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# Sudhanva Gurumurthi

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## Research Interests

Computer Architecture, Non-Volatile Memory, Storage Systems, Data Center Architecture, Performance Evaluation.

## Education

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| <b>PhD - Computer Science and Engineering</b><br><b>Dissertation:</b> Power Management of Enterprise Storage Systems<br>Advisor - Anand Sivasubramaniam<br><i>Pennsylvania State University, University Park, PA, USA</i> | 2000-2005 |
| <b>Bachelor of Engineering - Computer Science and Engineering</b><br><i>College of Engineering Guindy, Anna University, Chennai, India</i>  | 1996-2000 |

## Work Experience

- **Fall 2011-Present**  
Associate Professor  
*Department of Computer Science*  
*University of Virginia*  
Charlottesville, VA, USA
- **Fall 2005-Summer 2011**  
Assistant Professor  
*Department of Computer Science*  
*University of Virginia*  
Charlottesville, VA, USA
- **Spring-Summer 2004**  
Graduate Intern  
*Intel Massachusetts*  
Hudson, MA, USA  
*My project involved the design and prototyping of a distributed software system for error monitoring of a large pool of systems. This project subsequently won the Intel Divisional Recognition Award and the Intel Achievement Award. I also developed a soft-error tolerant cache coherence protocol.*
- **Summer 2003**  
Technical Co-Op  
*IBM Research*  
Austin, TX, USA  
*My project involved developing a simulator and performing a design-space exploration study of the memory controller of p-Series servers.*

- **Fall 2001 - Spring 2003, Fall 2003, Fall 2004, Spring 2005**

Research Assistant  
*CSE Department, Pennsylvania State University*  
University Park, PA, USA

- **Fall/Spring 2001**

Teaching Assistant for an introductory C++ course.  
*CSE Department, Pennsylvania State University*  
University Park, PA, USA

## Consulting Activities

- **February 2008 - July 2010**

Simulation and Pathfinding of Efficient And Reliable Systems (SPEARS) Group  
*Intel Massachusetts*  
Hudson, MA, USA  
*Worked on projects related to the design of QAVF predictors and architecture support for fault-tolerance and accelerators.*

## Awards/Honors

- ACM Senior Member, 2011.  
*(This recognizes ACM members with “at least 10 years of professional experience who have demonstrated performance that sets them apart from their peers through technical leadership, and technical or professional contributions”.)*
- IEEE Senior Member, 2010.  
*(Fewer than 8% of the IEEE’s 400,000 members hold this membership grade, which “recognizes significant professional technical accomplishment.”)*
- Keynote Speaker, HPCA Workshop on the Use of Emerging Storage and Memory Technologies (WEST), 2010
- Associate Editor-in-Chief, IEEE Computer Architecture Letters, 2010
- National Science Foundation Highlight to the United States Congress, 2009
- Paper selected for IEEE Micro Top Picks from the Computer Architecture Conferences, 2009  
*(Top Picks recognizes “the most industry relevant and significant papers of 2008 in computer architecture.”)*
- NSF CAREER Award, 2007
- Nominated by Penn State for the ACM Doctoral Dissertation Award, 2005  
*(One nomination per university)*
- CSE Research Assistant Award, 2004  
*(Four awarded per year for outstanding research in Computer Science and Engineering)*
- Robert M. Owens Memorial Scholarship, 2003  
*(One awarded per year for outstanding research in computer systems)*
- Paper selected for the VLDB Journal Special Issue on the Best Papers of VLDB 2001

## Selected Press Coverage and External Articles

- “A Preview of Future Disk Drives”, MIT Technology Review, June 13, 2011.
- “The Energy of an Internet Search”, Science News for Kids, December 2010.
- “2010 Yearbook recognizes 25 famous locals you may not have heard of”, C-Ville Weekly, April 20, 2010.
- IEEE Micro Top Picks 2009 Paper featured in IEEE Computing Now - “Directions in Enterprise Data Storage Systems”, March 2010.

- “U.Va. Venture Summit Tackles Energy Frontier and Big Questions”, UVA Today, March 29, 2010.
- “UVa Venture Summit Aims to Find Funds for Researchers”, Charlottesville Daily Progress, March 25, 2010.
- “Google Grant Helping Data Center Project”, Charlottesville Daily Progress, February 10, 2010.
- “Google Funds ‘Radical’ Efficiency Research”, Data Center Knowledge, February 10, 2010.
- “U.Va. Computer Science Professor Receives \$1 Million Google Research Award to Study Energy Efficiency in Data Centers”, UVA Today, February 10, 2010.
- “Google Awards \$1 Million for Research Effort to Slash Energy Consumption in Internet Data Centers”, Dr. Dobb’s Journal, February 4, 2010.
- “University Receives Efficiency Grant”, The Cavalier Daily, February 3, 2010.
- “Google Gives Millions of Dollars in Research Awards”, CNET News, February 2, 2010.
- “Announcing Google’s Focused Research Awards”, Google Blog, February 2, 2010.
- NSF FY 2010 Budget Request to Congress (Highlight), May 7, 2009.
- “U.Va. Engineering Professors’ Paper Recognized by IEEE and Google”, UVA Today, March 16, 2009.
- “Google University Research Awards”, Google Research Blog, January 28, 2009.
- “CAREER Award Enables Adaptive Active Storage Research”, UVA Research News, November 7, 2007.

## **Publications**

### **NOTE:**

- **Three Most Cited Papers:**
  - S. Gurumurthi et al., ISCA 2003 - 287 Citations
  - S. Gurumurthi et al., HPCA 2002 - 119 Citations
  - W. Zhang et al., DSN 2003 - 69 Citations
- In total, my papers have been cited **1043 times**. The citation data was obtained using Google Scholar™. (*The data is based on Google Scholar search results in January 2012*)
- University of Virginia student co-authors advised by me are underlined. Other University of Virginia student co-authors are indicated by an asterisk.

## **Book**

- PCM Book’11** M. Qureshi, S. Gurumurthi, B. Rajendran, Phase Change Memory: From Devices to Systems, *Synthesis Lectures on Computer Architecture Series*, Editor: Mark D. Hill, Morgan and Claypool Publishers, December 2011.

