San Jose, California
59. Xiang Cao (finishing date: June 2017)
Thesis: Efficient Data Management and Processing in Big Data Applications
Initial Employer: Grand Valley State University, Michigan
60. Xiongzi Ge (finishing date: July 2017)
Thesis Title: Improving Data Management and Data Movement Efficiency in Hybrid Storage Systems
Initial Employer: NetApp Advanced Technology Group, North Carolina
61. Alireza Haghdooost (finishing date: June 2018)
Thesis Title: Towards Performance and Reliability Enhancements of Enterprise Data Storage Systems
Initial Employer: Dell/EMC, Minneapolis

Current Ph.D. Students:

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1982: Eunjin Han, Mai-Yung Yeh, Shuhua Lee
1984: Hasan Moustafa Dandashly, Alfred Huang, Eling Lou, Hanhsing Tan, Shuhwa Yu, Kouchuan Chang, Yeanshiang Lee
1987: Jan Kaldager, Earl Roethke, Karen Kleckner
1988: Tyan Leemay Yen, Aling Wu
1989: Corey Carlson, Yeongleh Lee, Shijer Lin
1990: Tim Barry
1991: Victor Lin, Wayne Schaffran
1993: Yiju Yu, Ming-Tsung Darda Chang
1994: Lu Cheng, Michael H Lee, Ailing Ding, Charlene Sheueling Du
1995: Keith Cramer, Liangwei Kang, Paisal Keattithananant, Lan Lai
1996: Mahmood Qadir, Anthony Harder, Sudesh Kamath, Dan Li, Daiwei Yau, Weimin Xin, Anand Srinivasan
1997: Ying-Li Wu, Dongli Su, Xiaolei Hu
1998: Shu-Fen Jen, Shouyen Teng, Hyeran Lim

1999: Zhifang liu, Feng Nie, Suhnil Ghelani, Aarti Lakhani, Visha Sinha, Jeong-Hyeok Seo, Aditya Datta
 2000: Vikram Kapoor, Chirag Wighe, Calvin Chu, Imelda Sutedjo, Sai Chivukula, Hongjing Zeng, Feng Li
 2001: Peng-Fei Chuang, Suthep Vichiendilokkul, Aixin Liu
 2002: Mahjabeen Parween, Biren Damani, Fang Zhang, Vikas Nahata, Sai Bathina, Avindashreddy Bathula, Urooj Ahmed
 2003: Ming Yu, Priyanka Jain, Rupali Jain, Parthasarathy Sundaram, Heyi Wang, Zeyan Wang, Yu-Han Yang, Xu Zhang, Kartik Gopal, Shuang Yi Tang, Abhishek Dhasmana, Sughosh Kalghatgi, Nishesh Gupta, Hui Ye, Jibin Zheng, Srikanth Chirravuri, Amit Paka, Shankar Srinivasan, Praveen Venkataramaiah, Farrukh Norman, Durgaprasad Velagaleti, Geeta Gharpure, Aravindan Raghuvier, Rajiv Srinivassan
 2004: Vijaya Lenka, Jingjing Gu, Subramanya Abhishek, Nitin Bhandari, Brad Pokormy, Joengmin Hwang, Rao Raghavendra
 2005: Muhammad Jawad, Jinglei Li, Xianbo Zhang
 2006: Ben Miller
 2007: Meera Jindal, Girish Moodalbail
 2008: Sunil Subramanya, John Unterholzner
 2013: Pradeep Ganesan, Muthukumar Murugan, Sandeep Ummadi, Xinyang Yang
 2016: Jeremy Kieser