

GAURAV SHARMA

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RESEARCH INTERESTS

- Signal Processing for Communications and Bioinformatics
- Multimedia Security, Data Hiding, and Authentication
- Color Imaging and Image Processing

EDUCATION

- 08/92 – 08/96* **Ph.D. (Electrical & Computer Engr., Minor: Mathematics)**
North Carolina State University, Raleigh, NC. **GPA = 4.0/4.0**
Dissertation : “Signal Processing for Evaluation and Design of Color Recording Devices”
Adviser : Prof. H. Joel Trussell
- 08/92 – 06/95* **M.S. (Applied Math.)**
North Carolina State University, Raleigh, NC. **GPA = 4.0/4.0**
- 08/90 – 01/92* **Master of Engineering (Electrical Communication Engr.)**
Indian Institute of Science(IISc), Bangalore, India. **GPA = 7.7/8.0**
- 08/86 – 06/90* **Bachelor of Engineering (Electronics & Communication Engr.)**
Indian Institute of Technology (formerly Univ. of R.), Roorkee, India. **First division with honors**

EXPERIENCE

- 08/03 –* **University of Rochester, Rochester, NY**
Associate Professor, Electrical and Computer Engineering Dept., 08/03 –
Associate Professor, Dept. of Biostatistics and Computational Biology, 10/08 –
Research in multimedia security, bioinformatics/genomic signal processing, color imaging/image processing, and digital halftoning. Graduate and undergraduate teaching in signal/image processing, communications, digital color imaging, and information theory.
- Director, Center for Emerging and Innovative Sciences (CEIS), 07/09 –*
Director, Center for Electronic Imaging Systems (CEIS), 07/08 – 07/09
Executive leadership of CEIS – a NYSTAR (New York State Foundation for Science, Technology and Innovation) funded center for advanced technology located at the University of Rochester. The Center charter is to promote economic growth in the state through transfer of university research to industry. Responsible for strategy, development plans, and operations of the center.
- Associate Director, Center for Electronic Imaging Systems (CEIS), 09/07 – 06/08*
Led all technical activities at CEIS. Responsible for coordinating proposal evaluations, annual showcase, and technical highlights in reports and presentations.

06/93 – 08/03

Xerox Research and Technology, Webster, NY

Principal Scientist, 03/03 - 08/03

Member of Research Staff, 08/96 - 03/03

Research Intern, 06/93-08/93, 06/94-08/94, 07/95-08/95

Individual Contributor responsible for research in digital imaging and image processing for next generation printers, multi-function devices and emerging document solutions and services. Technical areas: color imaging, scanning, hardcopy and electronic image watermarking, multimedia security, halftoning, display color characterization, and networked color solutions. In addition to direct contributions to Xerox products, the research engendered one *edited book*, *30 patents* (with over ten additional pending applications), and over *40 journal and conference publications*.

Project Leader, Color Imaging R&D, 01/02 - 08/03

Lead and managed a six-member research team that shared the two-fold responsibilities of: a) developing and delivering color management technology to Xerox business groups and b) research and development in future color imaging algorithms and document solutions and services. Responsible for setting project targets and research objectives in collaboration with business groups and upper management and for project administration and coordination in order to accomplish these targets. Also responsible for personnel matters relating to performance evaluation and salary planning. Provided technical leadership to the Xerox color community via an internal color forum and conducted evaluations of internal and external intellectual property in color imaging.

03/2000 – 05/2003

Adjunct Faculty, *EE/CE Depts., Rochester Institute of Technology*, Rochester, NY

Developed and taught graduate/senior undergraduate courses on communication networks, speech and image compression, and data and computer communications.

08/92 – 08/96

Research & Teaching Assistant, *ECE Dept., North Carolina State Univ.*, Raleigh, NC

Conducted research in color signal processing and image restoration. Assisted in teaching of graduate courses in digital signal and image processing.

02/92 – 06/92

R & D Engr., *Switching Div., Center for Development of Telematics*, Bangalore

Worked with others in the team on finalizing the specifications and architecture for a 100,000 line ISDN exchange.

06/89 – 08/89

Summer Intern, *Space Applications Center*, Ahmedabad, India.

Implemented a DSP-based digital Voice Echo canceler for telephony applications.

COURSES DEVELOPED AND CONDUCTED

- Information Theory, ECE#450 Fall 2008, Spring 2006, 2004, Univ. of Rochester, (graduate).
- Communication Systems, ECE #242, Spring 2008, 2007, 2006, 2005, Univ. of Rochester, (undergraduate).
- Digital Communications, ECE#444/244 Fall 2009, 2007, 2006, 2004, 2003, Univ. of Rochester, (graduate/senior).
- Special Topics in Image Processing, ECE #492N, Spring 2005, Univ. of Rochester, (graduate).
- Digital Image Processing, EE#301-779 Spring 2003, Rochester Institute of Technology (graduate).
- Data & Computer Commun., CE#306-694 Spring 2001, Rochester Institute of Technology (graduate).
- Speech and Image Compression, EE#301-749 Winter 2001, Rochester Institute of Technology (graduate).
- Communication Networks, EE#301-692 Spring 2000, Rochester Institute of Technology (graduate/senior).

GRADUATE THESIS DIRECTION

- *Doctoral Students*

- “Digital watermarking methods for authentication, tamper localization and lossless recovery,” Mehmet U. Celik, ECE Dept., Univ. of Rochester, thesis completed Dec. 2004 (co-advised with A. M. Tekalp).
- “Image Registration for Multi-view Image Processing,” Gülçin Caner, Celik, ECE Dept., Univ. of Rochester, thesis completed July 2006 (co-advised with A. M. Tekalp and W. Heinzelman).
- “Clustered-Dot Periodic Halftones: Modeling, Modulation, and Applications,” Basak Oztan, ECE Dept., Univ. of Rochester, thesis completed July 2009.
- Co-advising and supervising graduate research of Oktay Altun, Research area: “Set-theoretic Watermarking” (with M. Bocko).
- Advising and supervising graduate research of Chao Yu, Research area: “Multi-view geometry and image processing for visual sensor networks.”
- Advising and supervising graduate research of Arif Harmanci, Research area: “Genomic Signal Processing.”
- Advising and supervising graduate research of Orhan Bulan, Research area: “Multi-media/Print Security.”
- Advising and supervising graduate research of David Coumou, Research area: “Watermark Synchronization.”
- Advising and supervising graduate research of Gary Dennis, Research area: “Microarray analysis modeling and optimization.”
- Advising and supervising graduate research of Iftekhar Naim, Research area: “TBD.”

- *Masters Students*

- Darius Fennell, Thesis: “Wavelet-based Moving Object Detection in Video with Camera Motion,” April 14, 2009.
- Yang Yu, Thesis: “Estimating Motion in IVUS Images Using Pyramidal Lucas Kanade Method,” April 14, 2009 (joint with Marvin Doyley).
- S. R. Aravindh Balaji, Thesis: “Pre-processing Methods for Lossless Compression of Color Look-Up Tables,” December 06, 2007.
- Angela D’Orazio, Thesis: “Adaptive Determination of Alignment Constraints for RNA Secondary Structure Prediction,” December 12, 2007.
- Vishnu Prasan, Thesis: “Image Broadcast in VANETs: A Feasibility Study Using JPEG 2000 with Unequal Error Protection,” December 12, 2007.
- Mithun Mukherjee, Thesis: “P-HIP : A multiresolution halftoning algorithm for progressive display,” EE Dept., Rochester Institute of Technology , thesis completed Dec. 2004.
- Adem Orsdemir, topic: “Multi-media Security,” December 2008.
- Junwen Mao, topic: “Image Forensics,” Jan 2009.
- Chaoyi Chen and Kunyu Xiong, Topic: “Vehicular Ad Hoc Networks,” December 2007.
- Adil Bilici, Topic: “Multi-dimensional data interpolation techniques for color device characterization,” ECE Dept., University of Rochester, August 2005.
- Ed Bremer, Topic: “Correspondence estimation in multi-view imagery,” ECE Dept., University of Rochester, December 2005.
- Matjaz Kranjc, Topic: “Power-aware routing for wireless sensor motes,” May 2006.
- MS Advisor: Dan Lewis, Ryan Aures, Chaoyi Chen, Kunyu Xiong, and Claude Fillion.

EDITED BOOK

- “Digital Color Imaging Handbook,” G. Sharma, Ed., CRC Press, 2003, ISBN: 084930900X.

CONTRIBUTED BOOK CHAPTERS

- “Color Fundamentals for Digital Imaging, G. Sharma, in “Digital Color Imaging Handbook,” G. Sharma, Ed., CRC Press, 2003.

