David E. Irwin

CONTACT INFORMATION

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INTERESTS

Cyber-Physical Systems, Sustainability, Green Computing, Cloud Computing, Sensor Systems

EDUCATION

Duke University. Ph.D. in Computer Science, December 2007
Advisor: Jeffrey S. Chase
Dissertation: *An Operating System Architecture for Networked Server Infrastructure*

Duke University. Master of Science in Computer Science, December 2005
Advisor: Jeffrey S. Chase

Vanderbilt University. Bachelor of Science, May 2001 (*magna cum laude*)
Double Major: Mathematics and Computer Science

RESEARCH SUMMARY AND BACKGROUND

I design and build experimental software systems. My primary research efforts focus primarily on Cyber-Physical Systems (CPS) with an emphasis on sustainability, as well as topics that will influence future CPSs, including Green Computing, Embedded Sensor Systems, and Next-generation Clouds and Networks.

ACADEMIC APPOINTMENTS

University of Massachusetts Amherst, **Assistant Professor**
Electrical and Computer Engineering Department, September 2012-present
Lead research in the Sustainable and Efficient Systems Laboratory. My research lies at the intersection of cyber-physical systems, sensing systems, and next-generation clouds and networks with a particular focus on sustainability.

Williams College, **Adjunct Faculty**
Computer Science Department, January 2009 and 2011
In the past, I have taught month-long seminars during the winter session on special topics in Computer Engineering. Past courses have focused on the technology that underlies Google and Green Computing.

University of Massachusetts Amherst, **Postdoctoral Research Associate**
Computer Science Department, September 2007-August 2012
Led research, taught courses, and mentored graduate and undergraduate students as part of the Laboratory for Advanced System Software.

Duke University, **Research Assistant**
Computer Science Department, September 2002-August 2007
Developed a platform for managing networked resources as part of my dissertation research. The platform serves as one of four control frameworks selected to be the foundation of NSF's GENI prototype.

Duke University, **Research Assistant**
Computer Science Department, May 2002-August 2002
Designed I/O efficient algorithms for parallel disks under Jeff Vitter. Received a scholarship to attend the EEF Summer School on Massive Data Sets at BRICS, which surveyed the state-of-the-art in the design and analysis of external memory algorithms and data structures.

PROFESSIONAL APPOINTMENTS

Hewlett-Packard Research Lab, **Research Intern**
March 2004-September 2004

In collaboration with Partha Ranganathan, designed and implemented policies for ensemble-level power management of dense servers to dynamically cap power usage while minimally affecting application-level performance. The research resulted in a publication at ISCA [25] as well as technology to be shipped in commercial blade servers.

IBM T.J. Watson Research Center, **Research Intern**
May 2003-August 2003
In collaboration with Lisa Amini, investigated techniques for leveraging emerging Grid technologies, e.g., the Globus toolkit, for adaptive load-shedding between Grid sites.

REFEREED PUBLICATIONS

Works in this category are refereed standard-length conference and workshop publications.

