

Adrian M. Caulfield

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Research Interests

My research interests straddle the boundary between hardware and software, with a focus on optimizing the use of non-volatile storage technologies in high performance computing systems. I look for ways of improving the performance of computer systems by co-designing hardware and software interfaces, optimizing software stacks, and integrating new memory technologies. My research includes both computer architecture and systems work, including storage system architecture design, hardware design and implementation, and operating system optimization. I enjoy working on large-scale research projects with working fully implemented hardware prototypes.

Education

In Progress: Ph.D., Computer Engineering Advisor: Dr. Steven Swanson University of California, San Diego, CA	Expected 2013
C.Phil, Computer Science Advisor: Dr. Steven Swanson University of California, San Diego, CA	2011
M.S., Computer Science Advisor: Dr. Steven Swanson University of California, San Diego, CA	2010
B.A., Computer Science with Minor in Mathematics Advisor: Dr. Mark Oskin University of Washington, Seattle, WA	2007

Research

Moneta/HASTE, University of California, San Diego Advisor: Dr. Steven Swanson Led the design and implementation of Moneta. Moneta is a complete FPGA based storage platform, targeting advanced non-volatile memory technologies like Phase Change Memory. It connects via PCI-express to a host system, and runs a heavily optimized, fully custom I/O stack allowing direct access to storage from applications without operating system and file system overheads.	2009-Present
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Non-Volatile Transactional Memory, University of California, San Diego **2009-Present**

Advisor: Dr. Steven Swanson

Designed and built a non-volatile memory emulation system to emulate software running on a system with both DRAM and non-volatile memories with varying latencies. Designed workloads for evaluating transactional memory system implementations.

Flash Memory Characterization, University of California, San Diego **2008-Present**

Advisor: Dr. Steven Swanson

Designed and built a Flash memory characterization platform using an FPGA prototyping board with custom daughter board. This platform allows for the direct analysis of Flash memory characteristics such as operation latencies, power usage, and other performance characteristics.

Gordon, University of California, San Diego **2007-2008**

Advisor: Dr. Steven Swanson

Designed a power and performance model to evaluate non-volatile memory viability on cluster based data-centric workloads. Designed an energy efficient system architecture for processing terabytes of data.

Research Accelerator for Multiple Processors (RAMP), University of Washington **2006-2007**

Advisor: Dr. Mark Oskin

Helped design and implement a prototype system based on a cluster of FPGAs with 8 Xilinx Microblaze cores each working towards a 1000+ processor system for many core research.

Refereed Journal and Conference Publications

Caulfield, A. M., Swanson, S. QuickSAN: A Storage Area Network for Fast, Distributed, Solid State Disks. *To appear in ISCA '13: Proceedings of the 40th annual International Symposium on Computer Architecture* (Tel-Aviv, Israel. June 23-27, 2013).

Caulfield, A. M., Mollov, T. I., Eisner, L., De, A., Coburn, J., Swanson, S. Providing Safe, User Space Access to Fast, Solid State Disks. *ASPLOS'12: Proceedings of the 17th international conference on Architectural Support for Programming Languages and Operating Systems* (London, England. March 3-7, 2012).

Akel, A., Caulfield, A. M., Mollov, T. I., Gupta R. K., Swanson, S. Onyx: A Prototype Phase-Change Memory Storage Array. In *Proceedings of the 3rd USENIX conference on Hot topics in storage and file systems* (Portland, Oregon, June 14, 2011). HotStorage'11.

Coburn, J., Caulfield, A. M., Akel, A., Grupp, L. M., Gupta, R. K., Jhala, R., Swanson, S. 2011. NV-Heaps: Making Persistent Objects Fast and Safe with Next-Generation, Non-Volatile Memories. *ASPLOS'11: Proceedings of the 16th international conference on Architectural Support for Programming Languages and Operating Systems* (Newport Beach, California. March 5-11, 2011).