## **Refereed Journal Papers**

- IEEE TVLSI** T. Siddiqua, S. Gurumurthi, Enhancing NBTI Recovery in SRAM Arrays through Recovery Boosting, *IEEE Transactions on Very Large Scale Integration Systems*, 2011. (*Accepted*)
- IEEE Micro Top Picks** S. Gurumurthi, S. Sankar, M.R. Stan, Using Intradisk Parallelism to Build Energy Efficient Storage Systems, *IEEE Micro Special Issue on Top Picks from the Computer Architecture Conferences of 2008*, 29(1):50-61, January/February 2009. (**Acceptance Rate: 15%**)
- IEEE TC** S. Sankar, Y. Zhang\*, S. Gurumurthi, M.R. Stan, Sensitivity-Based Optimization of Disk Architecture, *IEEE Transactions on Computers*, 58(1):69-81, January 2009.

- ASME JEP** Y. Kim, J. Choi, A. Sivasubramaniam, S. Gurumurthi, Managing Thermal Emergencies in Disk-Based Storage Systems, *ASME Journal of Electronic Packaging*, 130(4), December, 2008.
- IEEE Micro** S. Gurumurthi, Y. Kim, A. Sivasubramaniam, Using STEAM for Thermal Simulation of Storage Systems, *IEEE Micro - Special Issue on Computer Architecture Simulation and Modeling*, 26(4):43-51, July, 2006.
- ACM TOS** S. Gurumurthi, A. Sivasubramaniam, Thermal Issues in Disk Drive Design: Challenges and Possible Solutions, *ACM Transactions on Storage*, 2(1):41-73, February, 2006.
- IEEE Computer** S. Gurumurthi, A. Sivasubramaniam, M. Kandemir, H. Franke, Reducing Disk Power Consumption in Servers with DRPM, *IEEE Computer - Special Issue on Power-Aware and Temperature-Aware Computing*, 36(12):59-66, December, 2003.
- VLDB Journal** N. An, S. Gurumurthi, A. Sivasubramaniam, N. Vijaykrishnan, M. Kandemir, M.J. Irwin, Energy-Performance Trade-Offs for Spatial Access Methods on Memory Resident Data, *The VLDB Journal - Special Issue on Best Papers of VLDB 2001*, 11(3):179-197, November, 2002.

### Invited Journal Papers

- IEEE Micro** S. Gurumurthi, Architecting Storage for the Cloud Computing Era, *IEEE Micro*, 29(6):68-71, November/December, 2009.
- ACM OSR** S. Gurumurthi, Should Disks be Speed Demons or Brainiacs? *ACM SIGOPS Operating Systems Review - Special Issue on File and Storage Systems*, 41(1):33-36, January 2007.

### Book Chapters

- CRC'12** Y. Kim, S. Gurumurthi, A. Sivasubramaniam, Dynamic Thermal Management for High-Performance Storage Systems, *Handbook of Energy-aware and Green Computing*, Editors: Ishfaq Ahmad and Sanjay Ranka, CRC Press, January 2012.
- WILEY'12** S. Gurumurthi, A. Sivasubramaniam, Energy Efficient Storage Systems for Data Centers, *Energy Efficient Distributed Computing Systems*, Editors: Albert Zomaya and Young Choon Lee, Wiley Publishers.

### Refereed Conference and Competitive Workshop Papers

- ICCAD'11** C.W. Smullen, A. Nigam\*, S. Gurumurthi, M.R. Stan, The STeTSiMS STT-RAM Simulation and Modeling System, *Proceedings of the International Conference on Computer-Aided Design*, San Jose, CA, November 2011.  
(Acceptance Rate: 30%)
- ISLPED'11** A. Nigam\*, C.W. Smullen, V. Mohan, E. Chen, S. Gurumurthi, M.R. Stan, Delivering on the Promise of Universal Memory for Spin Torque Transfer RAM (STT-RAM), *Proceedings of the International Symposium on Low-Power Electronics and Design*, Fukuoka, Japan, August, 2011.

**(Acceptance Rate: 23%)**

- ISQED'11** T. Siddiqua, S. Gurumurthi, M.R. Stan, Modeling and Analyzing NBTI in the Presence of Process Variation, *Proceedings of the International Symposium on the Quality of Electronic Design*, Santa Clara, CA, March, 2011.
- HPCA'11** C.W. Smullen, V. Mohan, A. Nigam\*, S. Gurumurthi, M.R. Stan, Relaxing Non-Volatility for Fast and Energy-Efficient STT-RAM Caches, *Proceedings of the International Symposium on High-Performance Computer Architecture*, San Antonio, TX, February, 2011.  
**(Acceptance Rate: 19%)**
- IGCC'10** C.W. Smullen, J.S. Coffman\*, S. Gurumurthi, Accelerating Enterprise Solid-State Disks with Non-Volatile Merge Caching, *Proceedings of the IEEE International Green Computing Conference*, Chicago, IL, August 2010.  
**(Acceptance Rate: 30%)**
- ISVLSI'10** T. Siddiqua, S. Gurumurthi, Recovery Boosting: A Technique to Enhance NBTI Recovery in SRAM Arrays, *Proceedings of the IEEE Computer Society Annual Symposium on VLSI*, Lixouri Kefalonia, Greece, July 2010.  
**(Acceptance Rate: 33%)**
- HotStorage'10** V. Mohan, T. Siddiqua, S. Gurumurthi, M.R. Stan, How I Learned to Stop Worrying and Love Flash Endurance, *USENIX Workshop on Hot Topics in Storage and File Systems*, Boston, MA, June 2010.  
**(Acceptance Rate: 31%)**
- GLSVLSI'10** T. Siddiqua, S. Gurumurthi, A Multi-Level Approach to Reduce the Impact of NBTI on Processor Functional Units, *Proceedings of the Great Lakes Symposium on VLSI*, Providence, RI, pages 67-72, May 2010.  
**(Acceptance Rate: 18%)**
- DATE'10** V. Mohan, S. Gurumurthi, M.R. Stan, FlashPower: A Detailed Power Model for NAND Flash Memory, *Proceedings of the Design, Automation, and Test in Europe Conference*, Dresden, Germany, pages 502-507, March 2010.  
**(Acceptance Rate: 30%)**
- SEMITHERM'10** W. Huang, K. Skadron, S. Gurumurthi, R.J. Ribando, M.R. Stan, Exploring the Thermal Impact on Manycore Processor Performance, *Proceedings of the Annual Thermal Measurement, Modeling, and Management Symposium*, Santa Clara, CA, pages 191-197, February 2010.
- SEMITHERM'10** W. Huang, K. Skadron, S. Gurumurthi, R.J. Ribando, M.R. Stan, Interaction of Scaling Trends in Processor Architecture and Cooling, *Proceedings of the Annual Thermal Measurement, Modeling, and Management Symposium*, Santa Clara, CA, pages 198-204, February 2010.
- MASCOTS'09** T. Siddiqua, S. Gurumurthi, Balancing Soft Error Coverage with Lifetime Reliability in Redundantly Multithreaded Processors, *Proceedings of the International Symposium on Modeling, Analysis, and Simulation of Computer and Telecommunication Systems*, London, UK, pages 99-110, September, 2009.  
**(Acceptance Rate: 20%)**
- ISPASS'09** W. Huang, K. Skadron, S. Gurumurthi, R. Ribando, M.R. Stan, Differentiating the Roles of IR Measurement and Simulation for Power and Temperature-Aware Design, *Proceedings of the International Symposium on Performance Analysis of Systems and Software*, Boston, MA, pages 1-10, April 2009.  
**(Acceptance Rate: 28%)**

