

Computer Science

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News

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Congratulations to Dr. Jane Haynes who has been promoted to Associate Professor with tenure.

The Laboratory for Advanced Networking welcomes two new staff members, Mr. William Marvel, IS Technical Support Specialist, and Ms. Jennifer Riggs, Administrative Coordinator.



Dr. Jane Haynes

Dr. Andrew Klapper, who is on sabbatical, spent the month of November as a visiting researcher at the Fields Institute for Research in the Mathematical Sciences in Toronto, Canada. While there he gave a talk titled "Function Field and Number Field Generalizations of Linear Feedback Shift Registers".

For the Spring semester, Dr. Andrew Klapper is a visiting researcher at the Program in Applied and Computational Mathematics at Princeton University. While there he is continuing his long-term collaboration with Mark Goresky at the Institute for Advanced Study.

The 2008 Sequences and Their Applications workshop (SETA '08) will be held in Lexington, KY, in the Fall of 2008. Dr. Andrew Klapper will be the general chair of the conference. This conference will bring together international researchers in the area of sequence design and analysis for communications, cryptography, and other application areas. More details will be given in later issues of the newsletter.

Dr. Raphael Finkel was elected to the Faculty Senate as a representative from the College of Engineering (term starting Fall 2006) and then to its "executive committee", called the Senate Council (term starting Spring 2007).

Dr. Raphael Finkel has been working with Professor

Gregory Stump (English) on categorizing languages by their morphological systems of principal parts. They have invented several definitions of principal parts and can compute this information given a language paradigm. They presented this work at the 12th International Morphology Meeting, Budapest, May 2006 and at the Analogy in Grammar: Form and Acquisition conference, September 2006, Max Planck Institute for Evolutionary Anthropology, Leipzig.

Together with Victor Marek and Mirek Truszczyński, Dr. Raphael Finkel presents a Sudoku "puzzle of the day" at <http://www.cs.uky.edu/~raphael/sud.html>.

Dr. Ken Calvert was a panelist on the topic "What would you do with one gigabit per second?" at the Columbia Institute for Tele-Informatics' Second conference on Ultrabroadband and the home, Columbia University, December 1st 2006.

Dr. Jane Haynes held a Workshop on Grand Challenges in Traceability at the NASA Independent Verification and Validation facility in August 2006, they had international experts in their field in attendance and they drafted grand challenges for traceability at that meeting

March 21 - 23 Dr. Jane Haynes will hold a Symposium on the Grand Challenges of Traceability/Traceability of Emerging Forms of Software Engineering (TEFSE) at Natural Bridge State park (Slade, KY) - this is sponsored by NSF, NASA, ACM, and the center of Excellence for Traceability. Tutorials will be held on the 21st at Young Library. the symposium will be the 22nd and 23rd.

www.traceabilitycenter.org/events/TEFSE07

Bryan Crawley, under the supervision of Dr. Raphael Finkel defended his dissertation in November, 2006. The title is "Methods with Implicit Calls as an Abstraction for Modularizing Crosscutting Concerns".

Dr. Ken Calvert had two Ph.D. students defend their dissertations in Fall 2006: Lili Wang in November, and Qingyu Zhang in December.

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Grants and Awards

Dr. Jurek Jaromczyk and Dr. Paul Piwowarski received a one-year grant titled “Student Learning Improvements Associated with Implementation of Team Projects in Computer Science Courses” for \$11,828 from the University of Kentucky Office of Assessment.

In September 2006, Dr. Jane Haynes received two 12-month grants: \$25K from NSF and \$204K from NASA, both for the Center of Excellence for Traceability and its associated Symposium on the Grand Challenges of Traceability/Traceability of Emerging Forms of Software Engineering (TEFSE) -- Alexander Dekhter and Jane Haynes are Co-Founders along with Jane Cleland-Huang of DePaul University.

Dr. Ken Calvert and Dr. James Griffioen received a 3 years grant titled “Postmodern Internetwork Architecture” for \$400K from NSF. This is a collaborative project with colleagues at the University of Maryland and University of Kansas.

Dr. Ken Calvert received a 3 years grant titled “Human-Centered Networking for the Home” for \$186K from NSF. This is a collaborative project with colleagues at Georgia Institute of Technology.

