Ravikanth S. Pappu - Research / Teaching / Publications

CONTACT INFORMATION

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EDUCATION

Massachusetts Institute of Technology
Ph.D., MIT Media Lab, February 2001

M.S., MIT Media Lab, May 1995

Villanova University
M.S.E.E., Department of Electrical and Computer Engineering, May 1993

Osmania University, Hyderabad, India
B. Eng., Department of Electronics and Communication Engineering, May 1991

RESEARCH EXPERIENCE

Dept. Of Biomedical Engineering, MIT.
Visiting Scientist **2009 – 2011**
Worked on a novel signal transduction scheme for DARPA's RealNose Project. The goal of the RealNose program is to model, design, and develop a novel sensor inspired by the canine olfactory system to include: air/odor intake, a detector layer (which includes olfactory receptors), a rapid (within seconds) signal transduction methodology, and a signal processing/statistical pattern recognition methodology for identifying odors and odor classes.

Massachusetts Institute of Technology, Cambridge, MA
Research Assistant, Physics and Media Group **1999 - 2001**
Discovered Physical One-Way Functions (POWFs) during doctoral work at MIT. The central result was to show that the physics of coherent transport through disordered 3D mesoscopic systems is capable of generating unique, tamper resistant, and unforgeable identifiers. POWFs are inexpensive to fabricate, prohibitively difficult to duplicate, admit no compact mathematical representation, and are intrinsically tamper-resistant. The dissertation also showed that POWFs can be generated by a broad range of physical systems and can be used within existing cryptographic frameworks. This work has over 1100 citations.

Research Assistant, Spatial Imaging Group **1993 - 1999**
Worked on developing algorithms for rapid computing of holograms, information-theoretic and statistical aspects of computational holography, and haptic holography. This work resulted in efficient algorithms for computing holograms and the world's first dynamic holographic video system with haptic interaction.

Mitsubishi Electric Research Lab, Cambridge, MA, USA.
Summer Intern **1997**
Implemented a computer-vision system to classify the focus of attention of a subject who is switching his or her attention between a number of surrounding objects. The specific application is to use this system as the engine for an automobile collision avoidance system.

Villanova University, Villanova, PA
Research Assistant, ECE Department **1991 - 1993**
Worked on the application of wavelets to digital communication. This work showed that it is possible to exploit location and scale orthogonality of wavelets to transmit more than one wavelet-coded bit in a single bit interval, thereby increasing bandwidth efficiency. Published one of the earliest papers using wavelets in the field of communication engineering.

TEACHING EXPERIENCE

RFIDSEC 2011, University Of Massachusetts, Amherst
The Physics of RFID **2011**
Lecture on the fundamental physics of RFID to noted cryptography experts.

Computer Science Department, University Of Massachusetts, Amherst
Tutorial, REU Program **2008**
Reality Search Engines: Passive RFID Technology and Applications, delivered to an audience of 40 undergraduate, graduate, and faculty members on how RFID technology is enabling Reality Search Engines.

Indian School of Business, Hyderabad, India
Lecturer, Workshop on RFID **2007**
Delivered one-day lecture on RFID technology and emerging applications to an audience of 100 graduate students and professionals from a variety of industries.

ThingMagic Inc
Lecturer, ThingMagic Developer Course **2004 - 2007**
The Physics of RFID, lecture several times a year at ThingMagic's Developer Training classes. Audience comprises technical professionals interested in deploying scalable RFID systems.

Massachusetts Institute of Technology
Lecturer, MIT Executive Course **2005**
RFID in the Supply Chain, delivered to an audience of 50 executives, on the RFID technology and benefits.

Lecturer, MIT Course ESD 290 **2004 - 2005**
The Physics of RFID, delivered to an audience of 35-40 graduate students.

Lecturer, MAS 450/854 Holographic Imaging **1993 - 1999**
Teaching and lab assistant for Prof. Stephen Benton's graduate and undergraduate course *MAS 450/854 Holographic Imaging*. Lectured, taught labs, guided final projects, and graded assignments. Class comprised of 40 undergraduate and graduate students. Labs comprised of approximately 7-10 students.

Villanova University
Lecturer, Audio Engineering **1991 - 1993**
Teaching and lab assistant for Audio Engineering undergraduate course. Lectured, taught labs, guided final projects, and graded assignments. Class comprised of 20 undergraduate students. Labs comprised of approximately 5 students.

