Rohit Puri

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OBJECTIVE Algorithms/Software/Architecture oriented R&D position in multimedia signal processing, computer vision, communications, or networking

PERSONAL U.S. Permanent Resident

EDUCATION

- **Ph.D.** Electrical Engineering (8/99 – 8/02) GPA: 3.95/4.0
  EECS (Electrical Engineering and Computer Sciences), University of California, Berkeley
  Minor: Operations Research
  Recipient of **Eliahu I. Jury** doctoral thesis award for outstanding achievement in systems, communications, control or signal processing research

- **M.S.** Electrical Engineering (8/97 – 8/99) GPA: 3.98/4.0
  ECE (Electrical and Computer Engineering), University of Illinois, Urbana Champaign (UIUC)

- **B.Tech** Electrical Engineering (7/93 – 7/97) GPA: 9.52/10.0
  EE (Electrical Engineering), Indian Institute of Technology (IIT) Bombay, India.
  Ranked first in undergraduate class

JOB EXPERIENCE

Senior Software Developer, RhythmNewMedia Inc. (04/2008-)

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Senior Architect, Nvidia Inc. (01/2007-04/2008)

- Part of next-generation graphics processing unit (GPU) pipeline development effort. Tasks included development of test applications (using an in-house openGL/Direct3D like API and Cg programming language) for functionality and performance testing of different GPU pipeline stages
- Part of a low-power multi-format video decoder (H.264, VC1, MPEG-4, and JPEG) and AES encryption/decryption hardware pipeline development effort. Tasks included: (1) decoder pipeline architecture development, (2) architecture performance analysis, (3) hardware engine modeling (C/C++) and (4) test suite/regression scripts (Perl/Python/make) for hardware module verification

Senior Video Architect, PortalPlayer Inc. (8/2005-01/2007)

- Part of a low-power VC-1 (WMV9) video decoder development effort on an ARM core + hardware acceleration platform. Tasks included: (1) development of overall decoder pipeline architecture, (2) architecture for constituent hardware modules, (3) hardware engine modeling (using SystemC C++ library), and (4) test suite for hardware module verification. (5) Responsible for decoder compliance testing and (6) overall error handling architecture for decoder
- Part of a low-power H.264 video decoder development effort on an ARM core + hardware acceleration platform. Worked on different aspects of decoder including (1) hardware-software partitioning, (2) software architecture, (3) software performance optimization, (4) hardware engine architecture, (5) test suite for hardware module verification and (6) decoder compliance testing
- Proficiency in multimedia file formats including .mp4, .mov, .3gp, .avi and .asf
- Technical evaluation of 3rd party audio/video codec IP on ARM platform

Research Engineer, EECS Dept., University of California, Berkeley (8/2004-8/2005)

- Investigated fundamental complexity vs. robustness vs. compression performance trade-offs for proprietary PRISM (Power-efficient, Robust, hIgh-compression Syndrome based Multimedia coding) video codec based on distributed source coding concepts, vis-à-vis approaches based on standards such as H.264, MPEG-4 and MPEG-2

- Proposed a novel information-theoretic solution for source broadcast transmission to heterogeneous digital receivers, based on hybrid analog-digital source-channel coding including source and channel coding with side information.

Senior Video Engineer, Sony Electronics, Inc. (1/2003-8/2004)
- Codec development (algorithm and software) for multi-view (multiple cameras) video compression problem ensuring compatibility with H.264 standard
- Algorithm and software development for a wavelet transform based high-compression, highly scalable (quality, resolution, temporal and complexity), video codec as a part of the MPEG SVC (scalable video coding) effort

Post-Doctoral Research Engineer, EECS Dept., University of California, Berkeley (9/2002-11/2002)
- Optimal solution in an information-theoretic framework for the problem of seamless digital upgrade of existing analog broadcast transmission systems in adherence with the FCC spectrum regulations
- Developed an information-theoretic framework for distributed, low-complexity, high performance, robust coding algorithms for unreliable sensor networks

GRADUATE SCHOOL EXPERIENCE

Research Assistant, EECS Dept., University of California, Berkeley (8/99 –8/2002).
Advisor: Prof. Kannan Ramchandran
Ph.D Dissertation Title: Robust Multimedia Coding: Theory, Applications and Architectures.
- Invented PRISM video coding system, with properties of error robustness, high compression performance, and low encoding complexity, including applications to wireless (e.g., cellular, 802.11) and sensor networks
- Obtained the fundamental information theoretic rate regions as well as constructive coding strategies for multimedia transmission over best effort networks, based on the concepts of multiple descriptions coding
- Developed scalable architecture and protocols for parallel real-time video streaming from multiple, non-collaborating servers to achieve server load balancing, fault tolerance and Quality of Service (QoS)
- Introduced a cross-layer optimized framework for video streaming and multicast over heterogeneous networks such as the Internet and wireless networks