Dr. Jun Zhang received a \$88,468 Kentucky Science and Engineering Foundation grant entitled “Generalized Diffusion Simulation-Based Tractography for Mapping Human Brain,” in collaboration with Dr. Brian Gold in Medical School. This research project runs from January 1, 2007 to December 30, 2008.

Dr. Ruigang Yang received an unrestricted gift of \$25,000 from NVIDIA. It is part of NVIDIA’s Professor Partnership Award in 2006.

Late July/Aug. 2006, Dr. Jane Haynes and Dr. Alexander Dekhter and Senthil Sundaram (student) received the Best Paper Award at the NASA Software Assurance Symposium for our IEEE Transactions on S/W Eng. Journal paper “Advancing Candidate Link Generation for Requirements Tracing: The Study of Methods” (appeared Jan. 2006).

Presentations

Invited Presentations

Dr. Mirek Truszczyński gave an invited talk at Computer Science Logic, the annual conference of the European Association for Computer Science Logic. The conference took place in Szeged, Hungary, September 2006. Dr. Truszczyński spoke on algebraic foundations of nonmonotonic logics.

Dr. Ken Calvert gave an invited talk on “Scalable Network Management Using Ephemeral State” at the Max Plank Institut für Informatik, Saarbrücken, Germany, November 2nd 2006.

Conferences and Workshops

Dr. Debby Keen and Dr. Ryan McKenzie will present a faculty poster titled “Cooperative Learning in a Large-Enrollment Introductory (Literacy Level) Course” at the SIGCSE 07 Technical Symposium on Computer Science Education, March 7-10, 2007 in Covington, KY.

Ph.D. student Peng Dai and Dr. Judy Goldsmith’s paper “Multi-threaded BLAO* Algorithm,” accepted to *Florida Artificial Intelligence Research Symposium (FLAIRS ‘07)*. Will be presented by Mr. Dai this Spring in Florida.

Ph.D. Student Peng Dai gave a poster presentation entitled “Topological Value Iteration Algorithm for Markov Decision Processes”, co-authored by Dr. Judy Goldsmith at the Proc. International Joint Conference on Artificial Intelligence (IJCAI ‘07) in India, January 2007.

Ph.D. student Yin Wang presented a paper, “SVD stabilized block preconditioning for large dense linear systems from electromagnetic application”, co-authored by Dr. Jeonghwa Lee, Jun Zhang, and Cai-Cheng Lu (Electrical and Computer Engineering), at the Eighth IMACS International Symposium on Iterative Methods in Scientific Computing, College Station, TX, November, 2006.

Ph.D. student Dianwei Han presented a paper, “Two data mining algorithms for predicting the condition number of sparse matrices”, co-authored by Dr. Jun Zhang and Shuting Xu (former Ph.D. student, Virginia State University), at the 8th IMACS International Symposium on Iterative Methods in Scientific Computation, College Station, TX, November 2006.

Presentations *continued*

Ph.D. student Eun-Joo Lee presented a paper, “Incomplete LU preconditioning enhancement strategies for sparse matrices”, co-authored by Dr. Jun Zhang, at the 8th IMACS International Symposium on Iterative Methods in Scientific Computation, College Station, TX, November 2006.

Ph.D. student Jie Wang presented a paper, “Iterative matrix factorization techniques for high-accuracy privacy protection on non-negative-valued datasets”, at the 8th IMACS International Symposium on Iterative Methods in Scientific Computation, College Station, TX, November, 2006.

Dr. Ken Calvert gave a presentation “On What to Name” at the Dagstuhl Seminar on Naming and Addressing for Next-Generation Networks, Wadern, Germany, October 31 2006.

Dr. Ruigang Yang presented a short paper, “Toward the Light Field Display: Autostereoscopic Rendering via a Cluster of Projectors”, at Eurographics in Vienna, Austria, October 2006.

PhD student Qingxiong Yang presented his paper, “Real-time Global Stereo Matching Using Hierarchical Belief Propagation”, at the British Machine Vision Conference (BMVC) in England, October 2006.

Dr. Andrew Klapper presented the paper “Periodicity and Distribution Properties of Combined FCSR Sequences,” co-authored with Mark Goresky, at the Sequences and Their Applications workshop (SETA '06) in Beijing, China in September 2006.

Dr. Greg Wasilkowski gave two presentations: one was on 6th International Conference on Monte Carlo and Quasi-Monte Carlo Methods, Ulm, Germany, August 2006 and the other was Dagstuhl Seminar on Complexity and Algorithms for Continuous Problems, Dagstuhl, Germany, September 2006.