- MASCOTS'08** S. Sankar, S. Gurumurthi, M.R. Stan, Sensitivity Based Power Management of Enterprise Storage Systems, *Proceedings of the International Symposium on Modeling, Analysis, and Simulation of Computer and Telecommunication Systems*, Baltimore, MD, September 2008.  
(Acceptance Rate: 38%)
- ISCA'08** S. Sankar, S. Gurumurthi, M. Stan, Intra-Disk Parallelism: An Idea Whose Time Has Come, *Proceedings of the International Symposium on Computer Architecture*, Beijing, China, pages 303-314, June 2008.  
(Acceptance Rate: 14%)
- CF'08** C.W. Smullen, S.R. Tarapore, S. Gurumurthi, P. Ranganathan, M. Uysal, Active Storage Revisited: The Case for Power and Performance Benefits for Unstructured Data Processing Applications, *Proceedings of ACM International Conference on Computing Frontiers*, Ischia, Italy, pages 293-304, May, 2008.  
(Acceptance Rate: 27%)
- ISCA'07** K.R. Walcott, G. Humphreys, S. Gurumurthi, Dynamic Prediction of Architectural Vulnerability From Microarchitectural State, *Proceedings of the International Symposium on Computer Architecture*, San Diego, CA, pages 516-527, June 2007.  
(Acceptance Rate: 22%)
- DAC'07** Y. Zhang\*, S. Gurumurthi, M. Stan, SODA: Sensitivity Based Optimization of Disk Architecture, *Proceedings of the Design Automation Conference*, San Diego, CA, pages 865-870, June 2007.  
(Acceptance Rate: 23%)
- THETA'07** Y. Kim, J. Choi, A. Sivasubramaniam, S. Gurumurthi, Graceful Operation of Disk Drives Under Thermal Emergencies, *Proceedings of the International Conference on Thermal Issues in Emerging Technologies Theory and Application*, Cairo, Egypt, pages 119-125, January 2007.
- ASPLOS'06** A. Parashar, S. Gurumurthi, A. Sivasubramaniam, SlicK: Slice-Based Locality Exploitation for Efficient Redundant Multithreading, *Proceedings of the International Conference on Architectural Support for Programming Languages and Operating Systems*, San Jose, CA, pages 95-105, October 2006.  
(Acceptance Rate: 24%)
- ITHERM'06** S. Gurumurthi, The Need for Temperature-Aware Storage Systems, *Proceedings of the Intersociety Conference on Thermal and Thermomechanical Phenomena in Electronic Systems*, San Diego, CA, pages 387-394, May 2006.  
(Acceptance Rate: 61%)
- MSST'06** N. Paul\*, S. Gurumurthi, D. Evans, Thermal Attacks on Storage Systems, *Proceedings of the NASA Goddard/IEEE Conference on Mass Storage Systems and Technologies*, College Park, MD, pages 143-151, May 2006.  
(Acceptance Rate: 50%)
- HPCA'06** Y. Kim, S. Gurumurthi, A. Sivasubramaniam, Understanding the Performance-Temperature Interactions in Disk I/O of Server Workloads, *Proceedings of the International Symposium on High Performance Computer Architecture*, Austin, TX, pages 179-189, February 2006.  
(Acceptance Rate: 15%)
- ISCA'05** S. Gurumurthi, A. Sivasubramaniam, V.K. Natarajan, Disk Drive Roadmap from the Thermal Perspective: A Case for Dynamic Thermal Management, *Proceedings of the International Symposium on Computer Architecture*, Madison, WI, pages 38-49, June 2005.  
(Acceptance Rate: 23%)