PEER-REVIEWED JOURNAL PUBLICATIONS

1. “Continuous phase-modulated halftones,” B. Oztan and G. Sharma, *IEEE Trans. Image Proc.*, accepted for publication July 2009.

2. "Stochastic Sampling of the RNA Structural Alignment Space," A. O. Harmanci, G. Sharma, and D. H. Mathews, *Nucleic Acids Research*, advanced access published May 8, 2009, doi: 10.1093/nar/gkp276.
3. "Optimal Spread Spectrum Watermark Embedding via a Multistep Feasibility Formulation," H. O. Altun, A. Orsdemir, G. Sharma, and M. F. Bocko, *IEEE Trans. Image Proc.*, vol. 18, no. 2, Feb. 2009, pp. 371–387.
4. "Preprocessing Methods for Improved Lossless Compression of Color Look-up Tables," S. R. A. Balaji, G. Sharma, M. Q. Shaw, R. Guay, *Journal of Imaging Science and Technology*, vol. 52, no. 4, pp. 040901-1–9, Jul./Aug. 2008.
5. "Insertion, Deletion codes with feature-based embedding: A new paradigm for watermark synchronization with applications to speech watermarking," David J. Coumou, Gaurav Sharma, *IEEE Trans. Info. Forensics and Security*, vol. 3, no. 2, Jun 2008, pp. 153–165.
6. "PARTS: Probabilistic Alignment for RNA joinTs Secondary structure prediction," A. O. Harmanci, G. Sharma, and D. H. Mathews, *Nucleic Acids Research*, vol. 36, no. 7, Apr.2008, pp. 2406-2417.
7. "Misregistration sensitivity in clustered-dot color halftones," B. Oztan, G. Sharma, and R. P. Loce, *J. Electronic Imaging*, vol. 17, no. 2, Apr./Jun. 2008, pp. 023004,1–30.
8. "Efficient Pairwise RNA Structure Prediction Using Probabilistic Alignment Constraints in Dynalign," A. O. Harmanci, G. Sharma, D. H. Mathews, *BMC Bioinformatics*, 8:130, April 2007.
9. "Scanner Characterization for Color Measurement and Diagnostics," B. S. Lee, R. Bala, G. Sharma, *J. Electronic Imaging*, vol. 16, no. 4, pp. 043009–1–13, Oct./Dec. 2007.
10. "A set theoretic framework for watermarking and its application to semifragile tamper detection," Oktay Altun, Gaurav Sharma, Mehmet Celik, Mark Bocko, *IEEE Trans. Info. Forensics and Security*, vol. 1, no. 4, Dec. 2006, pp. 479–492.
11. "Local image registration by adaptive filtering," Gulcin Caner, A. Murat Tekalp, Gaurav Sharma, and Wendi Heinzelman, *IEEE Trans. Image Proc.*, vol. 15, no. 10, Oct. 2006, pp. 3053-3065.
12. "Lossless watermarking for image authentication: A new framework and an implementation," M. U. Celik, G. Sharma, and A. M. Tekalp, *IEEE Trans. Image Proc.*, vol. 15, no. 4, April 2006, pp. 1042-1049.
13. "Two-Dimensional Transforms for Device Color Correction and Calibration," R. Bala, G. Sharma, V. Monga, J. P. VandeCapelle, submitted to *IEEE Trans. Image Processing*, vol. 14, no. 8, pp. 1172–1186, Aug. 2005.
14. "System Optimization in Digital Color Imaging," R. Bala, G. Sharma, *IEEE Signal Processing Magazine, special issue on Color Imaging*, vol. 22, no. 1, pp. 55–63, Jan 2005.
15. "The CIEDE2000 Color-Difference Formula: Implementation Notes, Supplementary Test Data, and Mathematical Observations," G. Sharma, W. Wu, E. N. Dalal, *Color Research and Application* vol. 30, no. 1, pp. 21–30, Feb. 2005.
16. "Lossless generalized-LSB data embedding," M. U. Celik, G. Sharma, E. Saber, and A. M. Tekalp, *IEEE Trans. on Image Proc.*, vol. 14, no. 2, pp. 253-266, Feb. 2005.
17. "Collusion-resilient fingerprinting using random pre-warping," M. U. Celik, G. Sharma and A. M. Tekalp, *IEEE Signal Processing Letters*, vol. 11, no. 10, pp. 831–835, Oct. 2004.
18. "Gray-level-embedded lossless image compression," M. U. Celik, G. Sharma, and A. M. Tekalp, *Image Communication*, vol. 18, July 2003, pp. 443-454.
19. "Color printer characterization adjustment for different substrates," M. Shaw, G. Sharma, R. Bala, and E. N. Dalal, *Color Research and Application*, vol. 28, no. 6, Dec. 2003, pp. 454-467.
20. "Hierarchical watermarking for secure image authentication with localization," M. U. Celik, G. Sharma, E. Saber, and A. M. Tekalp, *IEEE Trans. on Image Proc.*, vol. 11, no. 6, June 2002, pp. 585-595.
21. "LCDs versus CRTs – Color-calibration and Gamut Considerations," G. Sharma, *Proceedings IEEE*, special issue on Flat Panel Display Technologies, vol. 90, no. 4, Apr. 2002, pp. 605-622.
22. "Show-through cancellation in scans of duplex printed documents," G. Sharma, *IEEE Trans. on Image Proc.*, vol. 10, No. 5, May 2001, pp. 736-754.
23. "Set theoretic estimation for problems in subtractive color," G. Sharma, *Color Research and Application*. vol. 25, no. 4, October 2000, pp. 333-348.
24. "Target-less scanner color calibration," G. Sharma, *Journal of Imaging Science and Technology*, vol. 44, no. 4, pp. 301–307, Jul./Aug. 2000.
25. "End-to-end color printer calibration by total least squares regression," M. Xia, E. Saber, G. Sharma, and A. M. Tekalp, *IEEE Trans. on Image Proc.*, vol. 8, no. 5, May 1999, pp. 700-716.

26. "Performance evaluation of burst error correcting codes on a Gilbert-Elliott channel," G. Sharma, A. A. Hassan, and A. Dholakia, *IEEE Trans. on Communications*, vol. 46, no. 7, July 1998, pp. 846-849.
27. "Color imaging for multimedia," G. Sharma, M. J. Vrhel, and H. J. Trussell, *Proceedings IEEE*, vol. 86, no. 6, Jun. 1998, pp. 1088-1108.
28. "Optimal non-negative color scanning filters," G. Sharma, H. J. Trussell, and M. J. Vrhel, *IEEE Trans. on Image Proc.*, vol. 7, no. 1, pp. 129-133, Jan 1998.
29. "Set theoretic signal restoration using an error in variables criterion," G. Sharma and H. J. Trussell, *IEEE Trans. on Image Proc.*, vol. 6, no. 12, Dec 1997, pp. 1692-1697.
30. "Digital color imaging," G. Sharma and H. J. Trussell, *IEEE Trans. on Image Proc.*, vol. 6, no. 7, Jul. 1997, pp. 901-932.
31. "Figures of merit for color scanners," G. Sharma and H. J. Trussell, *IEEE Trans. on Image Proc.*, vol. 6, no. 7, Jul. 1997, pp. 990-1001.
32. "Set theoretic estimation in color scanner characterization," G. Sharma and H. J. Trussell, *Jnl. Electronic Imaging*, vol. 5, no. 4, Oct. 1996, pp. 479-489.
33. "A DFT based alternating projection algorithm for parameter estimation of superimposed complex sinusoids," Gaurav Sharma and V.U. Reddy, *Signal Processing*, vol. 37, no. 1, May 1994, pp. 73-85.

NEWSLETTER ARTICLES

1. "Imaging Arithmetic: Physics U Math $>$ Physics + Math," G. Sharma, *Electronic Imaging*, Newsletter of the SPIE Electronic Imaging Technical Group, vol 15, no. 2, pp. 1, June 2005.