Ph.D. student Wensheng Shen presented a paper, “Computer modeling of perlecan regulation on growth factor binding”, co-authored by Dr. Jun Zhang, and Fuqian Yang (Materials Science), at the Joint SMB-SIAM Conference on the Life Science, Raleigh, NC, July 2006.

Ph.D. student Hu Wang presented a paper “An Efficient Update Algorithm for Supporting Mobility in Structured P2P Systems”, co-authored by Boxuan Gu and Dr. Zongming Fei, at International Conference on Communications in Computing, Las Vegas, Nevada, June 2006.

Liming Zhao (student) under the supervision of Dr. Jane Haynes presented their paper at Workshop on Predictive Models for Software Engineering (PROMISE) at ICSM. www.traceabilitycenter.org

Recent and upcoming colloquia

April 2, 2007 - at 4:00pm, location TBD
Expressiveness of Answer Set Languages
Paolo Ferraris (University of Texas)

March 19, 2007 - at 4:00pm, in Windstream Solutions Room (Hardymon Building room 100)
Clustering High Dimensional Data
Jinze Liu (University of North Carolina, Chapel Hill)

March 5, 2007 - at 4:00pm in Windstream Solutions Room (Hardymon Building room 100)
Towards a Science of Scientific Data Management
James Cheney (University of Edinburgh)

Feb. 19, 2007 - at 4:00pm in Windstream Solutions Room (Hardymon Building room 100)
Location-Aware Association Analysis Methods
Jin Soung Yoo (University of Minnesota)

November 29, 2006 - at 4:00pm in Alltel Solutions Center (Hardymon, Room 100)
Feature Identification: Combining Multiple Experts
Giuliano Antoniol (École Polytechnique de Montréal)

November 20, 2006 - at 4:00pm in OHR 226
The Light Portal: 3D Reconstruction and Visualization over Space and Time
Ruigang Yang (University of Kentucky)

September 6, 2006 - at 4:00pm in CB 122
Managing Imprecisions with Probabilistic Databases
Dan Suciu (University of Washington)
Host: Prof. Alex Dekhtyar

August 18, 2006 - at 3:00pm in Vis. Centre Conference Room
Visual Localization within a World composed of Planes
Friedrich Fraundorfer (University of Kentucky)

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Distinguished Lecture Series

February 22, 2007 - 5:30 PM

Shortening the Control Loop in Healthcare: A Computer Science Perspective

Professor John Guttag (Massachusetts Institute of Technology)

Host: Professor Ken Calvert

Location: Nursing Building Auditorium Room 201

Professional Activities

Editorial Board:

Dr. Andrew Klapper was appointed to the editorial board of the new journal *Advances in Mathematics of Communications*.

Dr. Jun Zhang has been invited to join the editorial boards of the *Open Journal of Applied Mathematics* and the *Open Journal of Mechanics*.



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Professional Activities - *continued*

Conference Program Committee:

Dr. Andrew Klapper: International Workshop on Sequence Design and Applications, to be held in Chengdu, China in Fall 2007.

Dr. Ken Calvert: IEEE Infocom 2007, Anchorage, Alaska, May 6-12 2007.

Dr. Jane Haynes: first International Conference on Software Engineering (premiere conference) Portraits in Practice track (ICSE), Minneapolis, May 2007.

Dr. Jane Haynes joined the editorial board for the *Journal on Software Testing Verification and Reliability (STVR)* and exited the editorial board of *IEEE Software*.

Conference Chairs:

Dr. Jun Zhang, will act as Local Chair and Member of the International Committee, International Conference on Life System Modeling and Simulations, Shanghai, China, September 2007.

Dr. Greg Wasilkowski organized 2 sessions at the 6th International Conference on Monte Carlo and Quasi-Monte Carlo Methods, Ulm, Germany, August 2006.

Dr. Paul Piwowarski served as a session chair for the 38th ACM Technical Symposium on Computer Science Education, March 2007.

Dr. Jun Zhang: KOSEN Workshop on Mathematics, Technology and Education, Ibaraki, Japan, December, 2006.

Dr. Andrew Klapper: Sequences and Their Applications workshop (SETA '06), Beijing, China, September 24-28, 2006.

Dr. Zongming Fei: The IEEE 26th International Conference on Distributed Computing Systems (ICDCS), Lisboa, Portugal, July 4-7, 2006.