- ISCA'04** A. Parashar, S. Gurumurthi, A. Sivasubramaniam, A Complexity-Effective Approach to ALU Bandwidth Enhancement for Instruction-Level Temporal Redundancy, *Proceedings of the International Symposium on Computer Architecture*, Munich, Germany, pages 376-386, June 2004.  
(Acceptance Rate: 14%)
- DSN'03** W. Zhang, S. Gurumurthi, M. Kandemir, A. Sivasubramaniam, ICR: In-Cache Replication for Enhancing Data Cache Reliability, *Proceedings of the International Conference on Dependable Systems and Networks*, San Francisco, CA, pages 291-300, June 2003.  
(Acceptance Rate: 21%)
- ISCA'03** S. Gurumurthi, A. Sivasubramaniam, M. Kandemir, H. Franke, DRPM: Dynamic Speed Control for Power Management in Server Class Disks, *Proceedings of the International Symposium on Computer Architecture*, San Diego, CA, pages 169-179, June 2003.  
(Acceptance Rate: 20%)
- ISPASS'03** S. Gurumurthi, J. Zhang, A. Sivasubramaniam, M. Kandemir, H. Franke, N. Vijaykrishnan, M.J. Irwin, Interplay of Energy and Performance for Disk Arrays Running Transaction Processing Workloads, *Proceedings of the International Symposium on Performance Analysis of Systems and Software*, Austin, TX, pages 123-132, March 2003.  
(Acceptance Rate: 35%)
- IPDPS'03** S. Gurumurthi, N. An, A. Sivasubramaniam, N. Vijaykrishnan, M. Kandemir, M.J. Irwin, Energy-Performance Considerations in Work Partitioning for Mobile Spatial Queries, *Proceedings of the International Parallel and Distributed Processing Symposium*, Nice, France, April 2003.  
(Acceptance Rate: 29%)
- HPCA'02** S. Gurumurthi, A. Sivasubramaniam, M.J. Irwin, N. Vijaykrishnan, M. Kandemir, T. Li, L.K. John, Using Complete Machine Simulation for Software Power Estimation: The SoftWatt Approach, *Proceedings of the International Symposium on High Performance Computer Architecture*, Boston, MA, pages 141-150, February 2002.  
(Acceptance Rate: 20%)
- VLDB'01** N. An, A. Sivasubramaniam, N. Vijaykrishnan, M. Kandemir, M.J. Irwin, S. Gurumurthi, Analyzing Energy Behavior of Spatial Access Methods for Memory-Resident Data, *Proceedings of the International Conference on Very Large Data Bases*, Rome, Italy, pages 411-420, September 2001.  
(Acceptance Rate: 17%)

## Refereed Workshop Papers

- SELSE'09** A. Biswas, N. Soundararajan, S.S. Mukherjee, S. Gurumurthi, Quantized AVF: A Means of Capturing Vulnerability Variations over Small Windows of Time, *IEEE Workshop on Silicon Errors in Logic - System Effects*, Stanford University, CA, March 2009.
- SELSE'09** T. Siddiqua, S. Gurumurthi, NBTI-Aware Dynamic Instruction Scheduling, *IEEE Workshop on Silicon Errors in Logic - System Effects*, Stanford University, CA, March 2009.
- SELSE'09** B.C. Sutton, S. Gurumurthi, Single-Threaded Mode AVF Prediction During Redundant Execution, *IEEE Workshop on Silicon Errors in Logic - System Effects*, Stanford University, CA, March 2009.
- MoBS'08** S.R. Tarapore, C.W. Smullen, S. Gurumurthi, MIDAS: An Execution-Driven Simulator for Active Storage Architectures, *Proceedings of the Workshop on Modeling, Benchmarking, and Simulation (Held in conjunction with ISCA)*, Beijing, China, June 2008.

- CATARS'08** N. George\*, J. Lach, S. Gurumurthi, Towards Transient Fault Tolerance for Heterogeneous Computing Platforms, *Proceedings of the Workshop of Compiler and Architectural Techniques for Application Reliability and Security (Held in conjunction with DSN)*, Anchorage, AK, June 2008.
- SNAPI'07** C.W. Smullen, S.R. Tarapore, S. Gurumurthi, A Benchmark Suite for Unstructured Data Processing, *Proceedings of the International Workshop on Storage Network Architecture and Parallel I/Os (Held in conjunction with MSST)*, San Diego, CA, September 2007.
- HPCRI'05** S. Gurumurthi, A. Parashar, A. Sivasubramaniam, SOS: Using Speculation for Memory Error Detection, *Proceedings of the Workshop on High Performance Computing Reliability Issues (Held in conjunction with HPCA)*, San Francisco, CA, February 2005.
- CAECW'05** V. Natarajan, S. Gurumurthi, A. Sivasubramaniam, Is Traditional Power Management + Prefetching == DRPM for Server Disks?, *Proceedings of the Workshop on Computer Architecture Evaluation Using Commercial Workloads (Held in conjunction with HPCA)*, San Francisco, CA, February 2005.

## Other Publications

- HPTS'11** S. Gurumurthi, Memory is the New Disk, International Workshop on High-Performance Transaction Systems, October 2011. (Abstract)
- NVMW'11** C.W. Smullen, S. Gurumurthi, Designing with STT-RAM: From Disks to Dies, Non-Volatile Memories Workshop, March 2011. (Abstract)  
(**Acceptance Rate: 51%**)
- NVMW'11** V.Mohan, S. Gurumurthi, Tools for Architecture-level Design and Analysis of Flash Memory Systems, Non-Volatile Memories Workshop, March 2011. (Poster)
- GHC'09** T. Siddiqua, S. Gurumurthi, Dynamic NBTI Management in Multicore Processor, Grace Hopper Celebration of Women in Computing Conference, September, 2009.  
(**Acceptance Rate: 10% of Submitted Abstracts; First Place Winner of the ACM Student Research Competition at GHC**)
- USENIX Security'06** A. Felt\*, N. Paul\*, D. Evans, S. Gurumurthi, Taking Virus Detection to the Next Level (Down), *USENIX Security Symposium - Work-in-Progress Abstract*, July 2006.
- COBASSA'05** N. Paul\*, S. Gurumurthi, D. Evans, Towards Disk-Level Malware Detection, *Proceedings of the Workshop on Code Based Software Security Assessment (Held in conjunction with WCRE)*, November 2005.
- DAC'02** S. Gurumurthi, Energy Efficient Software Design: The Resource-Constrained and Resource-Rich Perspectives, *Design Automation Conference - PhD Forum Poster*, June 2002.

## Patents

1. S. Gurumurthi, A. Biswas, J. Emer, S.S. Mukherjee, *Detecting Errors in Directory Entries*, U.S. Patent (Number: 7,475,321), January, 2009.