CONFERENCE PAPERS

1. "Joint stochastic sampling for RNA secondary structure prediction," A. O. Harmanci, G. Sharma, and D. H. Mathews, in *Proc. Seventh IEEE Intl. Wksp. on Genomic Signal Proc. and Stats. (GENSIPS)*, May 17-29, 2009, Minneapolis, MN, (CDROM).
2. "Q-SIFT: Efficient Feature Descriptors For Distributed Camera Calibration," C. Yu and G. Sharma, in *Proc. IEEE Intl. Conf. Acoustics Speech and Sig. Proc.*, April 19 - 24, 2009, Taipei, Taiwan, pp. 1849-1852.
3. "Geometric distortion signatures for printer identification," O. Bulan, J. Mao, and G. Sharma, in *Proc. IEEE Intl. Conf. Acoustics Speech and Sig. Proc.*, April 19 - 24, 2009, Taipei, Taiwan, pp. 1401-1404.
4. "Sensor Scheduling For Lifetime Maximization in User-Centric Image Sensor Networks," C. Yu and G. Sharma, in *Proc. SPIE: Visual Communications and Image Processing (VCIP)*, 18-22 January 2009, San Jose, CA, pp. 7257-OH-1-12. **Best Paper Award.**
5. "High Capacity Color Barcodes Using Dot Orientation and Color Separability," O. Bulan, V. Monga, G. Sharma, in *Proc. SPIE: Media Forensics and Security XI*, 18-22 January 2009, San Jose, CA.
6. "On the security and robustness of encryption via compressed sensing," Adem Orsdemir, H. Oktay Altun, Gaurav Sharma, and Mark F. Bocko, in *Proceedings Military Communications Conference (MILCOM)*, Nov. 17-19, 2008, San Diego, CA, [CDROM].
7. "Clustered-Dot Color Halftone Watermarks," B. Oztan and G. Sharma, in *Proc. IS&T/SID Sixteenth Color Imaging Conference: Color Science and Engineering: Systems, Technologies, Applications*, Portland, OR, 10-15 Nov. 2008, pp. 99-104.
8. "Adaptive Decoding for Halftone Orientation-based Data Hiding," O. Bulan, G. Sharma, and V. Monga, In *Proc. IEEE Intl. Conf. Image Proc.*, 12-15 October 2008, San Diego, CA, pp. 1280-1283.
9. "Application Of High Capacity Data Hiding In Halftone Images," O. Bulan, G. Sharma, V. Monga, *Proc. IS&T NIP24: Intl. Conf. Dig. Printing Technologies*, Pittsburgh, PA, 6-11 Sep. 2008, pp. 787-791.
10. "Improving Computational Efficiency for RNA Secondary Structure Prediction via Data-Adaptive Alignment Constraints," A. D'Orazio and G. Sharma, in *Proc. IEEE Intl. Wksp. on Genomic Signal Proc. and Stats. (GENSIPS)*, 8-10 June 2008, Phoenix, AZ, USA (CDROM).
11. "On the capacity of orientation modulation halftone channels," O. Bulan, G. Sharma, and V. Monga, in *Proc. IEEE Intl. Conf. Acoustics Speech and Sig. Proc.*, March 30-April 4, 2008, Las Vegas, NV, pp. 1685-1688.

12. "Probabilistic structural alignment of RNA sequences," A. O. Harmanci, Gaurav Sharma, and D. H. Mathews, in *Proc. IEEE Intl. Conf. Acoustics Speech and Sig. Proc.*, March 30-April 4, 2008, Las Vegas, NV, pp. 645–648.
13. "Distributed estimation using reduced dimensionality sensor observations: A separation perspective," C. Yu and G. Sharma, in *Proc. 40th Annual Conference on Information Sciences and Systems (CISS)*, Princeton, NJ, 19 – 21 Mar. 2008, pp. 150–154.
14. "Data embedding in hardcopy images via halftone-dot orientation modulation," O. Bulan, V. Monga, G. Sharma, and B. Oztan, In Delp et al. *Proc. SPIE: Security, Forensics, Steganography, and Watermarking of Multimedia Contents X*, vol. 6819, Jan. 2008, San Jose, CA, pp. 68190C-1–12.
15. "Improved embedding efficiency and AWGN robustness for SS watermarks via pre-coding," O. Altun, O. Bulan, G. Sharma, and M. Bocko, In Delp et al. *Proc. SPIE: Security, Forensics, Steganography, and Watermarking of Multimedia Contents X*, vol. 6819, Jan. 2008, San Jose, CA, pp. 68191F-1–12.
16. "Steganalysis-aware Steganography: Statistical indistinguishability despite high distortion," A. Orsdemir, O. Altun, G. Sharma, and M. Bocko, In Delp et al. *Proc. SPIE: Security, Forensics, Steganography, and Watermarking of Multimedia Contents X*, vol. 6819, Jan. 2008, San Jose, CA, pp. 681915–1–9.
17. "On side-informed coding of noisy sensor observations," C. Yu and G. Sharma, In *Proc. 41st Asilomar Conf. on Signals, Systems & Computers* Nov. 4-7, 2007, Pacific Grove, CA.
18. "Probabilistic methods for improving efficiency of RNA secondary structure prediction across multiple sequences," G. Sharma, A. O. Harmanci, and D. H. Mathews, In *Proc. 41st Asilomar Conf. on Signals, Systems & Computers*, Nov. 4-7, 2007, Pacific Grove, CA.
19. "Hierarchical compression of color look up tables," S. R. A. Balaji, G. Sharma, M. Q. Shaw, and R. Guay, in *Proc. IS&T/SID Fifteenth Color Imaging Conference: Color Science and Engineering: Systems, Technologies, Applications*, Albuquerque, NM, 5-9 Nov. 2007, pp. 261–266.
20. "Lifetime-distortion trade-off in image sensor networks," C. Yu, S. Soro, G. Sharma, and W. Heinzelman, In *Proc. IEEE Intl. Conf. Image Proc.*, 16-19 September 2007, San Antonio, Texas, pp. 129–132.
21. "Collusion resilient fingerprint design by alternating projections," O. Altun, G. Sharma, A. Orsdemir, and M. Bocko, In *Proc. IEEE Intl. Conf. Image Proc.*, 16-19 September 2007, San Antonio, Texas, pp. 437–440.
22. "Conditions for color misregistration sensitivity in clustered-dot halftones," B. Oztan, G. Sharma, and R. P. Loce, In *Proc. IEEE Intl. Conf. Image Proc.*, 16-19 September 2007, San Antonio, Texas, pp. 221–224.
23. "End-to-end channel assurance for communication over open voice channels," D. J. Coumou and G. Sharma, in *Military Communications Conference (MILCOM)*, Oct. 2007, pp. 1–7, 29-31, 2007, Orlando, Florida (invited paper).
24. "Toward Turbo Decoding of RNA Secondary Structure," A. Harmanci, G. Sharma, and D. H. Mathews, in *Proc. IEEE Intl. Conf. Acoustics Speech and Sig. Proc.*, 15-20 April, 2007, Honolulu, HI, vol I, pp. 365–368.
25. "Multi-view image registration for wide-baseline visual sensor networks," Gulcin Caner, A. Murat Tekalp, Gaurav Sharma, and Wendi Heinzelman, in *Proc. IEEE Intl. Conf. Image Proc.*, 8-11 October 2006, Atlanta, pp. 369–372.
26. "Self modulated halftones," B. Oztan and G. Sharma, in *Proc. IEEE Intl. Conf. Image Proc.*, 8-11 October 2006, Atlanta, pp. 1533–1536.
27. "Optimum watermark design by vector space projections," Oktay Altun, Gaurav Sharma, and Mark Bocko, in *Proc. IEEE Intl. Conf. Image Proc.*, 8-11 October 2006, Atlanta, pp. 1413–1416.
28. "Thin-plate splines for printer data interpolation," Gaurav Sharma and Mark Q. Shaw, in *Proc. EUSIPCO*, Sept. 2006 [CDROM].
29. "Watermark synchronization for feature-based embedding: Application to speech," David J. Coumou and Gaurav Sharma, in *Proc. IEEE Intl. Conf. on Multimedia and Expo.*, 09–13 Jul. 2006, pp. 849–852.
30. "Watermark synchronization: Perspectives and a new paradigm," Gaurav Sharma and David J. Coumou, in *Proc. 40th Annual Conference on Information Sciences and Systems (CISS)*, Princeton, NJ, 22 – 24 Mar. 2006, pp. 1182–1187. *Invited paper*.
31. "Continuous phase modulated halftones and their application to halftone data embedding," B. Oztan and G. Sharma, in *Proc. IEEE Intl. Conf. Acoustics Speech and Sig. Proc.*, May 15-17, 2006, Toulouse, France, vol. II, pp. 333–336. **Student Paper award winner**.
32. "Set theoretic quantization index modulation watermarking," Oktay Altun, Gaurav Sharma, and Mark Bocko, in *Proc. IEEE Intl. Conf. Acoustics Speech and Sig. Proc.*, May 15-17, 2006, Toulouse, France, vol. II, pp. 229–232.
33. "Multiple watermarking: A vector space projections approach," Oktay Altun, Gaurav Sharma, and Mark Bocko, in *Proc. SPIE: Computational Imaging IV*, vol. 6065, C. A. Bouman and E. L. Miller, Eds., Jan. 2006, San Jose, CA, pp. 60650O1–60650O12.

