CANTURK ISCI

CONTACT INFORMATION

5308 Riverside Station Blvd
Secaucus, NJ 07093 USA

Phone: +1 609 468 7744
E-mail: canturk@alumni.princeton.edu
Web: http://www.canturkisci.com/

INTERESTS

- Cloud computing and virtualization
- Sustainable, green computing, data center energy, performance and resource management
- Computer architecture and its interaction with systems software
- Energy-efficient, adaptive and reliable computing systems

EDUCATION

Ph.D. **Princeton University**, Princeton, NJ — Sep 2001 – Jun 2007
M.A. Electrical Engineering
Advisor: Margaret Martonosi

M.Sc. **University of Westminster**, London, UK — Sep 2000 – Sep 2001
VLSI System Design (*Graduated with Distinction*)
Advisors: Izzet Kale and R.C.S. Morling

B.Sc. **Bilkent University**, Ankara, Turkey — Sep 1996 – Jun 2000
Electrical and Electronics Engineering (*Graduated with High Honors*)

PROFESSIONAL EXPERIENCE

IBM T.J. Watson Research Center, Hawthorne, NY

Research Staff Member in Data Center Energy Management Group — Oct 2008 – Present

- Led and contributed to several projects on adaptive, runtime, autonomic and distributed energy, performance and thermal management of virtualized environments, data centers, systems and processor microarchitectures.
- Led the invention, design and implementation of a novel, hypervisor-agnostic virtualization resource management technology, based on runtime virtual machine demand estimation, which is integrated into multiple IBM virtualization management products including WebSphere CloudBurst Appliance and VMControl.
- Served as the technical lead for a new, highly-efficient and aggressive virtualization power management project spanning multiple years from initial concept, design and development to a complete full prototype implementation, collaborating with multiple teams across different geographies. The outcome of this work influenced key energy and virtualization design configurations for IBM enterprise systems and management middleware products.
- Worked on the design and full hardware-software implementation of an autonomic data center robot for monitoring and optimizing cooling infrastructure and for tracking IT assets. The developed robotic mapping and monitoring technology is used in multiple live data centers, is showcased in major industry forums including Tivoli Pulse and Advanced Energy Conference, and is included in four IBM Industry Solutions Labs worldwide.

VMware Inc., Palo Alto, CA

Senior Member of Technical Staff in R&D Performance Group — Jul 2007 – Oct 2008

- Worked on characterizing and improving the performance and scalability of VMware VirtualCenter virtualization management infrastructure and its core services.
- Identified key scalability trends, performance bottlenecks and improvements in virtualized systems. Designed solutions addressing key performance issues and improvements that have been integrated into VMware's virtualization management products including VirtualCenter (vCenter), Distributed Resource Scheduling (DRS) and Distributed Power Management (DPM).
- Led the power-performance analysis and optimization research and development for DRS and DPM. Developed a cluster-level power-performance analysis framework for DRS and DPM.
- Contributed to distributed and local resource management policies of VirtualCenter management endpoint and ESX hypervisor.

Princeton University, Department of Electrical Engineering, Princeton, NJ

Research Assistant in Parapet Research Group Sep 2001 – Jun 2007

- Conducted research on runtime modeling of processor power and thermal behavior on real systems. Developed runtime power and temperature estimation frameworks.
- Investigated repetitive phase behavior of applications. Demonstrated effective phase classification techniques based on runtime performance monitoring and application control-flow signatures with dynamic instrumentation.
- Devised novel online phase detection, phase and duration prediction methods that are resilient to real-system variability effects for dynamically-varying application behavior.
- Designed and evaluated workload-adaptive, autonomous and predictive power management techniques for real systems and future chip multiprocessor architectures.

Intel Research, Corporate Technology Group/System Technology Lab, Hillsboro, OR

Intern in Platform Capabilities Lab May 2006 – Sep 2006

Worked on energy-efficient resource allocation in heterogeneous data centers. Developed architectural feature based analytical models and training based statistical methods to predict workload behavior across platforms. Implemented a phase prediction based, workload adaptive frequency scaling governor for a new multi-core server platform. Designed allocation policies that utilize across-platform workload behavior predictors for energy-efficient management of large-scale data centers.