## External Research Funding

- *A Data-Centric Approach to Energy Proportionality*  
Sponsor: Google Energy Efficiency and Proportionality in Datacenter-class Computing grant  
Amount: \$1,500,000  
Date: 3 Years  
Co-PI; PIs: Ricardo Bianchini (Rutgers) and Frederic Chong (UCSB). Other CO-PIs: Thomas Wenisch (Michigan)  
(25% of the Funds Allocated to Each PI)
- *Energy-Efficient Storage Architectures for Data Centers*  
Sponsor: Google Research Award  
Amount: \$80,000  
Date: 01/01/2009  
**Sole PI**
- *Reliability Sensors at the Circuit and Architecture Levels*  
Sponsor: Intel Corporation  
Amount: \$70,000  
Dates: (First Payment: 09/01/2008; Second payment: 6/10/2009; Renewable Yearly)  
Co-PI; PI: Mircea Stan (ECE) (50% of the Funds Allocated to Each PI)
- *Research Experiences for Undergraduates Supplement*  
Sponsor: National Science Foundation  
(Supplement to *CRI: Comprehensive, Industry-Strength System-Level Thermal Modeling*)  
Amount: \$12,763  
Dates: 05/01/2008 - 04/30/2009  
Co-PI; PI: Kevin Skadron. Other Co-PIs: Mircea Stan (ECE) and Robert J. Ribando (MAE) (25% of the Funds Allocated to Each PI)
- *Novel Disk Drive Architectures for Efficient Processing of Unstructured Datasets*  
Sponsor: Google Research Award  
Amount: \$40,000  
Date: 12/21/2007  
**Sole PI**
- *Storage-Centric Architectures*  
Sponsor: Hewlett-Packard Company  
Amount: \$35,000  
Date: 06/29/2007  
**Sole PI**
- *Research Experiences for Undergraduates Supplement*  
Sponsor: National Science Foundation  
(Supplement to *CT-ISG: Disk-Level Malware Detection and Response*)  
Amount: \$12,000  
Dates: 06/01/2007 - 07/31/2007  
Co-PI; PI: David Evans (50% of the Funds Allocated to Each PI)
- *Research Experiences for Undergraduates Supplement*  
Sponsor: National Science Foundation  
(Supplement to *CAREER: Architectural Techniques and Tools for Adaptive Active Storage Systems*)  
Amount: \$12,000  
Dates: 04/01/2007 - 03/31/2008  
**Sole PI**
- *CAREER: Architectural Techniques and Tools for Adaptive Active Storage Systems (Award #: 0643925)*  
Sponsor: National Science Foundation  
Amount: \$400,000  
Dates: 04/01/2007 - 03/31/2012  
**Sole PI**

- *CT-ISG: Disk-Level Malware Detection and Response (Award #: 0627527)*  
Sponsor: National Science Foundation  
Amount: \$400,000  
Dates: 09/01/2006 - 08/31/2009  
Co-PI; PI: David Evans (50% of the Funds Allocated to Each PI)
- *Processor Support for Platform Level Security*  
Sponsor: Intel Corporation  
Amount: \$83,456.00  
Dates: (First Payment: 07/27/2006; Second Payment: 05/15/2007)  
**Sole PI**
- *CRI: Comprehensive, Industry-Strength System-Level Thermal Modeling (Award #: 0551630)*  
Sponsor: National Science Foundation  
Amount: \$485,000  
Dates: 05/15/2006 - 04/30/2009  
Co-PI; PI: Kevin Skadron. Other Co-PIs: Mircea Stan (ECE) and Robert J. Ribando (MAE) (25% of the Funds Allocated to Each PI)

## Talks

### Invited Conference Talks

- “Towards Energy-Efficient Data Centers”, nanoSTAR Spring Symposium, University of Virginia, Charlottesville, VA, May 2010.
- “The Role of Storage Class Memory in Future Hardware Platforms: Challenges and Opportunities”, HPCA Workshop on the Use of Emerging Storage and Memory Technologies (WEST), Bangalore, India, January 2010. (**Keynote Speaker**)
- “Intra-Disk Parallelism: A Green Storage Solution for Data Centers”, Storage Developer Conference, Santa Clara, CA, September 2008. (**Academic Innovation Spotlight Speaker**)
- “Towards Hybrid Enterprise Storage Systems”, SNIA Summer Symposium, San Jose, CA, July 2008.

### Colloquium Talks

- “Non-Volatile Memory Hierarchies”, Intel Corporation, Hudson, MA, September 2011.
- “Non-Volatile Memory Hierarchies”, Microsoft Research, Redmond, WA, June 2011.
- “Energy-Efficient Server Memory Hierarchies”, NetApp Webinar, February 2011.
- “Architecting Energy Efficient Storage for Data Centers”, IBM T.J. Watson Research Center, Hawthorne, NY, July 2010.
- “Efficient Processor Fault Tolerance”, Duke University, Durham, NC, May 2010.
- “Efficient Processor Fault Tolerance”, University of Michigan, Ann Arbor, MI, April 2010.
- “Efficient Processor Fault Tolerance”, University of California, San Diego, CA, April 2010.
- “Efficient Processor Fault Tolerance”, University of Wisconsin, Madison, WI, April 2010.
- “Efficient Processor Fault Tolerance”, Harvard University, Cambridge, MA, April 2010.
- “Efficient Soft Error Protection for Microprocessors”, HP R&D Engineering Seminar - Computer Architecture Technologist series, March 2010.
- “Efficient Processor Fault Tolerance”, University of Illinois, Urbana-Champaign, IL, February 2010.
- “Intra-Disk Parallelism: A Green Storage Architecture for Data Centers”, Indian Institute of Science, Bangalore, India, January 2010.