34. "Plane-based calibration of cameras with zoom variation," Chao Yu and Gaurav Sharma, in *Proc. SPIE: Visual Communications and Image Processing*, vol. 6077, J. G. Apostolopoulos and A. Said, Eds., 15 - 19 Jan. 2006, San Jose, CA.
35. "Analysis of misregistration induced color shifts in the superposition of periodic screens," B. Oztan, G. Sharma, and R. P. Loce, in *Proc. SPIE: Color Imaging XI: Processing, Hardcopy, and Applications*, vol. 6058, R. Eschbach and G. G. Marcu, Eds., Jan 17-19, 2006, San Jose, CA.
36. "Novel Scanner Characterization Method for Color Measurement and Diagnostics Applications," B.S. Lee, R. Bala, G. Sharma, in *Proc. SPIE: Computational Imaging IV*, vol. 6065, C. A. Bouman and E. L. Miller, Eds., Jan. 2006, San Jose, CA, pp. 606512-1-606512-11.
37. "Semifragile hierarchical watermarking in a set theoretic framework," O. Altun, G. Sharma, M. Celik, and M. Bocko, in *Proc. IEEE Intl. Conf. Image Proc.* Sept. 11-14, 2005, Genova, Italy, vol. I, pp. 1001 - 1004.
38. "Informed watermarking in the fractional Fourier Domain," O. Altun, G. Sharma, and M. Bocko, in *Proc. EUSIPCO 2005*, Sept. 4-8, 2005, Antalya, Turkey.
39. "Pitch and duration modification for speech watermarking," M. Celik, G. Sharma, and A. M. Tekalp, in *Proc. IEEE Intl. Conf. Acoustics Speech and Sig. Proc.*, 2005, vol. II, pp.17-20.
40. "Morphological steganalysis of audio signals and the principle of diminishing marginal distortions," O. Altun, G. Sharma, M. Celik, M. Sterling, E. Titlebaum, and M. Bocko, in *Proc. IEEE Intl. Conf. Acoustics Speech and Sig. Proc.*, 2005, vol. II, pp. 21-24.
41. "An adaptive filtering framework for image registration," G. Caner, A. M. Tekalp, G. Sharma, and W. Heinzelman, in *Proc. IEEE Intl. Conf. Acoustics Speech and Sig. Proc.*, vol. II, pp. 885-888.
42. "Imaging Arithmetic: Physics U Math $>$ Physics + Math," G. Sharma, in *Proc. SPIE: Color Imaging X: Processing, Hardcopy, and Applications*, vol. 5667, Jan. 2005, Invited Paper, pp.95-106.
43. "What color is it?," R. Eschbach, G. Sharma, and G. B. Unal, in *Proc. SPIE: Color Imaging X: Processing, Hardcopy, and Applications*, vol. 5667, 2005, pp. 186-192.
44. "A multiresolution halftoning algorithm for progressive display," M. Mukherjee and G. Sharma, in *Proc. SPIE: Color Imaging X: Processing, Hardcopy, and Applications*, vol. 5667, Jan. 2005, pp. 525-533.
45. "Quantitative evaluation of misregistration induced color shifts in color halftones," G. Sharma B. Oztan and R. P. Loce, in *Proc. SPIE: Color Imaging X: Processing, Hardcopy, and Applications*, vol. 5667, Jan. 2005, pp.501-512.
46. "Smooth blending of two inks of similar hue to simulate one ink," M. Q. Shaw, R. Bala, and G. Sharma, in *Proc. SPIE: Color Imaging X: Processing, Hardcopy, and Applications*, vol. 5667, Jan. 2005, pp.409-416.
47. "Local image registration: an adaptive filtering framework," G. Caner, A. M. Tekalp, G. Sharma, and W. Heinzelman, in *Proc. SPIE: Computational Imaging III*, C. A. Bouman and E. L. Miller, Eds., Jan. 2005, vol. 5674, pp. 159-168.
48. "A communication systems framework for microarray data acquisition," G. Sharma, in *Proc. Thirty-Eighth Asilomar Conf. on Signals, Systems & Computers*, Nov. 2004.
49. "Mathematical Discontinuities in CIEDE2000 Color Difference Computations," G. Sharma, W. Wu, E. N. Dalal, M. Celik, in *Proc. IS&T/SID Twelfth Color Imaging Conference: Color Science and Engineering: Systems, Technologies, Applications*, Scottsdale, AZ, 9-12 Nov. 2004, pp. 334-339.
50. "Efficient Classification of Scanned Media Using Spatial Statistics," G. B. Unal, G. Sharma, R. Eschbach, in *Proc. IEEE Intl. Conf. Image Proc.*, 24-27 October 2004, Singapore, pp. 2395-2398.
51. "Show-through watermarking of duplex printed documents," G. Sharma and S. Wang, *Proc. SPIE: Security, Steganography, and Watermarking of Multimedia Contents VI*, vol. 5306, San Jose, 19-22, Jan 2004.
52. "Universal image steganalysis using rate-distortion curves," M. U. Celik, G. Sharma, and A. M. Tekalp, *Proc. SPIE: Security, Steganography, and Watermarking of Multimedia Contents VI*, vol. 5306, San Jose, 19-22, Jan 2004.
53. "Stochastic Screens robust to mis-registration in multi-pass printing," G. Sharma, S. Wang, and Z. Fan *Proc. SPIE: Color Imaging: Processing, Hard Copy, and Applications IX*, vol. 5293, San Jose, 19-22, Jan 2004, pp. 460-468.
54. "Two-dimensional transforms for device color calibration," R. Bala, V. Monga, G. Sharma, J. P. VandeCapelle, *Proc. SPIE: Color Imaging: Processing, Hard Copy, and Applications IX*, vol. 5293, San Jose, 19-22, Jan 2004, pp. 250-261.
55. "Illuminant multiplexed imaging: GCR and special effects," G. Sharma, R. P. Loce, S. J. Harrington, and Y. Zhang, *Proc. IS&T/SID Eleventh Color Imaging Conference: Color Science, Systems and Applications*, 04-07 Nov. 2003, Scottsdale, AZ, pp 266-271. **Winner of the 2003 Best Poster "Cactus" Award.**