Managers: Ram Chary/Rick Forand, *Mentor:* Eugene Gorbatov

IBM T.J. Watson Research Center, Yorktown Heights, NY

Intern in Reliability and Power Aware Microarchitectures Group Jun 2005 – Sep 2005

Worked on global power management techniques for chip multiprocessors. Developed a trace based multiprocessor analysis tool for early evaluation of global power management policies. Explored different methods for dynamically tuning the execution of individual cores to meet chip-level power/performance goals. Designed and evaluated per-core dynamic voltage and frequency scaling policies to meet chip-wide power budget targets.

Manager: Pradip Bose, *Mentor:* Alper Buyuktosunoglu

IBM T.J. Watson Research Center, Yorktown Heights, NY

Co-op in Reliability and Power Aware Microarchitectures Group Jul 2004 – Dec 2004

Worked on runtime performance monitoring and phase analysis of IBM POWER4 systems. Designed long-term value and duration prediction methodologies for workload performance phase behavior with applications to dynamic voltage and frequency scaling. Contributed in automated thermal microbenchmark generation for online temperature analysis of real systems.

Manager: Pradip Bose, *Mentor:* Alper Buyuktosunoglu

HONORS AND AWARDS

Best Paper Award with *Towards Data Center Self-Diagnosis Using a Mobile Robot*, IEEE ICAC 2011	2011
Best of Show Award with *Robotic Mapping and Monitoring of Data Centers and Workplaces with THOMAS*, IBM TechConnect 2010	2010
Best Research Poster with *Predicting VM Behavior for DRS & DPM Cost/Benefit Analysis*, VMWorld'08, Las Vegas, NV	2008
Graduate Fellowship, Princeton University, Department of Electrical Engineering	2001 – 2002
M.Sc. with Distinction, University of Westminster, Department of Electronic Systems, London, UK	2001
Millennium Scholarship, awarded by British Council to a single candidate in Turkey for postgraduate study in Britain	2000 – 2001
Ranked 33rd in National Selection Examination for Graduate Studies (LES) among approximately one hundred thousand candidates, Turkey	2000
Undergraduate Fellowship, Bilkent University, Ankara, Turkey	1996 – 2000
Ranked 45th in National University Entrance Exam among approximately 1.5 million candidates, Turkey	1996
Ranked 11th in National Physics Olympiads, Turkey	1995

ACTIVITIES

Industry Chair, IEEE Computer Society, Special Technical Community on Sustainable Computing	2011 – Present
Invited Keynote Speaker, IEEE TEMM 2011, Thermal Monitoring and Management in Large Scale Computing Systems	2011
Chair of Academic Affairs, Princeton University Graduate Student Government	2005 – 2006
Organizer of Computer Engineering Graduate Workshop (CEW), Princeton University, Department of Electrical Engineering	2002 – 2003
Member, IEEE	1999 – Present

Program Committee Member for IEEE IPDPS'09, ACM SIGCOMM e-Energy'10, IEEE ISPA'10, ACM ICS'11, ACM SIGMETRICS'11, HPPAC'11, IEEE ERSS'11, ACM GreenMetrics'11

Reviewer for PACT'03, HPCA'04, ISCA'04, ISLPED'04, ASPLOS'04, MICRO'04, ISLPED'05, PAC2'05, CAL'05, ISPASS'06, ASPLOS'06, SC'06, TPDS'07, TCAD'07, HPPAC'07, DAC'07, ISCA'07, TPDS'08, TACO'08, MICRO'08, TC'08, HPCA'08, TCAD'09, ISPASS'09, HPCA'09, TC'09, PACT'09, ISLPED'09, IPDPS'09, TACO'09, TPDS'09, ISCA'10, TPDS'10, e-Energy'10, ISPA'10, HPDC'10, SC'10, IM'11, TACO'11, SC'11, SIGMETRICS'11, ICS'11, HPPAC'11, ERSS'11, GreenMetrics'11

PUBLICATIONS

(Electronic copies available at **`http://www.canturkisci.com/ETC/MYpublications.html`)**

Canturk Isci, Jiuxing Liu, Bulent Abali, Jeff Kephart, and Jack Kouloheris, ***Improving Server Utilization Using Fast Virtual Machine Migration.*** IBM Journal of Research and Development, Special Issue on Systems and Software for Cloud Computing, 2011.

Kevin Deland, John Nelson. Jim Theonsen, Jon Lenchner, Canturk Isci, Jon Connell, Jeff Kephart and Iqbal Mohomed, ***A Robot-in-Residence for Data Center Thermal Monitoring and Energy Efficiency Management***. ACM Conference on Embedded Networked Sensor Systems (SenSys), 2011.