Visitor, Intel Inc., Media and Graphics Lab, Microprocessor Research Lab, Santa Clara, California (7/2002)
Mentor: Dr. Minerva Yeung
- Complexity-distortion-rate analysis of various multimedia coding algorithms (H.264, MPEG, matching pursuits) for the Intel Pentium processor architecture using the Vtune performance analyzer developed at Intel

Visitor, Laboratory of Audio Visual Communications, Ecole Polytechnique Federale de Lausanne (EPFL) Switzerland (6/2001-8/2001).
- Implemented a video multicasting system including a wavelet transform based complexity-scalable layered video codec for delivery of live satellite feed across the EPFL campus network

Summer Intern, AT&T Newman Springs Lab., Red Bank, New Jersey (5/99 - 8/99).
Mentor: Dr. Amy Reibman
- Developed an H.263+ standard compatible multiple descriptions video codec for the H.263+ error resilience mode, presented at ITU-Video Coding Experts Group meetings at Berlin (3-6 August 1999) and Red Bank (19-22 October, 1999)

Research Assistant. Beckman Institute and ECE Dept., University of Illinois, Urbana-Champaign (8/97 – 5/99)
Advisor: Prof. Kannan Ramchandran
Masters Thesis Title: Multiple Description Codes with Novel Congestion Control for Video Streaming
- Designed an end-to-end video streaming system comprising of a robust source encoder and a TCP-friendly transport layer protocol (got best paper award at Packet Video 2000 workshop)
- Proposed an optimal source-channel rate allocation scheme for robust video transmission over wireless channels employing optimized hybrid error control mechanisms (combination of error correction codes and retransmissions)

SKILLS
- In-depth knowledge of video/image compression standards including H.263, H.264, MPEG-2, MPEG-4, VC-1 (WMV9) and JPEG. Familiar with AES (Advanced Encryption Standard) encryption/decryption standard
- Programming: C, C++, Ruby, MATLAB, UNIX network programming
- Web: Ruby on Rails (RoR), HTML/XHTML, CSS, XSLT/XPath

- Other: Perl, UNIX shell programming, Python, make
- Development Environments: Microsoft Visual C++, Linux/Unix, ARM Developer Suite
- Architectures: ARM7TDMI, Intel x86, Motorola 56302, TMS320C5X

ACTIVITIES AND HONORS

- **Finalist** at UC Berkeley Business Plan Competition 2005 – member of team PrismVideo, a provider of technology and solutions to accelerate the deployment of next-generation mobile video applications
- Recipient of **Eliahu I. Jury doctoral thesis award** for outstanding achievement in systems, communications, control or signal processing research for my "work on robust, reliable and efficient multimedia delivery over packet networks and wireless channels", by the EECS Department, University of California, Berkeley (2004)
- **Best Paper Award** at the Packet Video Workshop for "Application of FEC based Multiple Description Coding to Internet Video Streaming and Multicast", Forte Village Resort, Sardinia, Italy, May 2000 (2000)
- **Institute Silver Medal** for securing the top rank in the undergraduate class, IIT Bombay (1997)
- **Scholarship** for securing position in the top 0.1% in Mathematics in the Central Board of Secondary Education Examination, India (1992)
- Active Reviewer for several prestigious journals and conferences (IEEE as well as Elsevier)

PUBLICATIONS SUMMARY

- About 15 patent/invention disclosure applications filed at University of California, Berkeley, Sony Electronics Inc., and PortalPlayer Inc.
- More than 35 peer-reviewed publications in internationally acclaimed journals and conference proceedings
- More than 10 contributions to the ISO (MPEGx) video standardization groups, ITU (H.26x) video standardization group, book chapters and technical reports
- Several invited presentations/tutorials at various research forums and international conferences