56. "Collusion-resilient fingerprinting using random pre-warping," M. U. Celik, G. Sharma, A. M. Tekalp, *Proc. IEEE Intl. Conf. on Image Processing*, 14-17 September 2003, Barcelona, Spain.
57. "Illuminant multiplexed imaging: basics and demonstration," G. Sharma, R. P. Loce, S. J. Harrington, and Y. Zhang, in *Final Prog. and Proc. of The PICS Conference: The Digital Photography Conference*, 13-16 May 2003, Rochester, NY, pp. 542-547.
58. "Level-successive encoding for digital photography," M. U. Celik, A. M. Tekalp, and G. Sharma, in *Final Prog. and Proc. of The PICS Conference: The Digital Photography Conference*, 13-16 May 2003, Rochester, NY, pp. 330-334.
59. "Error-diffusion robust to mis-registration in multi-pass printing," Z. Fan, G. Sharma, and S. Wang, in *Final Prog. and Proc. of The PICS Conference: The Digital Photography Conference*, 13-16 May 2003, Rochester, NY, pp. 413-420.
60. "Robust Processing of Color Target Measurements for Device Characterization," R. Bala, G. Sharma, D. Venable, in *Final Prog. and Proc. of The PICS Conference: The Digital Photography Conference*, 13-16 May 2003, Rochester, NY, pp. 413-420.
61. "Level-embedded lossless image compression," M. U. Celik, A. M. Tekalp, G. Sharma, in *Proc. IEEE ICASSP 2003*, 6-10 April 2003, Hong Kong, pp. III-245-248.
62. "Lossless Authentication Watermark (LAW)," M. U. Celik, G. Sharma, A. M. Tekalp, and E. Saber, *Proc. SPIE: Security and Watermarking of Multimedia Contents V, vol. 5020*, 20-24 January 2003, San Jose, CA, pp. 689-698.
63. "Minimal-effort characterization of color printers for additional substrates," M. Shaw, G. Sharma, R. Bala, and E. N. Dalal, *Proc. IS&T/SID Tenth Color Imaging Conference: Color Science, Systems and Applications*, 12-15 Nov. 2002, Scottsdale, AZ, pp. 202-207. **Winner of the 2002 Best Poster "Cactus" Award.**
64. "Reversible data hiding," M. U. Celik, G. Sharma, E. Saber, and A. M. Tekalp, *Proc. IEEE Intl. Conf. on Image Processing*, 22-25 Sept 2002, Rochester, NY, pp.II-157-160.
65. "Comparative evaluation of color characterization and gamut of LCDs versus CRTs," G. Sharma, *Proc. SPIE: Color Imaging: Device Independent Color, Color Hard Copy, and Applications VII*, 20-25 January 2002, San Jose, CA, vol. 4663, pp. 177-186.
66. "Spectrum recovery from colorimetric data for color reproductions," G. Sharma and S. Wang, *Proc. SPIE: Color Imaging: Device Independent Color, Color Hard Copy, and Applications VII*, 20-25 January 2002, San Jose, CA, vol. 4663, pp. 8-14.
67. "Digital video authentication with self recovery," M. U. Celik, G. Sharma, E. Saber, and A.M. Tekalp, *Proc. SPIE: Security and Watermarking of Multimedia Contents IV*, 20-25 January 2002, San Jose, CA, vol. 4675.
68. "A hierarchical image authentication watermark with improved localization and security," M. U. Celik, G. Sharma, E. Saber, and A. M. Tekalp, *Proc. IEEE Intl. Conf. on Image Processing*, 7-10 Oct. 2001, Thessaloniki, Greece, pp. 502-505.
69. "Influence of Resolution on Scanner Noise Perceptibility," G. Sharma and K. T. Knox, *Final Program and Proc. IS&T's PICS Conference*, 22-25 April 2001, Montréal, Canada, pp. 137-141.
70. "Analysis of feature-based geometry invariant watermarking," M.U. Celik, E. Saber, G. Sharma, and A. M. Tekalp, *Proc. SPIE: Security and Watermarking of Multimedia Contents III*, vol. 4314, pp. 261-268.
71. "Cancellation of show-through in duplex scanning," G. Sharma, *Proc. IEEE Intl. Conf. on Image Processing*, 10-13 Sept. 2000, Vancouver, BC, Canada, pp. II-609-612.
72. "Target-less scanner color calibration," G. Sharma, *Proc. IS&T/SID Seventh Color Imaging Conference: Color Science, Systems and Applications*, Scottsdale, AZ, 16-19 November 1999, pp. 69-74.
73. "Total least squares regression in Neugebauer model parameter estimation for dot-on-dot halftone screens," M. Xia, E. Saber, G. Sharma, and A. M. Tekalp, *Proc. IS&T NIP14: Intl. Conf. Dig. Printing Technologies*, Toronto, Canada, 18-23 Oct. 1998, pp. 281-284.
74. "Total least squares techniques in color printer characterization," M. Xia, E. Saber, G. Sharma, and A. M. Tekalp, *Proc. IEEE Intl. Conf. Image Proc.*, Chicago, IL, 4-7 Oct. 1998, pp. 69-73.
75. "The impact of UCR on scanner calibration," G. Sharma, S. Wang, D. Sidavanahalli, and K. T. Knox, *Proc. IS&T PICS Conference*, Portland, OR, 17-20 May 1998, pp. 121-124.
76. "Adaptive color rendering for images with flesh tone content," M. Xia, E. Saber, A. M. Tekalp, and G. Sharma, *Proc. SPIE: Color imaging : device-independent color, color hard copy, and graphic arts*, 28-30 Jan. 1998, San Jose, CA, vol. 3300, pp. 173-181.
77. "Measures of goodness for color scanners," G. Sharma and H. J. Trussell, in *Proc. IS&T/SID Fourth Color Imaging Conference: Color Science, Systems, and Applications*, Scottsdale, AZ, 19-22 Nov. 1996, pp. 28-32.

78. "Optimal filter design for multi-illuminant color correction," G. Sharma and H. J. Trussell, *Proc. IS&T/OSA Optics and Imaging in the Information Age*, 20-24 Oct. 1996, Rochester, NY, pp. 83-86.
79. "Restoration of uncertain blurs using an error in variables criterion," G. Sharma and H. J. Trussell, *Proceedings IEEE International Conference on Image Processing*, 16-19 Sept. 1996, Lausanne, Switzerland, pp. III-81-84.
80. "Simulation of error trapping decoders on a fading channel," G. Sharma, A. Dholakia and A.A. Hassan, in *Proc. IEEE Vehicular Technology Conference*, 28 Apr.-1 May 1996, Atlanta, GA, vol. 2, pp. 1361-1365.
81. "Comparison of measures of goodness of color scanning filters," H.J. Trussell, G. Sharma, P. Chen and S.A. Rajala, *Proc. Ninth IEEE Workshop on Image and Multi-dimensional signal processing*, March 3-6, 1996, Belize, pp. 98-99.
82. "Color scanner performance trade-offs," G. Sharma and H.J. Trussell, in *Proc. SPIE: Color imaging : device-independent color, color hard copy, and graphic arts*, 29 Jan-1 Feb. 1996, San Jose, CA, vol. 2658, pp. 270-278.
83. "Automatic calibration of halftones," K. Knox, C. Hains and G. Sharma, *Proc. SPIE: Human Vision and Electronic Imaging*, 29 Jan-1 Feb. 1996, San Jose, CA, vol. 2657, pp. 432-436.
84. "Decomposition of fluorescent illuminant spectra for accurate colorimetry," G. Sharma and H.J. Trussell, *Proceedings IEEE International Conference on Image Processing*, 13-16 Nov. 1994, Austin, TX, vol. II, pp. 1002-1006.
85. "Signal processing methods in color calibration," H.J. Trussell and G. Sharma, *Proc. SPIE: Device Independent Color Imaging*, 6-10 Feb. 1994, San Jose, CA, vol. 2170, pp. 18-23.
86. "Application of set theoretic methods to the calibration of colorimetry instrumentation," G. Sharma and H.J. Trussell, Contributed Lecture, *Cornelius Lanczos International Centenary Conference*, 12-17 Dec. 1993, Raleigh, NC.
87. "Characterization of scanner sensitivity," G. Sharma and H.J. Trussell, *Proc. of the IS&T/SID Color Imaging Conference: Transforms and Portability of Color*, 7-11 Nov. 1993, Scottsdale, AZ, pp. 103-107.

BOOK REVIEWS

- "Introduction to Digital Color Imaging by Hsien-Che Lee," reviewed by G. Sharma, *IEEE Sig. Proc. Mag.*, vol. 23, no. 5, Sept. 2006, pp. 119-120.
- "Introduction to Digital Color Imaging by Hsien-Che Lee," reviewed by G. Sharma, *J. Electronic Imaging*, vol. 15, No. 2, August 2006, pp. 029901,1-2.
- "Visual Color and Color Mixture by Jozef B. Cohen" reviewed by G. Sharma, *Color Research and Application*, vol. 28, no. 1, Feb. 2003, pp 76.

INVITED SEMINARS, TALKS, PANELS

1. "Set-theoretic Watermarking: A Feasibility Framework for Data Embedding," G. Sharma, *Research Seminar, ECE Dept., State University of New York (SUNY) at Binghamton*, February 25, 2009, Binghamton, NY.
2. "High Capacity Data Embedding in Halftone Images via Dot Orientation Modulation," O. Bulan, V. Monga, G. Sharma, *invited Technical Presentation at the Rochester Chapter of Society for Imaging Science and Technology*, Rochester, NY, 11 Feb. 2009.
3. "Joint Prediction of RNA Secondary Structure," G. Sharma, *invited seminar at the Electrical and Systems Engineering Department, Washington University, Saint Louis*, February 04, 2009, Saint Louis, MO.
4. Panelist for "Research in Color Science: Next Challenges," panel at HP Labs, Jan 23, 2009.
5. "Set-theoretic Watermarking: A Feasibility Framework for Data Embedding," G. Sharma, *invited seminar at the Chicago Chapter of the IEEE Signal Processing Society*, October 31, 2008, Chicago, IL.
6. "High Capacity Data Hiding in Halftone Images," G. Sharma, *invited presentation at Xerox Research Center*, February 21, 2008, Webster, NY.
7. "Set theoretic Watermarking: A Feasibility Framework for Data Hiding," G. Sharma, *invited presentation at Hewlett Packard Laboratories*, January 31, 2008, Palo Alto, CA.
8. "Efficient Joint Prediction of RNA Secondary Structure," G. Sharma, *invited presentation at Computer Science Research Institute, Sandia National Laboratories*, November 9, 2007, Albuquerque NM.

