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Research Interests

My research interests are in unmanned traffic management systems, network security, wireless networks, network optimization, and network information theory.

Education and Work Experience

- 9/2017 – present **San José State University**
Assistant Professor, Department of Electrical Engineering
- 9/2013 – 8/2017 **Texas A&M University**
NSF Center for Science of Information Post-Doctoral Research Fellow
- 9/2009 – 8/2013 **University of Illinois at Urbana-Champaign,**
Ph.D., Electrical Engineering
Thesis: A Clean Slate Approach to Secure Wireless Ad-Hoc Networking
Advisor: Professor P.R. Kumar
- 9/2006 – 8/2008 **University of Waterloo,** (Ontario, Canada)
M.ASc., Electrical Engineering
Advisor: Professor Liang-Liang Xie
- 9/2001 - 5/2006 **University of Waterloo,** (Ontario, Canada)
B.ASc., Electrical Engineering
(With distinction – Dean’s Honour List)

Research Projects

Security of Wireless Ad-Hoc Networks

A seemingly unavoidable limitation of network security is the absence of any security guarantees. Every generation of protocols brings a new set of vulnerabilities, often discovered after they have been exploited. Our work proposes a provably secure protocol suite that eliminates the arms race between attacks and security patches and also achieves the “min-max” optimal throughput. This protocol suite addresses all aspects of wireless ad-hoc network operation from start-up to neighbor discovery, network discovery, data transfer, and verification.

An Information-Theoretic Framework for Multi-Hop Wireless Networks

Information Theory studies the rates of information that can be reliably transmitted over unreliable channels. We examine multi-source, multi-relay, all-cast channels. Fundamental limits on achievable rates are derived for the “decode-forward” strategy of information transmission, which models the behavior of multi-hop wireless networks.

Unmanned Traffic Management Systems

City airspace is increasingly populated with unmanned aerial vehicles (UAVs), raising unique security and safety concerns. This project aims to develop an unmanned traffic management system based on wireless ad-hoc networking protocols. By using this technology to communicate with their neighbors, autonomous swarms of UAVs can avoid colliding with each other.

Publications*Monograph*

Jonathan Ponniah, Yih-Chun Hu and P. R. Kumar (2015), "A Clean Slate Approach to Secure Wireless Networking", *Foundations and Trends^(r) in Networking*: Vol. 9: No. 1, pp 1-105.

Journal

Jonathan Ponniah and Liang-Liang Xie, "Flow Decomposition for Multi-User Channels - Part 2" *in preparation*

Jonathan Ponniah and Liang-Liang Xie, "Flow Decomposition for Multi-User Channels - Part 1" *to be submitted to the Transactions on Information Theory, available upon request*

Jonathan Ponniah, Yih-Chun Hu and P. R. Kumar "A System-Theoretic Clean Slate Approach to Secure Ad-Hoc Wireless Networking: Open Unsynchronized Networks" accepted to *IEEE Transactions on Control of Network Systems, Special Issue on Cyber-physical Systems, 2015*

Jonathan Ponniah, Yih-Chun Hu and P. R. Kumar, "A System-Theoretic Clean Slate Approach to Provably Secure Ad Hoc Wireless Networking," in *IEEE Transactions on Control of Network Systems, 2015*

Jonathan Ponniah, Yih-Chun Hu and P. R. Kumar "An Orthogonal Multiple Access Coding Scheme," *Communication in Information and Systems, Vol.12: No.1, pp 41-76, 2012*

Conferences

Jonathan Ponniah and Liang-Liang Xie, "A Multi-Hop Framework for Multi-Source, Multi-Relay, All-Cast Channels" In *Proc. of 2018 IEEE ISIT, Vail, Colorado, July 9-15, 2018.*

Jonathan Ponniah and Liang-Liang Xie, "An Achievable Rate Region for the Two-Way Multiple-Relay Channel," In *Proc. of 2016 IEEE ISIT, Barcelona, Spain, July 9-15, 2016.*

Jonathan Ponniah, Yih-Chun Hu, and P.R. Kumar, "A Clean Slate Design for Secure Wireless Ad-Hoc Networks – Part 1: Closed Synchronized Networks," *13th International Symposium on Modelling and Optimization in Mobile, Ad-Hoc, and Wireless Networks (WiOpt '15).*

Jonathan Ponniah, Yih-Chun Hu, and P.R. Kumar, "A Clean Slate Design for Secure Wireless Ad-Hoc Networks – Part 2: Open Unsynchronized Networks," *13th International Symposium on Modelling and Optimization in Mobile, Ad-Hoc, and Wireless Networks (WiOpt '15).*

Jonathan Ponniah, Liang-Liang Xie; Kumar, P.R., "The Two-Way Multi-Relay Channel," in *IEEE 2015 Information Theory Workshop (ITW), pp.1-5, April 26-May 1, 2015.*