- “Intra-Disk Parallelism: A Green Storage Solution for Data Centers”, Cambridge University, Cambridge, UK, September 2009.
- “Intra-Disk Parallelism: A Green Storage Solution for Data Centers”, University of California at Santa Cruz, Santa Cruz, CA, September 2008.
- “Intra-Disk Parallelism”, Google, Mountain View, CA, July 2008.
- “Disk-Level Behavioral Malware Detection”, Intel Corporation, Hillsboro, OR, August 2007.
- “Disk-Level Behavioral Malware Detection”, Georgia Institute of Technology, Atlanta, GA, April 2007.
- “Disk-Level Behavioral Malware Detection”, VMWare, Palo Alto, CA, March 2007.
- “Power Management of Enterprise Storage Systems”, HP Labs, Palo Alto, CA, October 2006.
- “Processor Support for Platform Level Security”, Intel Corporation, Hudson, MA, September 2006.
- “Virtual Redundant Threading”, University of Virginia, Charlottesville, VA, April 2005.
- “Power Management of Enterprise Storage Systems”, University of Virginia, Charlottesville, VA, April 2005.
- “Power Management of Enterprise Storage Systems”, Purdue University, West Lafayette, IN, April 2005.
- “Power Management of Enterprise Storage Systems”, Rutgers University, New Brunswick, NJ, April 2005.
- “Virtual Redundant Threading”, University of Rochester, Rochester, NY, March 2005.
- “Power Management of Enterprise Storage Systems”, University of Rochester, Rochester, NY, March 2005.
- “Virtual Redundant Threading”, University of Massachusetts – Amherst, Amherst, MA, February 2005.
- “Power Management of Enterprise Storage Systems”, University of Massachusetts – Amherst, Amherst, MA, February 2005.
- “Power Management of Enterprise Storage Systems”, University of Minnesota – Twin-Cities, Minneapolis, MN, February 2005.
- “Power Management of Enterprise Storage Systems” Princeton University, Princeton, NJ, February 2005.
- “Thermal Issues in Disk Drive Design: Challenges and Solutions”, Seagate Research Center, Pittsburgh, PA, March 2005.
- “A Complexity-Effective Approach to ALU Bandwidth Enhancement for Instruction-Level Temporal Redundancy”, Intel Corporation, Hudson, MA, June 2004.
- “Power-Aware Design of the Main-Memory System in Servers”, IBM Research, Austin, TX, August 2003.

### **Invited Technical Panels and Meetings**

- Invited Participant, NSF Workshop on Cross-Layer Power Optimization and Management (CPOM), Los Angeles, CA, February 2012.
- “The Storage Stack of Future Data Centers”, Workshop on Architectural Concerns in Large Datacenters (ACLD), Debate: The Future of Persistent Storage in a Datacenter, Held in conjunction with ISCA 2010, Saint-Malo, France, June 2010.
- “Energy-Efficient Storage for Data Centers”, Regional Energy Initiatives and Opportunities panel, University of Virginia Venture Summit, Charlottesville, VA, March 2010.
- “Towards Hybrid Enterprise Storage Systems”, Storage Networking Industry Association (SNIA) Solid-State Devices (SSD) Forum Meeting, SNIA Summer Symposium, San Jose, CA, July 2008.

## **Graduate Students Directed**

### **Current Advisees**

- Taniya Siddiqua (Advisee since Spring 2008)
  - PhD Qualifying Exam Passed: Fall 2010
  - Expected Graduation: Summer 2012
- Vidyabhushan Mohan (Advisee since Spring 2009)
  - PhD Qualifying Exam Passed: Spring 2011
  - Expected Graduation: Fall 2013
- Sriram Sankar (Advisee since Spring 2011)
  - PhD Qualifying Exam Passed: Fall 2011
  - Expected Graduation: Fall 2013
- Luyao (Karen) Jiang (Independent Study Advisee)

### **Graduated Doctoral Students**

- Clinton Wills Smullen, IV
  - PhD Completed in Fall 2011
  - Dissertation Title: Designing Giga-Scale Memory Systems with STT-RAM
  - First Employment: Google, Mountain View, CA

### **Graduated Masters Students**

- Abhishek Rawat  
MCS, August 2011  
Project Title: *Accelerating Reliability Simulations for NAND Flash based Solid-State Disks*
- Blake Carey Sutton  
MCS, May 2009  
Project Title: *Single-Threaded Mode AVF Prediction During Redundant Execution*
- Kristen Rachelle Walcott  
MCS, May 2007  
Project Title: *Dynamic Prediction of Architectural Vulnerability From Microarchitectural State*

### **Doctoral Committees**

- Ming Mao (*CS - Committee Chair*)  
Advisor: Marty Humphrey
- Sae Woong Kil (*MAE*)  
Thesis Title: A numerical analysis of Fluid-Structure Interactions in an Air and Helium filled Hard Disk Drive  
Advisor: Hossein Haj-Hariri
- Kristen Rachelle Walcott (*CS*)  
PhD Proposal Completed in December 2010  
Thesis Title: Exploiting Hardware Mechanisms and Multicore Technology in Software Testing  
Advisor: Mary Lou Soffa
- Michael Boyer (*CpE*)  
Advisor: Kevin Skadron
- Shuai Che (*CpE*)  
Advisor: Kevin Skadron

- Jiawei Huang (*CpE*)  
PhD Proposal Completed in December 2010  
Thesis Title: ColSpace: A Circuit Design Methodology for Efficiency-Efficacy Tradeoff Using Imprecise Hardware  
Advisor: John Lach
- Nishant George (*CpE*)  
PhD Proposal Completed in March 2010  
Thesis Title: Modeling and Mitigating Emerging Transient Faults in Nanoscale Digital Devices  
Advisor: John Lach
- Adam Cabe (*ECE*)  
PhD Defense Completed in September 2010  
Thesis Title: Power Reduction and Reliability Enhancement Tradeoffs in VLSI Systems  
Advisor: Mircea Stan
- Randy Mann (*ECE*)  
PhD Defense Completed in October 2010  
Thesis Title: Interactions of Technology and Design in Nano-Scale SRAM  
Advisor: Benton Calhoun
- Hao Huang (*CS*)  
PhD Completed in June 2008  
Thesis Title: *Storage@desk: A New Mass Storage System with Quality of Service Guarantees for Large Organizations*  
Advisor: Andrew Grimshaw
- Nathanael R. Paul (*CS*)  
PhD Completed in May 2008  
Thesis Title: *Disk-Level Malware Detection and Response*  
Advisor: David Evans
- Jeremy Sheaffer (*CS*)  
PhD Completed in August 2007  
Thesis Title: *Physical Challenges in Reliable Graphics Hardware Design*  
Advisor: Kevin Skadron
- Yan Zhang (*ECE*)  
PhD Completed in August 2006  
Thesis Title: *Temperature-Aware Power Modeling and Optimization in Deep Submicron CMOS*  
Advisor: Mircea Stan
- Tibor Horvath (*CS*)  
PhD Completed in May 2008  
Thesis Title: *Energy Management in Real-Time Multi-Tier Internet Services*  
Advisor: Kevin Skadron
- Angshuman Parashar (*Penn State CSE*)  
PhD Completed in May 2007  
Thesis Title: *Redundancy and Parallelism Tradeoffs for Reliable, High-Performance Architectures*  
Advisor: Anand Sivasubramaniam
- David Tarjan (*CpE*)  
PhD Completed in June 2009  
Thesis Title: *Efficient Throughput Cores for Asymmetric Manycore Processors*  
Advisor: Kevin Skadron
- Yingmin Li (*CS*)  
PhD Completed in August 2006  
Thesis Title: *Physically Constrained Architecture for Chip Multiprocessors*  
Advisor: Kevin Skadron