9. "Imaging Arithmetic: Physics U Math $>$ Physics + Math," G. Sharma, *invited presentation at Ricoh Innovations Inc.*, November 2, 2007, San Jose, CA.
10. "Set-theoretic Watermarking," G. Sharma, *invited presentation as part of Engineering Week at Harris Corporation*, February 20, 2007, Rochester, NY.
11. "Efficient Joint Prediction of RNA Secondary Structure," G. Sharma, *invited presentation at Microsoft Research*, January 26, 2007, Redmond, WA.
12. "Imaging Arithmetic: Physics U Math $>$ Physics + Math," G. Sharma, *invited presentation at North Carolina State University, Electrical and Computer Engineering Dept.*, October 6, 2006, Raleigh, NC.
13. "Set-theoretic Watermarking," G. Sharma, *invited presentation at Syracuse University, Dept. of Electrical Engineering and Computer Science*, August 17, 2006, Syracuse, NY.
14. "Multimedia Authentication Watermarks: Integrating Cryptography with Signal Processing," G. Sharma, *invited presentation at General Motors, India Science Laboratory*, July 06, 2006, Bangalore, India.
15. "Multimedia Authentication Watermarks: Integrating Cryptography with Signal Processing," G. Sharma, *invited presentation at Dept of Mathematics and Statistics*, May 10, 2006, Rochester Institute of Technology, Rochester, NY.
16. "Authentication Watermarking: Security, Localization, and a new Lossless Framework," G. Sharma, *invited presentation for Xerox Innovation Group*, March 16, 2006, Webster, NY.
17. "Mis-registration color models for periodic halftone screens," G. Sharma, *invited presentation at Xerox Labs, El Segundo, CA*, Jan. 20, 2006.
18. "Authentication Watermarking: Security, Localization, and a new Lossless Framework," G. Sharma, *invited presentation for IEEE Rochester Signal Processing Society Chapter*, Nov. 30, 2005.
19. "Physically Motivated Signal Processing: Applications in Digital Imaging," G. Sharma, *National University of Singapore, ECE Dept*, Oct 28, 2004.
20. "Authentication Watermarking: Security, Localization, and a new Lossless Framework," G. Sharma, *invited presentation at National University of Singapore, CS Dept*, Oct 28, 2004.
21. "Authentication Watermarking: Security, Localization, and a new Lossless Framework," G. Sharma, *invited seminar at Polytechnic University Brooklyn, CS Dept*, Oct 01, 2004.
22. "Exploiting Physics in Digital Imaging," G. Sharma, *University of Montreal, Computer Science Colloquium*, 20 May 2004, Montreal, Canada.
23. "Signal Processing for Physical Imaging," G. Sharma, *Cornell University Electrical and Computer Engineering Colloquium*, 20 April 2004, Ithaca, NY.
24. "Color Image Capture: Challenges and Opportunities," G. Sharma, *invited presentation before the Rochester Institute of Technology, IEEE Student Chapter*, 06 Feb 2004, Rochester, NY.
25. "Show-through in Duplex Documents: Correction and Exploits," G. Sharma, *invited presentation at Sony America*, 23 Jan 2004, San Jose, CA.
26. "Two-dimensional transforms for device color calibration," R. Bala, G. Sharma, V. Monga, *invited presentation at the late breaking news session IS&T/SID Eleventh Color Imaging Conference: Color Science, Systems and Applications*, 07 Nov. 2003, Scottsdale, AZ.
27. "Digital Color Scanning: Challenges and Opportunities," G. Sharma, *invited presentation at Hewlett-Packard*, Barcelona, Spain, 18 Oct. 2003.
28. "Show-through cancellation for duplex scanning," G. Sharma, *invited Technical Presentation before Rochester Chapter of Society for Imaging Science and Technology*, Rochester, NY, 21 Feb. 2001.
29. "Document echo cancellation: electronic show-through correction for scans of duplex printed pages," G. Sharma, *invited seminar at Department of Electrical and Computer Engineering, Univ. of Rochester*, Rochester, NY, 03 Oct. 2001.
30. "Image Processing for Digital Imaging," G. Sharma, *invited seminar at Silicon Automation Systems (now Sasken), Bangalore, India*, October 17, 2000.
31. "Image Processing for Digital Imaging," G. Sharma, *invited seminar at the Department of Electrical Computer Engineering, Indian Institute of Science, Bangalore, India*, October 16, 2000.
32. "Show-through cancellation for duplex scanning," G. Sharma, *IEEE Western New York Image Processing Workshop*, Rochester, NY, 17 Sept. 1999.

33. "A systems approach to color scanning," (*Invited Talk*) G. Sharma, *IEEE Western NY Image Proc. Workshop*, Rochester, NY, 19 Sept. 1997.
34. "Total least squares regression in color printer calibration," M.Xia, E. Saber, G. Sharma, and A. M. Tekalp, *IEEE Western NY Image Proc. Workshop*, Rochester, NY, 19 Sept. 1997.

PATENTS

1. US Patent # 7580149, "Method and system for identification of repeat print jobs using object level hash tables," issued August 25, 2009, Inventors: V. Monga and G. Sharma.
2. US Patent # 7558961, "Systems and methods for embedding messages in look-up tables," issued Jul 07, 2009, Inventors: G. Sharma and S. A. Schweid.
3. US Patent # 7525704, on "System for providing depth discrimination of source images encoded in a rendered composite image," issued 28 April 2009, Inventors: R. P. Loce, Y. Zhang, G. Sharma, S. J. Harrington, P. Crean.
4. US Patent # 7474783, on "Systems and Methods for Associating Color Profiles with a Scanned Input Image Using Spatial Attributes," issued 6 January 2009, Inventors: G. Sharma, R. Eschbach, S. Wang.
5. US Patent # 7453604, on "Systems and Methods for Estimating an Image Marking Process Using Scanned Image Attributes," issued 18 November 2008, Inventors: R. Eschbach, G. Sharma. S. Wang.
6. US Patent # 7450873, on "Marking system involving non-business usage," issued 11 November 2008, Inventors: G. Sharma, R. Sherman, C. J. Regruit, R. J. Rolleston, S. Revankar.
7. US Patent # 7379588, on "System for spectral multiplexing of source images to provide a composite image, for rendering the composite image, and for spectral demultiplexing of the composite image to obtain a normalized color image," issued 25 May 2008, Inventors: R. P. Loce, Y. Zhang, G. Sharma.
8. US Patent # 7376264, "Systems for spectral multiplexing of a source image and a background image to provide a composite image, for rendering the composite image, and for spectral demultiplexing of the composite images," issued 20 May 2008, Inventors: R. P. Loce, Y. Zhang, G. Sharma, and S. J. Harrington.
9. US Patent # 7355752, "Two-Dimensional Calibration Architectures for Color Devices," issued 8 Apr. 2008, Inventors: G. Sharma, R. Bala, J. P. VandeCapelle, M. S. Maltz, L. K. Mestha.
10. US Patent # 7352491, "System and Method for Selecting the Best Set of Devices for Rendering Color Documents," issued 1 Apr. 2008, Inventors: R. Bala, G. Sharma, R. J. Rolleston.
11. US Patent # 7339704, "Method for Standardizing Input CMYK Values for Clustered Printing Environments," issued 4 Mar. 2008, Inventors: L. K. Mestha, N. W. Zeck, K. J. Mihalyov, and G. Sharma.
12. US Patent #7336401, "Systems and Methods for Estimating an Image Marking Process Using Event Mapping of Scanned Image Attributes," issued 26 Feb. 2008, Inventors: G. Unal and R. Eschbach and G. Sharma.
13. US Patent #7328116, "Visual Monitor Calibration," issued 05 Feb. 2008, Inventors: R. Bala, R. Eschbach, G. Sharma.
14. US Patent #7295703, "Method for Scanner Characterization for Color Measurement of Printed Media having Four or More Colorants," issued 13 Nov. 2007, Inventors: R. Bala, J. Stinehour, G. Sharma.
15. US Patent #7286682, "Show-through Watermarking of Duplex Printed Documents," issued 23 Oct. 2007, Inventors: G. Sharma and S. Wang.
16. US Patent #7272261, "Method and System for Classifying Scanned Media," issued 18 Sept. 2007, Inventors: S. Wang, R. Eschbach, G. Sharma.
17. US Patent #7269297, "Illuminant-Neutral Gray Component Replacement in Systems for spectral multiplexing of source images to provide a composite image, for rendering the composite image, and for spectral demultiplexing of the composite image," issued 11 Sept. 2007, Inventors: R. P. Loce, Y. Zhang, and G. Sharma
18. US Patent #7230738, "System for spectral multiplexing of source images to provide a composite image with noise encoding to increase image confusion in the composite image, for rendering the composite image, and for spectral demultiplexing of the composite image," issued June 12, 2007, Inventors: Y. Zhang, G. Sharma, R. P. Loce, and S. J. Harrington.
19. United States Patent # 7218785, "Systems for spectral multiplexing of source images to provide a composite image, for rendering the composite image, and for spectral demultiplexing of the composite image," issued 15 May 2007, Inventors: G. Sharma, R. P. Loce, and S. J. Harrington.