1. Aditya Mishra, **David Irwin**, Prashant Shenoy, Jim Kurose, and Ting Zhu. SmartCharge: Cutting the Electricity Bill in Smart Homes with Energy Storage. In *Proceedings of the Third International Conference on Future Energy Systems (e-Energy)*, Madrid, Spain, May 2012. Acceptance Ratio: 22/63 = 35%.
2. Barath Raghavan, **David Irwin**, Jeannie Albrecht, Justin Ma, and Adam Streed. An Intermittent Energy Internet Architecture. In *Proceedings of the Third International Conference on Future Energy Systems (e-Energy)*, Madrid, Spain, May 2012. Acceptance Ratio: 7/22 = 32%. **Short Paper.**.
3. Sean Barker, Aditya Mishra, **David Irwin**, Prashant Shenoy, and Jeannie Albrecht. SmartCap: Flattening Peak Electricity Demand in Smart Homes. In *Proceedings of the Tenth IEEE International Conference on Pervasive Computing and Communications (PerCom)*, Lugano, Switzerland, March 2012. Acceptance Ratio: 16/150 = 11%. **Appears in Best Papers Session**.
4. Andrés Molina-Markham, George Danezis, Kevin Fu, Prashant Shenoy, and **David Irwin**. Designing Privacy-preserving Smart Meters with Low-cost Microcontrollers. In *Proceedings of the Sixteenth International Conference on Financial Cryptography and Data Security (FC)*, Bonaire, February 2012. Acceptance Ratio: 23/88 = 26%.
5. **David Irwin**, Anthony Wu, Sean Barker, Aditya Mishra, Prashant Shenoy, and Jeannie Albrecht. Exploiting Home Automation Protocols for Load Monitoring in Smart Buildings. In *Proceedings of the Third Workshop On Embedded Sensing Systems For Energy-Efficiency In Buildings (BuildSys)*, pages 7–12, Seattle, Washington, November 2011. Acceptance Ratio: 10/29 = 35%.
6. Ting Zhu, Aditya Mishra, **David Irwin**, Navin Sharma, Don Towsley, and Prashant Sheony. The Case for Efficient Renewable Energy Management for Smart Homes. In *Proceedings of the Third Workshop On Embedded Sensing Systems For Energy-Efficiency In Buildings (BuildSys)*, pages 67–72, Seattle, Washington, November 2011. Acceptance Ratio: 10/29 = 34.5%.
7. Navin Sharma, Pranshu Sharma, **David Irwin**, and Prashant Shenoy. Predicting Solar Generation from Weather Forecasts Using Machine Learning. In *Proceedings of the Second IEEE International Conference on Smart Grid Communications (SmartGridComm)*, Brussels, Belgium, October 2011. Acceptance Ratio: 105/265 = 40%.
8. **David Irwin**, Navin Sharma, and Prashant Shenoy. Towards Continuous Policy-driven Demand Response in Data Centers. *Computer Communications Review (CCR)*, 41(4):489–494, October 2011. **GreenNets'11 paper re-published in SIGCOMM 2011 Best Workshop Papers section**.
9. **David Irwin**, Navin Sharma, and Prashant Shenoy. Towards Continuous Policy-driven Demand Response in Data Centers. In *Proceedings of the SIGCOMM Workshop on Energy and IT: from Green Networking to Smarter Systems (GreenNets)*, pages 19–24, Toronto, Canada, August 2011. Acceptance Ratio: 8/19 = 42%. **Best Paper Award**.
10. Ville Satopää, Jeannie Albrecht, **David Irwin**, and Barath Raghavan. Finding a 'Kneedle' in a Haystack: Detecting Knee Points in System Behavior. In *Proceedings of the Third ICDCS Workshop on Simplifying Complex Networks for Practitioners (Simplex)*, pages 166–171, Minneapolis, Minnesota, June 2011.

11. Navin Sharma, Sean Barker, **David Irwin**, and Prashant Shenoy. Blink: Managing Server Clusters on Intermittent Power. In *Proceedings of the Sixteenth International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS)*, pages 185–198, Newport Beach, California, March 2011. Acceptance Ratio: 32/152 = 21%.

12. Navin Sharma, **David Irwin**, Prashant Shenoy, and Michael Zink. MultiSense: Fine-grained Multiplexing for Steerable Camera Sensor Networks. In *Proceedings of the Second ACM Multimedia Systems Conference (MMSys)*, pages 23–34, San Jose, California, February 2011. Acceptance Ratio: 15/41 = 37%.

13. Ilia Baldine, Yufeng Xin, Anirban Mandal, Chris Heermann, Jeffrey Chase, Varun Marupadi, Aydan Yumerefendi, and **David Irwin**. Networked Cloud Orchestration: A GENI Perspective. In *Proceedings of the Second IEEE Workshop on Management of Emerging Networks and Services (MENS)*, pages 573–578, Miami, Florida, December 2010.