Caulfield, A. M., De, A., Coburn, J., Mollov, T. I., Gupta, R. K., Swanson, S. Moneta: A High-performance Storage Array Architecture for Next-generation, Non-volatile Memories. In *Proceedings of the 43rd Annual IEEE/ACM international Symposium on Microarchitecture* (Atlanta, Georgia, December 4-8, 2010). MICRO 43. ACM, New York, NY.

Grupp, L. M., Caulfield, A. M., Coburn, J., Davis, J., Swanson, S. 2010. Beyond the Datasheet: Using Test Beds to Probe Non-Volatile Memories' Dark Secrets. In *Proceedings of IEEE Globecom 2010 Workshop on Application of Communication Theory to Emerging Memory Technologies* (Miami, Florida. December 6, 2010). ACTEMT 2010.

Caulfield, A. M., Coburn, J., Mollov, T. I., De, A., Akel, A., He, J., Jagatheesan, A., Gupta, R. K., Snavely, A., Swanson, S. Understanding the Impact of Emerging Non-Volatile Memories on High-Performance, IO-Intensive Computing. In *Proceedings of the Conference on High Performance Computing, Networking, Storage, and Analysis* (New Orleans, Louisiana, November 13 – 19, 2010). SC'10. ACM, New York, NY.

Lee, S., Fleming, K., Park, J., Ha K., Caulfield, A. M., Swanson S., Arvind, Kim, J. 2010. BlueSSD: An Open Platform for Cross-layer Experiments for NAND Flash-based SSDs. *Workshop on Architectural Research Prototyping* (Saint-Malo, France. June 19, 2010).

Grupp, L. M., Caulfield, A. M., Coburn, J., Swanson, S., Yaakobi, E., Siegel, P. H., and Wolf, J. K. 2009. Characterizing flash memory: anomalies, observations, and applications. In *Proceedings of the 42nd Annual IEEE/ACM international Symposium on Microarchitecture* (New York, New York, December 12 - 16, 2009). MICRO 42. ACM, New York, NY, 24-33

Caulfield, A. M., Grupp, L. M., and Swanson, S. 2009. Gordon: using flash memory to build fast, power-efficient clusters for data-intensive applications. In *Proceeding of the 14th international Conference on Architectural Support For Programming Languages and Operating Systems* (Washington, DC, USA, March 07 - 11, 2009). ASPLOS '09. ACM, New York, NY, 217-228 (**Selected for Micro Top Picks 2009**)

Other Publications

Putnam, A., Caulfield, A. 2007. RAMP Purple: Scalable Many-Core Processor Emulation for Architecture, Compiler, and Programming Language Research. DAC University Booth. (San Diego, CA. 2007).

Talks & Presentations

“Moneta-Direct: Providing Safe, User Space Access to Fast, Solid State Disks.” March 2012
17th International Conference on Architectural Support for Programming Language and Operating Systems
London, UK

“Moneta: High-performance Storage Array Architecture for Next-generation, Non-volatile Memories” March 2011
2011 Non-Volatile Memories Workshop
La Jolla, CA

“Moneta: A High-performance Storage Array Architecture for Next-generation, Non-volatile Memories” Dec. 2010
43rd International Symposium on Microarchitecture
Atlanta, GA

“Gordon” March 2009
14th International Conference on Architectural Support for Programming Language and Operating Systems
Washington, D.C.

“Performance Optimizations for Advanced Non-volatile Storage Arrays” August 2010
2010 Flash Memory Summit
Santa Clara, CA

“Secure Erasure of Flash Memory” August 2009
2009 Flash Memory Summit
Santa Clara, CA

Teaching Experience

Teaching Assistant. *UCSD CSE 141L* – Introduction to Computer Architecture (Lab) Winter 2012
Designed and created infrastructure to teach course based on MIPS ISA, leading students through the design and implementation of a single-cycle and then 5-stage pipelined MIPS processor in Verilog. Assisted with grading, held lab hours, and responded to student questions.

Professional Service

Submissions chair for Non-Volatile Memories Workshop 2011-2012
External reviewer for HPCA 2012
External reviewer for HPCA 2011

References

Available on request.