20. United States Patent # 7215792, "Systems for spectral multiplexing of source images to provide a composite image with gray component replacement, for rendering the composite image, and for spectral demultiplexing of the composite image," issued 8 May 2007, Inventors: G. Sharma, Y. Zhang, R. P. Loce, and S. J. Harrington.
21. US Patent Application #7199905, "Systems and Methods for halftoning Multiple Color Separation Layers by Interlayer Error Diffusion," issued 3 Apr. 2007, Inventor: G. Sharma.
22. US Patent #7155068, "Systems for spectral multiplexing of source images to provide a composite image, for rendering the composite image, and for spectral demultiplexing the composite image, which achieve increased dynamic range in a recovered source image," issued 26 Dec. 2006, Inventors: Y. Zhang, G. Sharma, R. P. Loce, S. J. Harrington.
23. US Patent # 7145697, "Show-through compensation apparatus and method," , issued 05 Dec. 2006 , Inventors: G. Sharma and K. T. Knox.
24. US Patent #7136522, "Systems for spectral multiplexing of source images to provide a composite image, for rendering the composite image, and for spectral demultiplexing of the composite image to animate recovered source images," issued 14 Nov. 2006, Inventors: S. J. Harrington, R. P. Loce, and G. Sharma.
25. United States Patent # 7136189, "Color halftoning using a Multi-level Successive-filling halftone screening algorithm," issued 14 Nov. 2006, Inventors: G. Sharma, H. Shin, S. W. Wang, and Z. Fan.
26. US Patent #7127112, "System for spectral multiplexing of source images to provide a composite image, for rendering the composite image, and for spectral demultiplexing of the composite image by use of an image capture device," issued Oct. 24, 2006, Inventors: G. Sharma and R. P. Loce and S. J. Harrington.
27. US Patent #7095530, "Color Vector halftoning using Successive-filling with improved color registration latitude," issued Aug. 22, 2006, Inventors: D. Mantell and G. Sharma.
28. US Patent #7085004, "Calibration system for document processing system including visual layout validation for target measurements," issued Aug. 01, 2006, Inventors: G. Sharma and T. Balasubramanian.
29. US Patent # 6992797, "Systems and methods for embedding messages in look-up tables," issued Jan 31, 2006, Inventors: G. Sharma and S. A. Schweid.
30. US Patent # 6927381, "Photosensitive Imaging System Sensitive to Orange Light," issued 09 August, 2005, Inventors: P. A. Hosier, J. C. Tandon, J. E. Jedlicka, G. Sharma and A. E. Perregaux, R. P. Herloski.
31. US Patent # 6895101, "System and method for embedding information in digital signals," issued 17 May, 2005, Inventors: M. U. Celik, G. Sharma, and A. M. Tekalp.
32. US Patent # 6844941, "Color Halftoning Using a Single Successive Filling Halftone Screen," issued Jan 18, 2005, Inventors: G. Sharma, S. Wang, and Z. Fan.
33. US Patent # 6654143, "Printer Characterization Adjustment for Different Papers," issued Nov. 25, 2003, Inventors: E. Dalal, R. Balasubramanian, R. Rasmussen, G. Sharma, M. Shaw, M. E. Farrell, D. C. Robinson.
34. US Patent # 6647140, "Spectrum Inverter Apparatus and Method," Issued Nov. 11, 2003, Inventors: S. W. Wang, G. Sharma.
35. US Patent # 6646248, "Photosensitive Imaging Apparatus Sensitive to Orange Light," Issued Nov. 11, 2003, Inventors: P. A. Hosier, J. C. Tandon, J. E. Jedlicka, G. Sharma, A. E. Perregaux, R. P. Herloski.
36. US Patent # 6525845 "Methods and apparatus for modifying image data based on identification of marking process," Issued Feb. 25, 2003, Inventors: G. Sharma, S. A. Schweid, and J. Shiau.
37. US Patent # 6501567, "Method and system for designing spatially-partitioned and correlated stochastic screens for color halftoning," Issued Dec. 31, 2002, Inventors: G. Sharma and S. Wang.
38. US Patent # 6353675, "Methods and apparatus for identifying marking process and modifying image data based on image spatial characteristics," Issued Mar. 05, 2002, Inventor: G. Sharma.
39. US Patent # 6288798, "Show-through compensation apparatus and method," Issued Sep. 11, 2001, Inventor: G. Sharma.
40. US Patent # 6088095, "Model based spectral calibration of color scanners," Issued July 11, 2000, Inventor: G. Sharma.
41. US Patent # 05649073, "Automatic calibration of halftones," Issued July 15, 1997, Inventors: K. T. Knox, C. Hains, and G. Sharma.
42. Over ten US patent applications pending on methods for color characterization, data-hiding, image watermarking, halftoning, image analysis, correction of scanning artifacts, and novel color imaging.

HONORS AND AWARDS

- Best paper award, Visual Communications and Image Processing, 2009 (with Chao Yu).
- IEEE Region I Technical Innovation Award for “Contributions to the Theory and Practice of Color Imaging and Imaging Systems,” 2008.
- Elected to Sigma Xi, the scientific research society.
- Listed in Marqui’s Who’s Who in Science and Engineering, and in Marqui’s Who’s Who.
- Xerox Inventor Recognition “Star” Award (25 patents), May 2007.
- Elected to Phi Kappa Phi and Pi Mu Epsilon national honor societies.
- Received M.N.S. Swamy and S.V.C. Aiya medals awarded to the best outgoing student in the master’s class in ECE at Indian Institute of Science, Bangalore, India (out of 45 students).
- Received the Xerox Technical Minority Scholarship in 1993.
- Xerox Emerging Leaders Program, 2003.
- Co-author on paper receiving student paper award at ICASSP 2006.
- Recipient of Cactus prize awarded for best poster at IS&T/SID’s Color Imaging Conference in 2002 and 2003.
- Achievement Award, Xerox Innovation Group, for significant contributions in technical leadership.

PROFESSIONAL SERVICE/ACTIVITIES

- Associate Editor, IS&T/SPIE Journal of Electronic Imaging, 2003-.
- Associate Editor, Research Letters in Signal Processing, Hindawi Publishing Corporation (Open Access), 2008-.
- Associate Editor, IEEE Transactions on Information Forensics and Security, 2004-2009.
- Associate Editor, IEEE Transactions on Image Processing, 2003-2008.
- Area Editor, IEEE Transactions on Image Processing, 2004-2007.
- Senior member IEEE.
- Vice-chair for the Image and Multiple Dimensional Signal Processing (IMDSP) Technical Committee (of IEEE Signal Processing Society), 2008-2009.
- Elected to Image and Multiple Dimensional Signal Processing (IMDSP) Technical Committee (of IEEE Signal Processing Society), term 2006–2012.
- Member of IMDSP Award Nomination Subcommittee, 2006, 2007.
- Member IEEE Industry DSP Technology Standing Committee, 2005-2008.
- Advisory Member IEEE Industry DSP Technology Standing Committee, 2009-.
- Member IEEE Signal Processing Society and IEEE Communications Society.
- Invited Panelist on Rochester Asians’ Network panel “Transitions from the Corporate World - Strategies for Success,” Penfield Country Club, Penfield, NY, Oct. 3 2008.
- Chair, IEEE Rochester Section, 2007.
- Treasurer, IEEE Rochester Section, 2005, 2006.
- Served as 2003 Chair, Rochester Chapter, IEEE Signal Processing Society. Various chapter officer positions from 2000-2003
- Member of the Society for Imaging Science and Technology (IS&T).
- Plenary Speaker Chair, *GENSIPS 2009: IEEE International Workshop on Genomic Signal Processing and Statistics*, May 17-21, 2009, Minneapolis, Minnesota.
- Tutorial Chair, *IS&T/SPIE’s Electronic Imaging Symposium*, 17-21 January 2010, San Jose, CA.
- Tutorial Chair, *IS&T’s NIP24: 24th International Congress on Digital Printing Technologies*, September 06-11, 2008, Pittsburgh, PA.