14. Andrés Molina-Markham, Prashant Shenoy, Kevin Fu, Emmanuel Cecchet, and **David Irwin**. Private Memoirs of a Smart Meter. In *Proceedings of the Second Workshop On Embedded Sensing Systems For Energy-Efficiency In Buildings (BuildSys)*, pages 61–66, Zürich, Switzerland, November 2010. Acceptance Ratio: 14/40 = 35%.

15. Navin Sharma, Jeremy Gummeson, **David Irwin**, and Prashant Shenoy. Cloudy Computing: Leveraging Weather Forecasts in Energy Harvesting Sensor Systems. In *Proceedings of the Seventh Annual IEEE Communications Society Conference on Sensor, Mesh, and Ad Hoc Communications and Networks (SECON)*, pages 136–144, Boston, Massachusetts, June 2010. Acceptance Ratio: 63/268 = 23%.

16. Bo An, Victor Lesser, **David Irwin**, and Michael Zink. Automated Negotiation with Decommitment for Dynamic Resource Allocation in Cloud Computing. In *Proceedings of the Ninth International Conference on Autonomous Agents and Multiagent Systems (AAMAS)*, pages 981–988, Toronto, Canada, May 2010. Acceptance Ratio: 163/685 = 24%.

17. **David Irwin**, Navin Sharma, Michael Zink, and Prashant Shenoy. Towards a Virtualized Sensing Environment. In *Proceedings of the Sixth International Conference on Testbeds and Research Infrastructures for the Development of Networks and Communities (TridentCom)*, pages 133–142, Berlin, Germany, May 2010.

18. Navin Sharma, Jeremy Gummeson, **David Irwin**, and Prashant J. Shenoy. SRCP: Simple Remote Control for Perpetual High-power Sensor Networks. In *Proceedings of the Sixth European Conference on Wireless Sensor Networks (EWSN)*, pages 358–374, Cork, Ireland, February 2009. Acceptance Ratio: 23/145 = 16%.

19. Aydan Yumerefendi, Piyush Shivam, **David Irwin**, Pradeep Gunda, Laura Grit, Azbayar Demberel, Jeff Chase, and Shivnath Babu. Towards an Autonomic Computing Testbed. In *Proceedings of the Second Workshop on Hot Topics in Autonomic Computing (HotAcII)*, Jacksonville, Florida, June 2007. Acceptance Ratio: 5/17 = 29%.

20. Jeff Chase, Laura Grit, **David Irwin**, Varun Marupadi, Piyush Shivam, and Aydan Yumerefendi. Beyond Virtual Data Centers: Toward an Open Resource Control Architecture. In *Proceedings of the International Conference on the Virtual Computing Initiative (ICVCI)*, Research Triangle Park, North Carolina, May 2007

21. Laura Grit, **David Irwin**, Varun Marupadi, Piyush Shivam, Aydan Yumerefendi, Jeff Chase, and Jeannie Albrecht. Harnessing Virtual Machine Resource Control for Job Management. In *Proceedings of the First Workshop on System-level Virtualization for High Performance Computing (HPCVirt)*, Lisbon, Portugal, March 2007.

22. Lavanya Ramakrishnan, Laura Grit, Adriana Iamanitchi, **David Irwin**, Aydan Yumerefendi, and Jeff Chase. Toward a Doctrine of Containment: Grid Hosting with Adaptive Resource Control. In *Proceedings of the Nineteenth International Conference for High Performance Computing, Networking, Storage and Analysis (SC)*, Tampa, Florida, November 2006. Acceptance Ratio: 54/239 = 23%.