INVITED TALKS

How Camels are Made, Keynote at RFIDSEC 2011, UMass, Amherst, June 2011
Passive RFID Innovation: 2005 to 2015, AUTOID SIG, MIT, February 2011
Conway's Law and Innovation: a conjecture, Trimble Engineering Council, January 2011
RFID Privacy Without Killing, Security Seminar, ECE Department, UMass, Amherst, November 2008
Searching Local Spacetime: New Applications For Passive RFID, Tech Talk, Google Inc., Cambridge, MA, March 2008
RFID Privacy Without Killing, RFID Security Workshop - From Theory To Practice, Johns Hopkins University, January 2008
Securing RFID: EPC Generation 2 and the New Challenges of RFID Security, RFID Journal Live, May 2006.
Panelist, MIT-Stanford Joint Conference on RFID Innovations and Values, November 2004
Panelist, RFID Workshop, Federal Communications Commission, October 2004
Panelist, National Research Council Workshop on RFID Technologies, May 2004
Privacy and Security in the EPC Network, RFID Privacy Workshop, MIT, November 2003
RFID Tag Readers: The Next Generation, Smart Labels Conference, March 2003
The Next generation of RFID Tag Readers, Smart Labels Conference, September 2002

Physical One-Way Functions, Security Seminar, Cambridge University, September 2002

SERVICE

External Committee Member, Duke University ECE Department, 2013/2014.
Reviewer, ACM Computer and Communications Security (CCS) 2013
Program Committee, 2nd Workshop on Secure Component and System Identification, 2010
Program Committee, IEEE International Conference on RFID 2009
Reviewer, IEEE Symposium on Security and Privacy 2008
Program Committee, IEEE International Conference on RFID 2008
Program Committee, Internet of Things 2008
Reviewer, IEEE Transactions on Automation Science and Engineering, 2007
Program Committee, IEEE International Conference on RFID 2007
Reviewer, Communications of the ACM 2007

REFEREED PUBLICATIONS

A. Mohan, R. Pappu, S. Shadmand, *D3 - A system for recording complex experiments with an extension of SigMF*, Proceedings of the GNU Radio Conference, 2018.

Y. Maguire, R. Pappu, *An Optimal Q-Algorithm For ISO 18000-6C UHF RFID*, IEEE Transactions in Automation Science and Engineering, Volume 6, Issue 1, pp. 16 - 24, 2009.

A. Juels, R. Pappu, B. Parno, *Unidirectional Secret Sharing Across Time and Space with Applications to RFID Security*, Proceedings of Usenix Security, July 2008

W. Plesniak, M. Halle, V.M. Bove, J. Barabas, R. Pappu, *Reconfigurable Image Projection Holograms*, Journal of Optical Engineering, November 2006.

S. Garfinkel, A. Juels, R. Pappu, *RFID Privacy: An Overview of Problems and Proposed Solutions*, IEEE Security and Privacy, Volume 3, Issue 3, pp. 34-43, May-June 2005.

W. Plesniak, R. Pappu, and S. Benton, *Haptic Holography: A Primitive Computational Plastic*, Proceedings of the IEEE, Vol. 91, No. 9, pp. 1443-1456, September 2003.

R. Pappu, B. Recht, J. Taylor, N. Gershenfeld, *Physical One-Way Functions*, Science, vol. 297, pp. 2026-2030, 20 September 2002.

O. Omojola, E. R. Post, M. D. Hancher, Y. Maguire, R. Pappu, B. Schoner, P. R. Russo, R. Fletcher, and N. Gershenfeld, *An installation of interactive furniture*, IBM Systems Journal, Volume 39, Numbers 3 & 4, 2000.

P. Gandhi, S. S. Rao, and R. Pappu, *Wavelets for waveform coding of digital symbols*, IEEE Transactions on Signal Processing, 1997.

R. Pappu, *Nonuniformly sampled computer-generated holograms*, Journal of Optical Engineering, June 1996.

BOOK CHAPTERS, CONFERENCE PAPERS, AND TECHNICAL REPORTS

R. Pappu, *Making IRL Computable: the Inevitable Internet of Things*, IQT Quarterly, Vol. 8, Issue 1, 2016

A. Brennen, N. Miller, R. Pappu, K. Pernia, L. Porter, *Visualizing Uncertainty in Human Geography Data*, IQT Labs Technical Report, 2017.

C. Floerkemeier, R. Pappu, *Evaluation of physical and logical layer RFID Simulation Engine*, Proceedings of the IEEE International Conference on RFID, April 2008.

W. Plesniak, R. Pappu, J. Underkoffler, M. Lucente, P. St. Hilaire, *Computational Display Holography*, in *Holographic Imaging*, S. A. Benton and V. M. Bove, May 2008.

R. Pappu, *Physical One-Way Functions*, CryptoBytes Technical Newsletter, RSA Laboratories, Vol. 6, No. 2, Summer 2003.

A. Juels, R. Pappu, *Squealing Euros: Privacy Protection in RFID-enabled banknotes*, Proceedings of the Financial Cryptography '03 conference, 2003.

M. Reynolds, J. Richards, S.Pathare, H. Tsai, Y. Maguire, R. Post, R. Pappu, B. Schoner, *Multi-Band, Low-Cost EPC Tag Reader*, AutoID Center Tech Report MIT-AUTOID-WH- 0121, 2002

W. Plesniak, R. Pappu, and S. Benton, *Tangible, Dynamic Holographic Images*, Three- Dimensional Holographic Imaging, eds: C. J. Kuo and M. H. Tsai, John Wiley & Sons, 2002

R. Pappu and P. Beardsley, *A qualitative approach to classifying gaze direction*, Proceedings of the Third IEEE International Conference on Automatic Face and Gesture Recognition, Nara, Japan, 1998.