JOURNAL PUBLICATIONS

- **An Integrated Source Transcoding and Congestion Control Paradigm for Video Streaming in the Internet**. Rohit Puri, Kang-Won Lee, Kannan Ramchandran and Vaduvur Bharghavan. IEEE Transactions on Multimedia, Vol. 3, No. 1, March 2001, pp 18-32.
- **Forward Error Correction (FEC) Codes Based Multiple Description Coding for Internet Video Streaming and Multicast.** Rohit Puri, Kang-Won Lee, Kannan Ramchandran and Vaduvur Bharghavan. Elsevier Signal Processing: Image Communication, Vol. 16, No. 8, May 2001, pp 745-762.
- **Multiple Description Video Coding Using Motion Compensated Temporal Prediction.** Amy R. Reibman, Hamid Jafarkhani, Yao Wang, Michael T. Orchard and Rohit Puri. IEEE Transactions on Circuits and Systems for Video Technology, Vol. 12, No. 3, March 2002, pp 193-204.
- **n-Channel Symmetric Multiple Descriptions - Part I: (n,k) Source Channel Erasure Codes.** S. Sandeep Pradhan, Rohit Puri and Kannan Ramchandran. IEEE Transactions on Information Theory, Vol. 50, No. 1, January 2004, pp 47-61.
- **n-Channel Symmetric Multiple Descriptions—Part II: An Achievable Rate-Distortion Region.** Rohit Puri, S. Sandeep Pradhan and Kannan Ramchandran. IEEE Transactions on Information Theory, Vol. 51, No. 4, April 2005, pp 1377-1392.
- **On Rate-Constrained Distributed Estimation in Unreliable Sensor Networks.** Prakash Ishwar, Rohit Puri, S. Sandeep Pradhan, and Kannan Ramchandran. IEEE Journal on Selected Areas in Communications, Vol. 23, No. 4, April 2005, pp 765-775.
- **Distributed Video Coding in Broadband Wireless Sensor Networks.** Rohit Puri, Abhik Majumdar, Prakash Ishwar and Kannan Ramchandran. IEEE Signal Processing Magazine, Vol. 23, No. 4, July 2006, pp 94-106.
- **VISDOM: VIdeo Streaming using Distributed encoding Over Multiple servers.** Abhik Majumdar, Rohit Puri and Kannan Ramchandran. Accepted IEEE Transactions on Circuits and Systems for Video Technology, October 2006.
- **PRISM: A Video Coding Paradigm Based with Motion Estimation at the Decoder.** Rohit Puri, Abhik Majumdar and Kannan Ramchandran. IEEE Transactions on Image Processing, Vol. 16, No. 10, October 2007, pp 2436-2448.
- **Colored Gaussian Source-channel Broadcast for Heterogeneous (Analog/Digital) Receivers.** Rohit Puri, Vinod M. Prabhakaran, and Kannan Ramchandran. IEEE Transactions on Information Theory, Vol. 54, No. 4, April 2008.

STANDARDS CONTRIBUTIONS

- **Multiple Description Video Coding Using Motion Compensated Prediction.** Amy R. Reibman, Rohit Puri, Hamid Jafarkhani, Yao Wang and Michael T. Orchard. Proposal H26L: ITU - Telecommunications Standardization Sector, Video Coding Experts Group (Question 15), eighth meeting, Berlin, 03-06 August 1999.

- **Packet Loss Performance of Multiple Description Video Coding.** Amy R. Reibman, Hamid Jafarkhani, Yao Wang, Michael T. Orchard and Rohit Puri. Proposal H26L: ITU - Telecommunications Standardization Sector, Video Coding Experts Group (Question 15), ninth meeting, Red Bank, 19-22 October 1999.
- **Multiple Descriptions Coding for Generalized Video Layering.** Ali Tabatabai, and Rohit Puri. ISO/IEC JTC1/SC29/WG11, Subgroup MPEG21/Video, 69th meeting at Redmond, WA, 19-23 July 2004.
- **Video coding based on distributed source coding principles.** Kannan Ramchandran, Rohit Puri, Abhik Majumdar, Jiajun Wang, and Marco Tagliasacchi. Workshop for future directions in video compression, 72nd MPEG meeting, April 20th 2005, Busan, Korea.
- **PRISM: Video coding based on motion compensation at decoder.** Kannan Ramchandran, Rohit Puri, Abhik Majumdar, Jiajun Wang, and Marco Tagliasacchi. Response to Call for Contributions for workshop for future directions in video compression, 74nd MPEG meeting, October 16th 2005, Nice, France.

BOOK CHAPTERS

- **Distributed Video Databases.** *The Handbook of Video Databases: Design and Applications.* Editors-in-chief: Borko Furht and Oge Marques. CRC Press, 2002/2003.
- **Distributed Video Coding and its Applications.** Abhik Majumdar, Rohit Puri, Jim Chou, and Kannan Ramchandran. *Multimedia over IP and Wireless Networks.* Editors: Philip A. Chou and Mihaela Van Der Schaar.
- **Channel Protection Fundamentals.** Raouf Hamzaoui, Vladimir Stankovic, Zixiang Xiong, Kannan Ramchandran, Rohit Puri, Abhik Majumdar, and Jim Chou. . *Multimedia over IP and Wireless Networks.* Editors: Philip A. Chou and Mihaela Van Der Schaar.