## Masters Committees

- Tanima Dey (CS)  
MCS to be Awarded in May 2011  
Project Title: *Characterizing Multi-Threaded Applications based on Shared-Resource Contention*  
Advisors: Jack Davidson and Mary Lou Soffa
- Prateeksha Satyamoorthy (Engineering Physics) - Committee Chair  
MS to be Awarded in May 2011  
Thesis Title: *STT-RAM for Shared Memory in GPUs*  
Advisor: Kevin Skadron
- Anurag Nigam (ECE)  
MS Completed in May 2010  
Thesis Title: *Self Consistent Parameterized Physical MTJ Compact Model for STT-RAM*  
Advisor: Mircea Stan
- Vidyabhushan Mohan (CS)  
MS Completed in May 2010  
Thesis Title: *Modeling the Physical Characteristics of NAND Flash Memory*  
Advisor: Sudhanva Gurumurthi
- Taniya Siddiqua (CS)  
MS Completed in December 2009  
Thesis Title: *Balancing Soft Error Coverage with Lifetime Reliability in Redundantly Multithreaded Processors*  
Advisor: Sudhanva Gurumurthi
- Shuai Che (CpE)  
MS Completed in January 2010  
Thesis Title: *Benchmarking GPUs for General Purpose Applications*  
Advisor: Kevin Skadron
- Steven Christopher Jocke (ECE)  
MS Completed in May 2009  
Thesis Title: *Design and Application of a Sub-Threshold Core Using a Customized Synthesis Flow*  
Advisor: Benton Calhoun
- Clinton Wills Smullen, IV (CS)  
MCS Completed in December 2008  
Project Title: *Revisiting Active Storage for Unstructured Data Processing Applications*  
Advisor: Sudhanva Gurumurthi
- Sriram Sankar  
MS Completed in August 2008  
Thesis Title: *Intra-Disk Parallelism*  
Advisor: Sudhanva Gurumurthi
- Jiayuan Meng (CS) - Committee Chair  
MCS Completed in August 2007  
Project Title: *Temporal and Spatial Streaming on a General Purpose MIMD Manycore Chip*  
Advisor: Kevin Skadron
- Chris White (CS)  
MCS Completed in May 2007  
Project Title: *Managing Data Locality in Hardware with Fractal*  
Advisor: Kevin Skadron
- David Tarjan (CpE)  
MS Completed in January 2007  
Thesis Title: *Merging Path, Global, and Local Indexing in Perceptron Branch Prediction*  
Advisor: Kevin Skadron

## Undergraduate Students and Student Theses Supervised

- Daniel Stephen Lee, March 2008  
Thesis Title: *Performance Evaluation of I/O Virtualization in the Xen Architecture*
- Sean Michael Talts (Summer 2007 REU Student)  
Project Topic: *Prototyping and Performance Evaluation of Disk-Level Malware Detection*

## Teaching

### NOTE:

- The course and instructor ratings are out of 5.0.

Course	Semester	Enrollment	Course Rating	Instructor Rating
CS 654 (Graduate) Computer Architecture	Fall 2005	23	4.10	4.43
CS 851 (Graduate) Advanced Techniques in Computer Architecture and Storage Systems	Spring 2006	8	4.52	4.74
CS 654 (Graduate) Computer Architecture	Fall 2006	29	4.01	4.15
CS 414 (Undergraduate) Operating Systems	Spring 2007	58	4.16	4.18
CS 654 (Graduate) Computer Architecture	Fall 2007	15	4.13	4.36
CS 433 (Undergraduate) Advanced Computer Architecture	Spring 2008	20	3.77	4.15
CS 654 (Graduate) Computer Architecture	Fall 2008	30	4.14	4.26
CS 101E (Undergraduate) Introduction to Computer Science	Spring 2009	88	3.65	3.81
CS 6501 (Graduate) Non-Volatile Memory Systems	Fall 2009	11	4.65	4.76
CS 6354 (Graduate) Computer Architecture	Fall 2010	11	4.07	4.73
CS 1111 (Undergraduate) Introduction to Computer Science	Spring 2011	86	3.99	4.17
CS 6354 (Graduate) Computer Architecture	Fall 2011	20	4.49	4.71

## Professional Service

### Conference Organization Committees

- **Program Committee**, International Green Computing Conference (**IGCC**), 2012.
- **Program Committee**, Non-Volatile Memories Workshop (**NVMW**), 2012.
- **Program Committee**, Workshop on Energy Efficient Design (**WEED**), 2011.
- **Program Committee**, Workshop on Energy Consumption and Reliability of Storage Systems (**ERSS**), 2011.
- **Program Committee**, WOSP/SIPEW International Conference on Performance Engineering (**ICPE**), 2011.
- **Program Committee**, International Symposium on High Performance Computer Architecture (**HPCA**), 2011.
- **Submissions Chair**, International Symposium on High Performance Computer Architecture (**HPCA**), 2011.