23. Laura Grit, **David Irwin**, Aydan Yumerefendi, and Jeff Chase. Virtual Machine Hosting for Networked Clusters: Building the Foundations for "Autonomic" Orchestration. In *Proceedings of the First International Workshop on Virtualization Technology in Distributed Computing (VTDC)*, Tampa, Florida, November 2006.
24. **David Irwin**, Jeff Chase, Laura Grit, Aydan Yumerefendi, David Becker, and Kenneth G. Yocum. Sharing Networked Resources with Brokered Leases. In *Proceedings of the USENIX Annual Technical Conference (USENIX)*, pages 199–212, Boston, Massachusetts, June 2006. Acceptance Ratio: 21/153 = 14%.
25. Parthasarathy Ranganathan, Phil Leech, **David Irwin**, and Jeffrey Chase. Ensemble-level Power Management for Dense Blade Servers. In *Proceedings of the Thirty-third Annual International Symposium on Computer Architecture (ISCA)*, pages 66–77, Boston, Massachusetts, June 2006. Acceptance Ratio: 31/234 = 13%.
26. **David Irwin**, Jeff Chase, Laura Grit, and Aydan Yumerefendi. Self-Recharging Virtual Currency. In *Proceedings of the Third SIGCOMM Workshop on Economics of Peer-to-Peer Systems (ECONP2P)*, pages 93–98, Philadephia, Pennslyvania, August 2005. Acceptance Ratio: 11/38 = 29%.
27. **David E. Irwin**, Laura E. Grit, and Jeffrey S. Chase. Balancing Risk and Reward in a Market-based Task Service. In *Proceedings of the Thirteenth Annual Symposium on High Performance Distributed Computing (HPDC)*, pages 160–169, Honolulu, Hawaii, June 2004. Acceptance Ratio: 24/153 = 16%.
28. Jeffrey S. Chase, **David E. Irwin**, Laura E. Grit, Justin D. Moore, and Sara E. Sprenkle. Dynamic Virtual Clusters in a Grid Site Manager. In *Proceedings of the Twelfth Annual Symposium on High Performance Distributed Computing (HPDC)*, pages 90–100, Seattle, Washington, June 2003. Acceptance Ratio: 25/121 = 21%.

OTHER PUBLICATIONS

Works in this category are papers reporting on significant research activities not reflected in the papers above, including refereed posters and demonstrations, invited papers, and technical reports.

29. Dilip Kumar Krishnappa, Eric Lyons, **David Irwin**, and Michael Zink. Compute Cloud Based Weather Detection and Warning System. In *Proceedings of the IEEE International Geoscience and Remote Sensing Symposium (IGARSS)*, Munich, Germany, July 2012. **Poster Paper**.
30. **David Irwin**, Prashant Shenoy, Emmanuel Cecchet, and Michael Zink. Resource Management in Data-Intensive Clouds: Opportunities and Challenges. In *Proceedings of the Seventeenth IEEE Workshop on Local and Metropolitan Area Networks (LANMAN)*, pages 1–6, Long Branch, New Jersey, May 2010. **Invited Paper**.
31. Piyush Shivam, Azbayar Demberel, Pradeep Gunda, **David Irwin**, Laura Grit, Aydan Yumerefendi, Shivnath Babu, and Jeff Chase. Automated and On-Demand Provisioning of Virtual Machines for Database Applications. In *Proceedings of the Twenty-sixth ACM SIGMOD Conference on Management of Data (SIGMOD)*, pages 1079–1081, Beijing, China, June 2007. Acceptance Ratio: 35/95 = 36.8%. **Demo Paper**.
32. **David Irwin**, Jeff Chase, Laura Grit, Aydan Yumerefendi, and Jeannie Albrecht. Underware: An Exokernel for the Internet? Technical report, Duke University CS-2007-01, January 2007.
33. Laura Grit, **David Irwin**, Aydan Yumerefendi, and Jeff Chase. Shirako: Virtual Machine Hosting for Networked Clusters. In *Session Proceedings of the Seventh USENIX Symposium on Operating System Design and Implementation (OSDI)*, Seattle, Washington, November 2006. **Poster Paper**.
34. Justin Moore, **David Irwin**, Laura Grit, Sara Sprenkle, and Jeff Chase. Managing Mixed-Use Clusters with Cluster-on-Demand. Technical report, Duke University CS-2002-07, November 2002.

SUBMITTED WORK

Works in this category are papers currently in submission to refereed journals, conferences, and workshops.