CONFERENCE PUBLICATIONS

- **Joint Source Channel Coding with Hybrid ARQ/FEC for Robust Video Transmission.** Rohit Puri, Kannan Ramchandran and Antonio Ortega. IEEE Multimedia Signal Processing Workshop, Redondo Beach, CA, Dec 1998.
- **Multiple Description Coding for Video Using Motion Compensated Prediction.** Amy R. Reibman, Hamid Jafarkhani, Yao Wang, Michael T. Orchard and Rohit Puri. IEEE International Conference on Image Processing (ICIP), Kobe, Japan, October 1999.
- **Multiple Description Source Coding Through Forward Error Correction Codes.** Rohit Puri and Kannan Ramchandran. 33rd Asilomar Conference on Signals, Systems, and Computers, Pacific Grove, CA, October 1999.
- **An Integrated Source Coding and Congestion Control Framework for Video Streaming in the Internet.** Kang-Won Lee, Rohit Puri, Kannan Ramchandran and Vaduvur Bharghavan. IEEE INFOCOM 2000, Tel-Aviv, Israel, March, 2000.
- **Application of FEC based Multiple Description Coding to Internet Video Streaming and Multicast.** Rohit Puri, Kang-Won Lee, Kannan Ramchandran and Vaduvur Bharghavan. Packet Video Workshop, Forte Village Resort, Sardinia, Italy, May 2000.
- **(n,k) Source Channel Erasure Codes: Can Parity Bits also Refine Quality?** Sandeep Pradhan, Rohit Puri and Kannan Ramchandran. Conference on Information Sciences and Systems, Baltimore, MD, March 2001.
- **MDS Source Channel Erasure Codes.** S. Sandeep Pradhan, Rohit Puri and Kannan Ramchandran. International Symposium on Information Theory, Recent Results Session, Washington DC, June 2001.
- **n-Channel Multiple Descriptions: Theory and Constructions.** Rohit Puri, S. Sandeep Pradhan and Kannan Ramchandran. Data Compression Conference (DCC), Snowbird, UT, April 2002.
- **Robust Video Multicast under Rate and Channel Variability with Application to Wireless LANs.** Abhik Majumdar, Rohit Puri, Kannan Ramchandran and Igor Kozintsev. IEEE International Symposium on Circuits and Systems (ISCAS), Scottsdale, AZ, May 2002.
- **Video Multicast in (Large) Local Area Networks.** Sergio Servetto, Rohit Puri, Jean-Paul Wagner, Pierre Scholtes and Martin Vetterli. IEEE INFOCOM 2002, New York City, NY, June 2002.
- **n-Channel Symmetric Multiple Descriptions: New Rate Regions.** Rohit Puri, S. Sandeep Pradhan and Kannan Ramchandran. International Symposium on Information Theory (ISIT), Lausanne, Switzerland, July 2002.
- **Rate-Distortion Efficient Video Transmission from Multiple Servers.** Abhik Majumdar, Rohit Puri and Kannan Ramchandran. International Conference on Multimedia and Expo (ICME), Lausanne, Switzerland, August 2002.
- **Distributed Multimedia Transmission from Multiple Servers.** Abhik Majumdar, Rohit Puri and Kannan Ramchandran. International Conference on Image Processing (ICIP), Rochester, NY, September 2002.
- **PRISM: A New Robust Video Coding Architecture Based on Distributed Compression Principles.** Rohit Puri and Kannan Ramchandran. 40th Allerton Conference on Communication, Control and Computing, Allerton, IL, October 2002.
- **On Seamless Digital Upgrade of Analog Transmission Systems using Coding with Side Information.** Rohit Puri, Kannan Ramchandran and S. Sandeep Pradhan. 40th Allerton Conference on Communication, Control and Computing, Allerton, IL, October 2002.