- **Program Committee**, IEEE International Symposium on Workload Characterization (**IISWC**), 2010.
- **Program Committee**, Workshop on Energy Efficient Design (**WEED**), 2010.
- **Program Committee**, Workshop on Emerging Storage class memory Technologies (**WEST**), 2010.
- **Program Committee**, USENIX Workshop on Sustainable Information Technology (**SustainIT**), 2010.
- **Program Committee**, USENIX Conference on File and Storage Technologies (**FAST**), 2010.
- **Program Committee**, IEEE Micro Top Picks from Computer Architecture Conferences (**Top Picks**), 2009.
- **Program Committee**, International Symposium on Computer Architecture (**ISCA**), 2009.
- **Program Committee**, International Symposium on Performance Analysis of Systems and Software (**ISPASS**), 2009.
- **Web Chair**, International Conference on Architectural Support for Programming Languages and Operating Systems (**ASPLOS**), 2009.
- **Program Committee**, ACM SIGMETRICS Conference on Measurement and Modeling of Computer Systems (**SIGMETRICS**), 2008.
- **Program Committee**, International Symposium on Performance Analysis of Systems and Software (**ISPASS**), 2008.
- **Program Committee**, International Conference on Architectural Support for Programming Languages and Operating Systems (**ASPLOS**), 2008.
- **Program Committee**, IEEE International Symposium on Workload Characterization (**IISWC**), 2007.
- **Program Committee**, International Conference on Parallel and Distributed Computing and Networks (**PDCN**), 2007.
- **Program Committee**, Reconfigurable and Adaptive Architecture Workshop (**RAAW**), 2006.
- **Program Committee**, Workshop on the Interaction Between Operating System and Computer Architecture (**WIOSCA**), 2006.
- **Program Committee**, International Conference on Parallel Architectures and Compilation Techniques (**PACT**), 2006.
- **Publications Chair**, International Conference on Parallel Architectures and Compilation Techniques (**PACT**), 2006.

## Workshop Organization

- **Workshop Co-Organizer** with Bhuvan Urgaonkar (Penn State), First Workshop on Integrating Solid-State Memory into the Storage Hierarchy (WISH), in conjunction with the International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS), 2009.

## Journal Editorship

- Associate Editor, IEEE Computer Architecture Letters, March 2011-Present.
- Associate Editor-in-Chief, IEEE Computer Architecture Letters, January 2010-March 2011.

## Tutorials

- Phase Change Memory, with Moinuddin Qureshi (IBM Research) and Bipin Rajendran (IBM Research)
  - “System Design with Phase Change Memory - Fundamentals, Opportunities, and Challenges”, The Non-Volatile Memories Workshop (NVMW), March 2011. (**140 Registered Attendees**)
  - “Phase Change Memory Technology - From Devices to Systems”, The International Symposium on Microarchitecture (MICRO), December 2010.
  - “Phase Change Memories: A Systems Perspective”, The International Symposium on High Performance Computer Architecture (HPCA), January 2010.

## Computer Science Department Service

- Graduate Admissions Committee, 2005, 2007, 2008, 2011
- *Chair*, PhD Qualifying Exam, Computer Architecture Reading List Ad-Hoc Committee, 2007
- CS Graduate Curriculum Committee, 2006, 2009
- CpE Graduate Committee, 2009
- Systems Infrastructure Committee, 2005, 2007

## School of Engineering and University Service

- Judge, SEAS Undergraduate Research and Design Symposium (URDS), 2011

## Conference Session Chairmanship

- *I/O Session*, International Symposium on High-Performance Computer Architecture (**HPCA**), 2011.
- *Flash - Savior of the Universe?* Session, USENIX Conference on File and Storage Technologies (**FAST**), 2010.
- *New Memory Technology* Mini-panel Session, International Symposium on Computer Architecture (**ISCA**), 2009.
- *Power and Storage in Enterprise Systems* Session, International Conference on Architectural Support for Programming Languages and Operating Systems (**ASPLOS**), 2009.

## Panel Organization

- **Organizer and Moderator**, Technical Panel: *Benchmarking for the Web 2.0 Era*, held at the IEEE International Symposium on Workload Characterization (**IISWC**), Boston, MA September 2007.

## Funding Panels

- US Department of Energy - 1 panel
- National Science Foundation - CAREER Award Panel (2 panels)
- National Science Foundation - Computer Architecture Panel (3 panels)
- National Science Foundation - Computer Systems Panel (1 panel)

## Grant Proposal Peer-Reviewing Activities

- National Science Foundation, 2009
- US-Israel Binational Science Foundation, 2009
- Swiss National Science Foundation, 2007
- University of California Energy Institute, 2006

## Conference and Journal Peer-Reviewing Activities

- *Selected Conferences*: International Symposium on Computer Architecture (ISCA), International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS), International Symposium on High Performance Computer Architecture (HPCA), USENIX Conference on File and Storage Technologies (FAST), International Conference on Dependable Systems and Networks (DSN), International Symposium on Performance Analysis of Systems and Software (ISPASS), ACM SIGPLAN/SIGBED Conference on Languages, Compilers, and Tools for Embedded Systems (LCTES), International Parallel and Distributed Processing Symposium (IPDPS), International Conference on Supercomputing (ICS)

- *Journals*: IEEE Embedded Systems Letters, ETRI Journal, IEEE Transactions on Computer Aided Design of Integrated Circuits and Systems, ACM Transactions on Design Automation of Electronic Systems, IEEE Spectrum, IEEE Transactions on Knowledge and Data Engineering, Elsevier Computer Networks, IEEE Transactions on Dependable and Secure Computing, IEEE Computer Architecture Letters, IEEE Transactions on Very Large Scale Integration Systems, ACM/Springer Multimedia Systems Journal, ACM Transactions on Architecture and Code Optimization, ACM Transactions on Storage, IEEE Transactions on Parallel and Distributed Systems, IEEE Transactions on Computers, GEOINFORMATICA Journal

### **Textbook Reviewing Activities**

- *Computer Systems: An Integrated Approach to Architecture and Operating Systems* by Umakishore Ramachandran (*Georgia Tech*), Addison-Wesley Publishing, 2008.
- *Computer Architecture: A Quantitative Approach* (Fourth Edition) by John Hennessy (*Stanford U.*) and David Patterson (*UC Berkeley*), Morgan Kaufmann Publishers/Elsevier, 2006.
- *Architecture Design for Soft Errors* by Shubhendu Mukherjee (*Intel Corporation*), Morgan Kaufmann Publishers/Elsevier, 2006/2007.

### **Professional Society Memberships**

- IEEE Computer Society (*Senior Member*)
- ACM SIGARCH (*Senior Member*)
- USENIX