35. Navin Sharma, Jeremey Gummeson, **David Irwin**, Ting Zhu, and Prashant Shenoy. Leveraging Weather Forecasts in Energy Harvesting Systems. *Tranasactions on Parallel and Distributed Systems. Under Review*, May 2012.
36. Navin Sharma, **David Irwin**, and Prashant Shenoy. A Distributed File System for Intermittent Power. In *Submission*, May 2012.
37. Dilip Kumar Krishnappa, Eric Lyons, **David Irwin**, and Michael Zink. CloudCast: Cloud Computing for Short-term Mobile Weather Forecasts. In *Submission*, May 2012.
38. Dilip Kumar Krishnappa, Eric Lyons, **David Irwin**, and Michael Zink. Network Capabilities of Cloud Services for a Real Time Scientific Application. In *Submission*, April 2012.
39. Navin Sharma, **David Irwin**, Prashant Shenoy, and Michael Zink. MultiSense: Proportional-Share for Mechanically Steerable Sensor Networks. *Multimedia Systems Journal. Under Review*, April 2012.

PANELS AND PRESENTATIONS

"An Intermittent Energy Internet Architecture" e-Energy, May 2012.
"Sensor-driven Energy Management for Sustainable Buildings" UMass Amherst, ECE, April 2012.
"Towards Continuous Policy-driven Demand Response in Data Centers" GreenNet, August 2011.
"Nowcasting: CASA Weather Radar Demonstration" GENI Alpha Demo at GEC9, November 2010.
"Cloudy Computing: Leveraging Weather Forecasts in Sensor Systems" at SECON, June 2010.
"Towards a Virtualized Sensing Environment" at TridentCom, May 2010.
"ViSE: A Virtualized Sensing Environment" at GEC3, October 2008.
"Adaptive Virtual Machine Hosting with Shirako" at UCSD, August 2006.
"Sharing Networked Resources with Brokered Leases" at USENIX, June 2006.
"Self-Recharging Virtual Currency" at ECONP2P, August 2005.
"Design and Implementation of Shirako" at UCSD, June 2005.
"Balancing Risk and Reward in a Market-based Task Scheduler" at HPDC, June 2004.
"Dynamic Virtual Clusters in a Grid Site Manager" at HPDC, June 2003.

SERVICE

Programm Committee: 2012 Conference on Testbeds and Research Infrastructures for the Development of Networks and Communities (TridentCom).
Programm Committee: 2009 Workshop on Hot Topics in Cloud Computing (HotCloud).

FUNDING

NSF SDCI Program. Senior Personnel. *The Missing Link: Connecting Eucalyptus Clouds with Multi-Layer Networks*. Sub-contract from Duke University. Funded September 1st, 2010-August 31st, 2013. $401,000.

NSF GENI Program (Solicitation 2). Principal Author and Senior Personnel. *Data-Intensive Cloud Control for GENI*. Funded October 1st, 2009 - September 30th, 2012. $534,000.

NSF GENI Program (Solicitation 1). Co-author and Senior Personnel. *Sensor Virtualization and Slivering in an Outdoor Wide-Area Wireless GENI Sensor/Actuator Network Testbed*. Funded October 1st, 2008 - September 30th, 2011. $490,000.

PROFESSIONAL AFFILIATIONS

I am a member of the Association for Computing Machinery (ACM), the ACM Special Interest Group on Operating Systems (SIGOPS), the USENIX Association, and the IEEE Computer Society.

TEACHING EXPERIENCE

Instructor, *CSCI W014 Green Computing*, Winter 2011
Developed a course on Green Computing at Williams College. The course covered the latest research topics and includes a lab component, where students modify Kill-A-Watt power meters from Home Depot to broadcast readings wirelessly to servers.

Instructor, *CSCI W011 Inside Google: The Technology and Its Impact on Our Culture*, Winter 2009
Developed and taught a course on the technology, including MapReduce, PageRank, Google File System, and BigTable, that underlies Google at Williams College.