- **Rate-Constrained Robust Estimation for Unreliable Sensor Networks.** Rohit Puri, Prakash Ishwar, S. Sandeep Pradhan and Kannan Ramchandran. 36th Asilomar Conference on Signals, Systems, and Computers, Pacific Grove, CA, November 2002.
- **PRISM: An Uplink-Friendly Multimedia Coding Paradigm**. Rohit Puri and Kannan Ramchandran. IEEE International Conference on Acoustics, Speech and Signal Processing, Hong Kong, April 2003.
- **On Rate-Constrained Estimation in Unreliable Sensor Networks**. Prakash Ishwar, Rohit Puri, S. Sandeep Pradhan and Kannan Ramchandran. IEEE International Workshop on Information Processing in Sensor Networks, Palo Alto, CA, April 2003.
- **An Achievable Rate-Distortion Region for an Unreliable Sensor Network Problem**. Prakash Ishwar, Rohit Puri, S. Sandeep Pradhan and Kannan Ramchandran. IEEE International Symposium on Information Theory (ISIT), Yokohama, Japan, July 2003.
- **PRISM: A "Reversed" Multimedia Coding Paradigm.** Rohit Puri and Kannan Ramchandran. IEEE International Conference on Image Processing (ICIP), Barcelona, Spain, September 2003.
- **A Hybrid Analog-Digital Framework for Source-Channel Broadcast.** Rohit Puri, Vinod M. Prabhakaran and Kannan Ramchandran. Conference on Information Sciences and Systems, Baltimore, MD, March 2005.
- **Analysis of Motion-complexity and Robustness for Video Transmission.** Prakash Ishwar, Rohit Puri, Abhik Majumdar, and Kannan Ramchandran.International Symposium on Multimedia over Wireless (ISMW), Maui, Hawaii, June 2005.
- **Complexity-Performance Trade-offs for Robust Distributed Video Coding.** Abhik Majumdar, Rohit Puri, Prakash Ishwar and Kannan Ramchandran.International Conference on Image Processing (ICIP), Genoa, Italy, September 2005.
- **Slepian-Wolf Codes for Parallel Sources: Design and Error Exponent Analysis.** Daniel Schonberg, Stark C. Draper, Rohit Puri, and Kannan Ramchandran. 43rd Allerton Conference on Communication, Control and Computing, Allerton, IL, September 2005.
- **Hybrid Analog-Digital Strategies for Source-Channel Broadcast.** Vinod M. Prabhakaran, Rohit Puri and Kannan Ramchandran. 43rd Allerton Conference on Communication, Control and Computing, Allerton, IL, September 2005.
- **Multi-camera Video Resolution Enhancement by Fusion of Spatial Disparity and Temporal Motion Fields.** Daniel Hazen, Rohit Puri and Kannan Ramchandran. IEEE International Conference on Computer Vision Systems, New York City, NY, January 2006.

TECHNICAL REPORTS

- **PRISM: A Real Time Multimedia Coding Architecture for Wireless Networks.** Rohit Puri and Kannan Ramchandran. Memorandum No. UCB/ERL M02/22, May 20, 2002.
- **(n,k) Source Channel Erasure Codes: Can Parity Bits also Refine Quality?** Sandeep Pradhan, Rohit Puri and Kannan Ramchandran. UCB/ERL, January 2001.

INVITED PRESENTATIONS/TUTORIALS

- **Robust Multimedia Encoding and Transmission.** Sony Electronics Inc., Algorithms and Architectures Group, San Jose, CA, April 11, 2002.
- **Robust Source Coding: Theory, Applications and Architectures.** IBM T.J. Watson Research Center, Yorktown Heights, NY, May 23, 2002.
- **Error Resilient Multimedia Coding: Theory, Applications and Architectures.** Intel Corporation, Microprocessor Research Labs, Santa Clara, CA, July 17, 2002.
- **Robust Multimedia Coding: From Information Theory to Practical Architectures.** Qualcomm Inc., Technologies and Ventures Group, San Diego, CA, September 5, 2002.
- **Robust Source Coding: Theory and Practice.** Sony Electronics Inc., Media Processing Division, San Jose, CA, September 27, 2002.
- **Some Notes on Coding Theory.** Electrical Engineering and Computer Sciences Department, University of California Berkeley, CA – 94720. October 16, 2003.
- **Multiple Descriptions Coding.** Electrical Engineering and Computer Sciences Department, University of California Berkeley, CA – 94720. October 28, 2004.
- **A Primer on Distributed Video Coding.** Kannan Ramchandran, Rohit Puri, Abhik Majumdar, and Jiajun Wang. International Conference on Video and Image Processing (ICVIP), Lausanne, Switzerland, April 2005.
- **Distributed Source Coding: Myths and Realities.** Kannan Ramchandran and Rohit Puri. IEEE International Conference on Image Processing (ICIP), Genoa, Italy, September 2005.

REFERENCES

- Prof. Kannan Ramchandran, (510) 642-2353, kannanr@eecs.berkeley.edu
- Prof. Antonio Ortega (213) 740-2320, ortega@sipi.usc.edu

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