Victor Jimenez, Francisco J. Cazorla, Roberto Gioiosa, Eren Kursun, Canturk Isci, Alper Buyuktosunoglu, Pradip Bose, Mateo Valero, ***A Case for Energy-Aware Accounting and Billing in Large-Scale Computing Facilities: Cost Metrics and Design Implications.*** IEEE MICRO, Systems for Very Large-Scale Computing, 2011.

Jonathan Lenchner, Canturk Isci, Jeffrey O. Kephart, Chris Mansley, Jonathan Connell, and Suzanne McIntosh, ***Towards Data Center Self-Diagnosis Using a Mobile Robot.*** IEEE International Conference on Autonomic Computing (ICAC), 2011. [Acceptance Rate: 22%] [**Best Paper Award**]

Hoi Chan, Jonathan Connell, Canturk Isci, Jonathan Lenchner, Jeffrey O. Kephart, Chris Mansley, and Suzanne McIntosh, ***A Robot as Mobile Sensor and Agent in Data Center Energy Management.*** IEEE International Conference on Autonomic Computing (ICAC), Demo Session, 2011.

Chris Mansley, Jonathan Connell, Canturk Isci, Jonathan Lenchner, Jeffrey O. Kephart, Suzanne McIntosh and Michael Schappert, ***Robotic Mapping and Monitoring of Data Centers.*** IEEE International Conference on Robotics and Automation (ICRA), 2011.

Ruhi Sarikaya, Canturk Isci and Alper Buyuktosunoglu, ***Runtime Workload Behavior Prediction Using Statistical Metric Modeling with Application to Dynamic Power Management.*** In IEEE International Symposium on Workload Characterization (IISWC), 2010. [Acceptance Rate: 38%]

Chris Mansley, Jonathan Connell, Canturk Isci, Jonathan Lenchner, Rajarshi Das and Jeffrey O. Kephart, ***Geometric Aspects of Robotic Mapping and Monitoring of Data Centers.*** 20th Annual Fall Workshop on Computational Geometry, 2010.

Víctor Jimenez, Francisco J. Cazorla, Roberto Gioiosa, Eren Kursun, Canturk Isci, Chen-Yong Cher, Alper Buyuktosunoglu, Pradip Bose, and Mateo Valero, ***Power and Thermal Characterization of POWER6 System.*** In the International Conference on Parallel Architectures and Compilation Techniques (PACT), Vienna, Austria, Sep. 2010. [Acceptance Rate: 17%]

Victor Jimenez, Francisco J. Cazorla, Roberto Gioiosa, Eren Kursun, Canturk Isci, Alper Buyuktosunoglu, Pradip Bose, and Mateo Valero , ***A Case for Energy-Aware Accounting in Large-Scale Computing Facilities: Cost Metrics and Implications for Processor Design.*** In the Architectural Concerns in Large Datacenters Workshop (ACLD), in conjunction with ISCA, 2010.

Xiaoqiao Meng, Canturk Isci, Jeff Kephart, Li Zhang, Eric Bouillet and Dimitrios Pendarakis, ***Efficient Resource Provisioning in Compute Clouds via VM Multiplexing***. In the 7th IEEE International Conference on Autonomic Computing (ICAC), 2010. [Acceptance Rate: 26%]

Hoi Chan, Rajarshi Das, Hendrik Hamann, Canturk Isci, Jeff Kephart, Jonathan Lenchner, Suzanne McIntosh and Andrew Stepanchuk, ***Towards Autonomic Data Center Energy Management.*** In the 7th IEEE International Conference on Autonomic Computing (ICAC), Demo Session, 2010.

Ruhi Sarikaya, Canturk Isci and Alper Buyuktosunoglu, ***Program Behavior Prediction Using a Statistical Metric Model.*** ACM Sigmetrics, 2010. [Acceptance Rate: 28%]

Canturk Isci, James Hanson, Ian Whalley, Malgorzata Steinder and Jeff Kephart , ***Runtime Demand Estimation for Effective Dynamic Resource Management.*** In IEEE/IFIP Network Operations and Management Symposium (NOMS), 2010. [Acceptance Rate: 27%]

Canturk Isci, James Hanson, Ian Whalley, Malgorzata Steinder and Jeff Kephart, ***Predicting Virtual Machine CPU Demand for Effective Autonomous Resource and Power Management.*** In IBM Conference on Proactive Problem Prediction, Avoidance and Diagnosis (P3AD), 2009. [Acceptance Rate: 28%]