W. Plesniak and R. Pappu, *Coincident display using haptics and holographic video*, Proceedings of ACM SIGCHI Conference on Human Factors in Computing Systems, Los Angeles, 1998.

R. Pappu and W. Plesniak, *Haptic interaction with holographic video images*, Proceedings of the IS&T/SPIE's Symposium on Electronic Imaging, Practical, Holography XII, San Jose, 1998.

R. Pappu, C. Sparrell, J. Underkoffler, A. Kropp, B. Chen, and W. Plesniak, *A generalized pipeline for preview and rendering of synthetic holograms*, Proceedings of the IS&T/SPIE's Symposium on Electronic Imaging, Practical, Holography XI, San Jose, 1997.

M. E. Lucente, R. Pappu, C. J. Sparrell, S. A. Benton, *Progress in holographic video with the acousto-optical modulator display*, Proc. SPIE Vol. 2577, p. 2-7, International Conference on Applications of Optical Holography, Toshio Honda; Ed., 1995

P. St.-Hilaire, M. E. Lucente, J. D. Sutter, R. Pappu, C. J. Sparrell, S. A. Benton, *Scaling up the MIT holographic video system*, Proc. SPIE Vol. 2333, p. 374-380, Fifth International Symposium on Display Holography, Tung H. Jeong; Ed., 1995.

S. Benton and R. Pappu, *Minimum Pixel Holograms*, Proceedings of the IS&T/SPIE's Symposium on Electronic Imaging, Practical Holography IX, San Jose, 1995.

P. Gandhi, S. S. Rao, and R. Pappu, *Wavelets for baseband coding of waveforms*, Proceedings of the IEEE GLOBECOM 1994.

P. Gandhi, S. S. Rao, and R. Pappu, *On Waveform Coding Using Wavelets*, Proceedings of the IEEE Asilomar Conference on Signals, Systems, and Computers, 1993.

S. S. Rao and R. Pappu, *Hierarchical Wavelet Neural Networks*, Proceedings of the IEEE-SP Workshop on Neural Networks for Signal Processing, 1993

S. S. Rao and R. Pappu, *Nonlinear Time Series Prediction Using Wavelet Networks*, Proceedings of the World Congress on Neural Networks, 1993.

PATENTS

US Patent US20130311519 A1, *Object recognition and localization service using RFID*
Application US US20130314210 A1, *Multi-modal entity tracking and display*
Application US 20120062366 A1, *RFID Tiles*
Application US 20120075072 A, *Co-located RFID Fields*
Application 12/333,988, *Radio Devices and Communications*
Application 12/595,109, *Methods and Apparatus For Self-Jamming Suppression In A Radio Frequency (RFID) Identification Reader*

Application US 2008/0181398 A1, *Methods and apparatus for enhancing privacy of objects associated with radio-frequency identification tags*, 2008
US Patent 7999658,*Method and apparatus for operating a radio device*
US Patent 7961078, *Method and apparatus for operating a radio device*
US Patent 7898391, *Multi-reader coordination in RFID systems*, 2007.
US Patent 7075412, *Method and apparatus for operating a radio device*, 2006.
US Patent 6584214, *Identification and verification using 3D features*, 2003.
US Patent 6211848, *Dynamic Holographic Video With Haptic Interaction*, 2001.

HONORS

Beth Israel Deaconess Medical Center, Board of Overseers, 2009
Boston Business Journal's 40 under 40, 2008
Fellow, World Technology Network, 2006
Carl T. Humphrey Memorial Award for Contributions to the Engineering Profession, Villanova University, 2004
MIT Technology Review's TR100 list of top 100 innovators under the age of 35, 2003
IBM Research Fellowship at MIT 1999, 2000, 2001
Mitsubishi Electric Research Laboratories Fellowship at MIT 1999
Elected Associate Member of Sigma Xi 1993
J. N. Tata Scholarship for the Higher Education of Indians, 1991
Nizam Trust Scholarship for Travel to the United States, 1991
Jawaharlal Nehru Summer Research Fellowship, 1991
Member of state team at the First Indian National Mathematical Olympiad, 1987

SOCIETY

ThinkCycle/Design That Matters: Co-conceived and co-implemented ThinkCycle in 2000. ThinkCycle is a non-profit initiative engaged in supporting distributed collaboration towards solving technical challenges facing underserved communities through open source design innovation. This project has yielded several interesting solutions including a portable microfilm projector for schools, a passive incubator for premature infants, and a compact IV kit for cholera treatment in the field. ThinkCycle was nominated for a 2006 World Technology Award in the Social Entrepreneurship category and was listed in *Worldchanging: A User's Guide for the 21st Century.* ThinkCycle morphed into *Design That Matters* in 2003. [www.designthatmatters.org]

Work An Hour For Education: Co-conceived and co-implemented this initiative. Work An Hour For Education called on people of Indian origin to donate one hour's worth of their pay to fund education projects in India. This web-based project, started in 1998, has raised over one million dollars to date and is held every year. [www.workanhour.com]