Jonathan Ponniah, Liang-Liang Xie, "An Achievable Rate for the Two-Way, Two-Relay Channel," In *Proc. of 2008 IEEE ISIT, Toronto, Canada, July 6-11, 2008.*

Teaching Experience

8/2017 – present Instructor, EE 112 Intro to Digital Signal Processing
Instructor, EE 281 Computer Networking
Department of Electrical Engineering, San José State University

5/2007 – 8/2007 Teaching Assistant, ECE 415 Digital Signal Processing
Department of Electrical Engineering, University of Waterloo, Canada

Awards and Honours

- 9/2007 – 8/2008 NSERC PGS M Graduate Scholarship
University of Waterloo, Canada
- 9/2006 – 8/2007 Ontario Graduate Scholarship
University of Waterloo, Canada
- 9/2001 – 8/2006 Queen Elizabeth II Aiming for the Top Tuition Scholarship
University of Waterloo, Canada
- 9/2001 Peel District School Board Award
(For the top two students in the graduating class)
Lorne Park Secondary School

Professional Activities

Reviewer for IEEE Transactions on Networking, IEEE Transactions on Control of Networked Systems, IEEE Transactions on Wireless Communications, 2016 International Symposium on Information Theory, Steering Committee for the Texas A&M Postdoctoral Association

Graduate Coursework

Information Theory, Network Information Theory, Real Analysis 1, Real Analysis 2, Detection and Estimation, Probability Theory 1, Probability Theory 2, Graph Theory, Control Theory, Optimization, Communication Systems, Random Processes

Invited Talks

- Feb. 4, 2016 An Achievable Rate Region for the Two-Way Multiple-Relay Channel
ITW 2016 Grad Day Talks
San Diego
- Dec. 5, 2013 A Clean Slate Approach to Secure Wireless Ad-Hoc Networks
MIT Seminar on Distributed Systems
- June 5, 2013 A Clean Slate Approach to Secure Wireless Ad-Hoc Networks
ITSOC School of Information Theory
Purdue

Professional Experience

5/2006 – 8/2006 **Hydro One**, *Engineering Contractor* *Toronto, Ontario, Canada*
7/2005 – 12/2005

- Responsible for the design, configuration and documentation of a bus protection system using a SEL 487-B digital relay.
- Wrote a standard describing both the general protection philosophy of the relay and the application specific requirements.
- Coordinated with an external consulting company, the relay manufacturer, the distributor, and the engineers at Hydro One to advance product testing and verification.
- Organized meetings and conference calls to resolve obstacles and complications that were encountered during the course of the project and ensured the timely completion of all deliverables.

Professional Experience Cont'd

7/2004 – 12/2004 **Interfaceware, Software Engineer** *Toronto, Canada*

- Created testing frameworks using object oriented C++ to ensure high quality software libraries.
- Designed the testing framework to test all possible failure modes, and all sections of code.
- Through innovative and creative methods, exposed numerous subtle or hidden bugs in libraries.
- Ensured testing frameworks were compatible with Linux and Windows environments.

1/2004 – 5/2004 **Hydro One, Engineering Co-op Student** *Toronto, Canada*

- Designed a system to distribute timing signals to digital relays in a transmission station
- Analyzed the effects of EMI, overloading, faults, signal distortion, and ground currents on the system, and created appropriate system protection from these events.
- Assessed the ability of various Ethernet switches and routers to function in a station LAN
- Examined the environmental resistance, physical design, failure-recovery algorithms, and network capabilities of the switches and documented the findings in a report.

1/2004 – 5/2004 **Ontario Power Generation, Engineering Co-op Student** *Toronto, Canada*
5/2003 – 7/2003

- Analyzed an analog gamma-monitoring device to determine its critical components and their possible failure modes.
- Developed over 200 procedures for testing relay control logic of Shutdown System 2 (SDS2), a critical safety system in a CANDU reactor.
- Identified a cost saving method of improving vapour recovery system performance by replacing relay control with PLCs.
- Wrote a 1.5 million dollar proposal to upgrade the vapour recovery system from relay logic to PLC control.

1/2002 – 5/2002 **City of Toronto, Engineering Co-op Student** *Toronto, Canada*

- Independently analyzed the algorithms of a mathematical model used to predict pavement condition.
- Determined a method of improving the model to predict pavement condition with far greater accuracy and therefore increase efficiency of city resources.
- Rating on Work-term report: Outstanding by the University of Waterloo.

References

Professor P.R. Kumar
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Texas A&M University
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Email: prk.tamu@gmail.com

Professor Yih-Chun Hu
Department of Electrical and Computer Engineering
University of Illinois at Urbana-Champaign
Phone: (217) 333-4220
Email: yihchun@illinois.edu

References Cont'd

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Professor Tie Liu
Department of Electrical and Computer Engineering
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