Ruhi Sarikaya, Canturk Isci and Alper Buyuktosunoglu, ***A Statistical Perspective for Metric Modeling.*** In IBM Conference on Proactive Problem Prediction, Avoidance and Diagnosis (P3AD), 2009. [Acceptance Rate: 28%]

Chengwei Wang, Canturk Isci, Chirag Bhatt, Ganesha Shanmuganathan, and Anne Holler, ***Predicting VM Behavior for DRS & DPM Cost/Benefit Analysis***. VMWorld 2008.
[**Best Research Poster, VMWorld'08**]

Ripal Nathuji, Canturk Isci and Eugene Gorbatov, ***Exploiting Platform Heterogeneity for Power Efficient Data Centers***. In the 4th IEEE International Conference on Autonomic Computing (ICAC-2007), Jun 2007. [Acceptance rate: 13%]

Canturk Isci, Gilberto Contreras and Margaret Martonosi, ***Live, Runtime Phase Monitoring and Prediction on Real Systems with Application to Dynamic Power Management***. In 39th ACM/IEEE International Symposium on Microarchitecture (MICRO-39), Dec 2006. [Acceptance rate: 24%]

Canturk Isci, Alper Buyuktosunoglu, Pradip Bose, Chen-Yong Cher and Margaret Martonosi, ***An Analysis of Efficient Multi-Core Global Power Management Policies: Maximizing Performance for a Given Power Budget***. In 39th ACM/IEEE International Symposium on Microarchitecture (MICRO-39), Dec 2006. [Acceptance rate: 24%]

Canturk Isci and Margaret Martonosi, ***Phase Detection and Prediction on Real Systems for Workload-Adaptive Power Management***. In SRC Student Symposium, Oct 2006.

Canturk Isci and Margaret Martonosi, ***Phase Characterization for Power: Evaluating Control-Flow-Based and Event-Counter-Based Techniques***. In 12th International Symposium on High-Performance Computer Architecture (HPCA-12), Feb 2006. [Acceptance rate: 15%]

Canturk Isci and Margaret Martonosi, ***Detecting Recurrent Phase Behavior under Real-System Variability***. In IEEE International Symposium on Workload Characterization (IISWC'05), Oct 2005. [Acceptance rate: 33%]

Canturk Isci, Margaret Martonosi and Alper Buyuktosunoglu, ***Long-term Workload Phases: Duration Predictions and Applications to DVFS***. In IEEE MICRO, Special Issue on Energy Efficient Design, Sep/Oct 2005.

Canturk Isci, Zhigang Hu, Margaret Martonosi and Pradip Bose, ***Building Microarchitectural Stressmarks for Thermal Testing***. In Austin Conference on Energy-Efficient Design (ACEED-2005) [*Internal Track*], Mar 2005.

Canturk Isci, Margaret Martonosi and Alper Buyuktosunoglu, ***Workload Phase Duration Prediction and its Application to DVFS***. In Austin Conference on Energy-Efficient Design (ACEED-2005) [*Internal Track*], Mar 2005.

Canturk Isci, Gilberto Contreras and Margaret Martonosi, ***Hardware Performance Counters for Detailed Runtime Power and Thermal Estimations: Experiences and Proposals***. In Hardware Performance Monitor Design and Functionality Workshop in conjunction with 11th International Symposium on High-Performance Computer Architecture (HPCA-11), Feb 2005.

Canturk Isci and Margaret Martonosi, ***Runtime Power Monitoring in High-End Processors: Methodology and Empirical Data***. In 36th ACM/IEEE International Symposium on Microarchitecture (MICRO-36), Dec 2003. [Acceptance rate: 25%]

Canturk Isci and Margaret Martonosi, ***Identifying Program Power Phase Behavior Using Power Vectors***. In 6th IEEE International Workshop on Workload Characterization (WWC-6), Nov 2003. [Acceptance rate: 30%]

PATENTS

Canturk Isci, Alper Buyuktosunoglu, Ruhi Sarikaya, Xiaoqiao Meng, Jeff Kephart, and Pradip Bose, ***A Virtual Performance Counter Layer.*** Patent filed, [IBM] 2011.

Xiaoqiao Meng, Canturk Isci, Jeff Kephart, and Li Zhang, ***Method for Using Virtual Machine Multiplexing to Improve Resource Provisioning in Compute Clouds.*** Patent filed, [IBM] 2010.