What is Computer Science?

What is happening in Computer Science at the University of Kentucky? What research is going on, and how can undergraduate students get involved?

These are just a few of the questions addressed during the first annual Senior Day 2006, sponsored by the Computer Science Department on September 30. Where to go to college and what to major in are two of the most important decisions that high school students will make, and Senior Day was designed to show students what possibilities exist for them at UK. Sixteen high school seniors met in the Hardymon Building on the UK campus, viewing demonstrations of current research and toured computer science labs. They also had the opportunity to participate in a formal question and answer session with faculty and students from the department. In the afternoon the students were led on a campus tour, and the day was capped by UK Football, vs. Central Michigan (Kentucky 45, Central Michigan 36). In addition, one lucky student won a new Dell laptop! Senior Day 2006 was a great success, and we look forward to Senior Day 2007.



My Research

Network Services and Applications

Dr. Zongming Fei
Associate Professor of Computer Science



The theme of my research has been the development of wide-area networking services, which are used by applications distributed across multiple administrative domains. The Internet has grown at an unprecedented pace since its inception, and has developed in scale and complexity beyond what was envisioned by the original designers. It has contributed to almost all fields of scientific research and impacted every aspect of our daily life. Yet we are demanding more from the Internet, from ease of use to faster response, from greater diversity of functionality to self-healing from failures. My work has concentrated on developing new networking services to meet the ever-growing demands on the Internet and promote new paradigms of using the Internet more efficiently. My research projects have been supported by the National Science Foundation, the Department of Treasury, and the Kentucky Science and Engineering Foundation. The areas of my research include application layer anycasting, content distribution networks, multimedia systems, and overlay networks.

Anycast is a new network service that associates an anycast group with a set of network entities and implements one-to-any communication functionality. One of the applications of anycast is the selection of replicated servers. Network-layer anycasting associates a common IP anycast address with a group of replicated servers. The routing protocol routes datagrams to the closest server using the routing distance metric. We examined the definition and support of the anycasting paradigm at the application layer, providing a service that uses an anycast resolver to map an anycast domain name and selection criteria into an IP address. By realizing anycasting at the application layer, we achieved flexibility in the optimization criteria and eased the deployment of the service.

Content distribution networks (CDNs) have been used to push content from the origin server to geographically distributed replicas, usually located at the edge of the network where clients are attached. Clients requesting web documents can go to the nearest replica instead of the origin server. This greatly reduces the response time of the clients and the overall network load. We investigated several important issues involved in designing content distribution networks. One example is to maintain the consistency of content at replicas with the origin server, especially for those documents that change dynamically. We proposed a new hybrid consistency algorithm, which generates less traffic than both the propagation approach and the invalidation approach. The basic scheme was extended to the case in which requests are not evenly

distributed over all replicas. We proposed a hierarchical framework which allows replicas at different levels to make a decision based on the statistics collected.

Delivering large media files over the Internet is a challenging task because it has some unique features that are different from delivering conventional web documents. We developed a fine-grained peer sharing technique for dealing with the problem in the context of content distribution networks. The replica servers were divided into groups, and those in the same group cooperated with each other to handle client requests. The key difference of the technique from conventional peer-to-peer systems was that the unit of peer sharing is not a complete media file, but at a finer granularity. By doing so, we improved the flexibility of replica servers for handling client requests. Our simulations showed that the fine-grained peer sharing approach can reduce both the initial latency of clients and the system rejection rate significantly over a simple peer sharing method.

Overlay networks are becoming increasingly popular because they allow applications to define virtual topologies among participating nodes and dynamically change the topology as needed. These “virtual networks” have been used to implement a variety of distributed applications including massive storage systems, event-notification, security systems, multimedia streaming, distributed lookup, publish-subscribe systems, and others. One key problem that has not been solved is that a node may fail or voluntarily leave the system in overlay networks. We studied the issue in overlay multicast in which a tree structure is established among the nodes participating in a multicast session. When a non-leaf end host leaves the session, all the nodes in the subtree of which it is root are affected.

We developed two techniques that contributed to minimizing the effect caused by failures and ungraceful departures. One is a cooperative failure detection mechanism that can greatly reduce the failure detection time. Another contribution was a proactive tree recovery mechanism for tree reconstruction. They together greatly improve the resilience of the overlay networks.