Claris Castillo, and Canturk Isci, ***Virtualization and Dynamic Resource Allocation Aware Storage Level Reordering Method for Memory-Intensive Applications.*** Patent filed, [IBM] 2010.

Jonathan Lenchner, Canturk Isci, Jeffrey O. Kephart, Rajarshi Das, Jonathan H. Connell, Hendrik Hamann, Levente Klein, and Michael A. Schappert, ***System for Detecting Energy Leaks in Indoor Environments Using a Mobile Robot.*** Patent filed, [IBM] 2010.

Jeffrey Kephart, Hoi Y. Chan, Rajarshi Das, David W. Levine, Canturk Isci, James E. Hanson, ***Saving Power by Managing the State of Inactive Servers.*** Patent filed, [IBM] 2010.

Canturk Isci, James Hanson, Ian Whalley, Jeffrey Kephart, Malgorzata Steinder, ***Virtual Machine Demand Estimation.*** Patent filed, [IBM] 2010.

Canturk Isci, Chengwei Wang, Chirag Bhatt, Ganesha Shanmuganathan, and Anne Holler, ***Process Demand Prediction for Distributed Power and Resource Management.*** Patent filed, [VMware] 2009; Issued 2011 (Patent# 8,046,468).

Eugene Gorbatov, Canturk Isci and Ripal Nathuji, ***Method for Power-Efficient Resource Allocation in Data Centers.*** Patent filed [Intel] 2007; Issued 2010 (Patent# 7,818,594).

Canturk Isci, Alper Buyuktosunoglu, Pradip Bose, Chen-Yong Cher, Prabhakar Kudva and Margaret Martonosi, ***System and Method of Efficient Resource Management by Predicting Stable Durations of a Workload Phase***. Patent filed [IBM] 2006.

THESES

Canturk Isci, ***Workload Adaptive Power Management with Live Phase Monitoring and Prediction***. Ph.D. Thesis, Princeton University, Princeton, NJ, Jun 2007.

Canturk Isci, ***Pseudo-Random Testing of Arithmetic Circuits***. M.Sc. Thesis, University of Westminster, London, UK, Oct 2001.

PRESENTATIONS

(Electronic copies available at `http://www.canturkisci.com/ETC/MYtalks.html`)

Thermal Monitoring and Management in Large Scale Computing Systems,
Invited Keynote, TEMM'11, Orlando, FL, Jul 2011.

Robotic Data Center Mapping and Monitoring,
Exhibit, Advanced Energy Conference, New York, NY, Nov 2010.

Runtime Demand Estimation for Effective Dynamic Resource Management,
NOMS'10, Osaka, Japan, Apr 2010.

Predicting Virtual Machine CPU Demand for Effective Autonomous Resource and Power Management,
P3AD'09, Yorktown Heights, NY, Apr 2009.

Distributed Power Management: Technical Deep Dive,
VMWorld'08, Las Vegas, NV, Sep 2008.

Live, Runtime Phase Monitoring and Prediction on Real Systems with Application to Dynamic Power Management, MICRO-39, Orlando, FL, Dec 2006.

An Analysis of Efficient Multi-Core Global Power Management Policies: Maximizing Performance for a Given Power Budget, MICRO-39, Orlando, FL, Dec 2006.

Phase Detection and Prediction on Real Systems for Workload-Adaptive Power Management,
Semiconductor Research Corporation (SRC) Student Symposium, Cary, NC, Oct 2006.

Phase Characterization for Power: Evaluating Control-Flow-Based and Event-Counter-Based Techniques,
HPCA-12, Austin, TX, Feb 2006.

Runtime Power Monitoring and Phase Analysis Methods for Power Management,
SRC Annual Review in Integrated Systems Design, Columbus, OH, Feb 2006.

Detecting Recurrent Phase Behavior under Real-System Variability,
IISWC'05, Austin, TX, Oct 2005.

Hardware Performance Counters for Detailed Runtime Power and Thermal Estimations: Experiences and

Proposals, Performance Monitoring Workshop in HPCA-11, San Francisco, CA, Feb 2005.

Runtime Power Monitoring in High-End Processors: Methodology and Empirical Data, MICRO-36, San Diego, CA, Dec 2003.

Identifying Program Power Phase Behavior Using Power Vectors, WWC-6, Austin, TX, Nov 2003.

COMPUTER SKILLS

Java, Matlab, C/C++, Perl, Python, VHDL, Verilog, Spice, Mentor Graphics design, simulation and fault analysis tools