- Program Chair: Invited Papers, NIP 23, “23rd International Conference on Digital Printing Technologies,” Sept. 16-21, 2007, Anchorage, Alaska.
- Workshops co-chair COMSWARE 2006, First International Conference on Communication Systems Software and Middleware (IEEE/ACM Sigmobil co-sponsored).
- Publications co-chair for IEEE International Conference on Image Processing (ICIP) 2002.
- Organizer and Chair, *2003 Western NY Image Processing Workshop*, Rochester, NY, Oct 17, 2003.
- Tutorial co-chair, *IS&T/SID 13th Color Imaging Conference*, 07-11 Nov. 2005, Scottsdale, AZ.
- Tutorial co-chair, *IS&T/SID 12th Color Imaging Conference*, 09-12 Nov. 2004, Scottsdale, AZ.
- Member of Jury for Student Paper Award Selections for *International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, 20 April 2009, Taipei, Taiwan.
- Session Chair, “Gene Regulatory Networks,” IEEE International Workshop on Genomic Signal Processing and Statistics (GENSIPS), 18 May 2009, Minneapolis, Minnesota.
- Session Chair, “Image Filtering (IVMSP-L2),” *International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, 21 April 2009, Taipei, Taiwan.
- Session Chair, “Object Detection and Recognition,” *Visual Communications and Image Processing (VCIP)*, 20 Jan. 2009, San Jose, CA.
- Session Chair, “Authentication,” *Media Forensics and Security XI, Electronic Imaging Symposium* 19-21 Jan. 2009, San Jose, CA.
- Session Chair, “Steganography and Steganalysis I (TA-L5),” *IEEE International Conference on Image Processing (ICIP)*, 14 Oct. 2008, San Diego, CA.
- Session Chair, “Feature Extraction and Analysis (IMDSP-L4),” *International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, 03 April 2008, Las Vegas, NV.
- Session Chair, “Processing of Physiological Signals (BISP-P1),” *International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, 02 April 2008, Las Vegas, NV.
- Session Chair, “Indexing and Retrieval,” *Visual Communications and Image Processing (VCIP)*, 29-31 Jan. 2008, San Jose, CA.
- Session Chair, “Physical Media,” *Security, Forensics, Steganography, and Watermarking of Multimedia Contents X, Electronic Imaging Symposium* 28-30 Jan. 2008, San Jose, CA.
- Session Chair, “Gamuts Galore,” *IS&T/SID Fifteenth Color Imaging Conference*, 9 Nov. 2007, Albuquerque, NM.
- Session Chair, “TA-P2: Security III: Watermarking,” *IEEE International Conference on Image Processing (ICIP)*, 18 September, 2007, San Antonio, TX.
- Session Chair, “Image Formation, Sampling, Display and Quality (IMDSP-P5),” *International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, 18 April 2007, Honolulu, HI.
- Session Chair, NIP 22 IS & T Digital Printing Conference, “Security and Forensic Printing,” 20 Sept. 2006, Denver, CO.
- Session Chair, “Digital Watermarking, Data Hiding and Steganography III (TP1-L1),” *International Conference on Multimedia and Expo (ICME)*, 11 July 2006, Toronto, Canada.
- Session Chair, “Watermarking (IMDSP-L10),” *International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, 19 May 2006, Toulouse, France.
- Session Chair, “Image Enhancement, Display & Rendering,” *International Congress of Imaging Science (ICIS)*, 09 May 2006, Rochester, NY.
- Session Chair, “Printing,” *IS&T/SID Thirteenth Color Imaging Conference*, 10 Nov. 2005, Scottsdale, AZ.
- Session Chair, “Color and lighting in computer images,” *IS&T/SID Eleventh Color Imaging Conference*, 04 Nov. 2003, Scottsdale, AZ.
- Session Chair, “Digital image capture,” IS&T’s PICS Conference, 22-25 April 2001, Montréal, Canada
- Session Chair, “Device technology,” CGIV2002: First European Conference on Colour in Graphics, Imaging, and Vision, 3-5 April 2002, Poitiers, France.
- Tutorial Instructor, “System Interactions in Digital Color Imaging,” at IS&T’s Sixteenth Color Imaging Conference, November 11, 2008, Portland, OR (with R. Bala).

- Tutorial Instructor, “Color Imaging System Optimization,” at IS&T’s NIP24: 24th International Congress on Digital Printing Technologies, September 08, 2008, Pittsburgh, PA (with R, Bala).
- Tutorial Instructor, “System Interactions in Color Imaging,” at IS&T’s International Congress on Imaging Science, May 07-11, 2006, Rochester, NY (with R, Bala).
- Tutorial Instructor, “System Interactions in Color Imaging,” at IS&T’s Twelfth Color Imaging Conference, Nov 09-12, 2004, Scottsdale, AZ (with R, Bala).
- Tutorial Instructor, “System Interactions in Color Imaging,” at IS&T’s Eleventh Color Imaging Conference, Nov 04-07, 2003, Scottsdale, AZ (with R, Bala).
- Tutorial Instructor, “Color image scanners,” at IS&T’s 11th Color Imaging Conference, Nov 12-15, 2002, Scottsdale, AZ.
- IEEE Student Branch Counselor, Univ. of Rochester Branch, Sept. 2003– Sept. 2008.
- Co-chair, University of Rochester, Bioinformatics cluster, Sept. 2006 – (with David H. Mathews).
- Judge, Seventh IEEE Student Design Contest, 05 May 2007, Rochester Institute of Technology, Rochester, NY.
- Judge, FIRST LEGO League NanoQuest Competition, 03 December, 2006, Rochester, NY.
- Area Chair, ICIP 2009 Technical Program Committee.
- Area Chair, ICASSP 2009 Technical Program Committee
- Area Chair, ICIP 2008 Technical Program Committee.
- Area Chair, ICASSP 2008 Technical Program Committee.
- Area Chair, ICASSP 2007 Technical Program Committee.
- Area Chair, ICIP 2007 Technical Program Committee.
- Technical program/Paper Review committee member for
 - IEEE International Conference on Image Processing (ICIP) 2002, 2004, 2005, 2006, 2007, 2008, 2009.
 - IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP) 2006, 2007, 2008, 2009.
 - Media Forensics and Security XI, 2009.
 - Security, Steganography and Watermarking of Multimedia Contents, (part of the Electronic Imaging Symposium), VIII (2006), IX (2007), X (2008).
 - Visual Communications and Image Processing (VCIP), (part of the Electronic Imaging Symposium), 2007, 2008, 2009.
 - IEEE International Conference on Multimedia and Expo (ICME) 2007, 2008.
 - IS &T/SID Color Imaging Conference 2004, 2005, 2006, 2008.
 - IEEE International Conference Circuits and Systems (ISCAS) 2004.
 - Colour in Graphics, Imaging, and Vision (CGIV) 2004, 2006.
 - Colour in Graphics and Image Processing 2000.
 - Systems Cybernetics and Informatics (SCI) 2000.
 - International Conference on Computer, Communication and Control Technologies: CCCT’03.
 - IS&T/SID Color Imaging Conference
- Member, CIE Technical Committee TC8-07, Multi-spectral Imaging
- Reviewer
 - IEEE Transactions on Information Forensics and Security
 - IEEE Transactions on Image Processing
 - Nucleic Acids Research (*Oxford Journals*).
 - IEEE Transactions on Signal Processing
 - IEEE Signal Processing Letters
 - IEEE Signal Processing Magazine
 - Signal Processing (*EURASIP Journal*)
 - IEEE Transactions on Communications
 - IEEE Journal of Selected Areas in Communications
 - Signal Processing: Image Communication (*EURASIP*)

- Journal of Electronic Imaging
- Color Research and Application
- Journal of Optical Society of America (A)
- Computer Vision and Image Understanding
- Journal of Imaging Science and Technology
- Journal of Society for Information Display
- Image Communication Journal
- Optical Engineering
- ETRI Journal (Korea)
- Real-time Imaging
- Journal of Digital Libraries
- Cambridge University Press
- Oxford University Press
- John Wiley & Sons
- CRC Press
- SPIE Press

SELECTED ARTICLES FEATURING RESEARCH IN POPULAR PRESS/WEB

- “Colored Lights Reveal Hidden Images,” by Paula M. Powell, *Photonics Spectra*, September 2003.
- “Eyecatcher from Xerox,” article by Ben Rand, *Rochester Democrat and Chronicle*, July 18, 2003, pp. 12D, 8D.
- “Disappearing Act: Xerox Researchers Demonstrate Color Prints with Images that Switch Under Different Colored Lights,” featured article on www.xeroxtechnology.com, May 15, 2003.
- “Unretouched by human hand,” article by Michael Behar *The Economist*, December 14-20, 2002, pp. 8,10.
- “Reversible data hiding embeds data in pictures,” *E4Engineering.com*, Nov. 29, 2002.
- “Digital data hiding pulls a reverse,” report by Daniel C. McCarthy on reversible data hiding work, *Photonics Spectra*, November 2002, pp. 23.
- “Encryption method getting the picture,” by Sandeep Junnarkar, CNet News.com, October 23, 2002.
- “Researchers discover imaging technique,” by Smriti Jacob, *Rochester Business Journal*, Daily (online) edition, September 26, 2002.
- “Researchers discover better way to embed, remove hidden data in digital images,” *Vision Systems Design*, (online) September 24, 2002.
- “New technique promises better digital watermarks,” by Dan Orzech, *CIO Information Network*, published (online) September 24, 2002.
- “Xerox, University of Rochester Researchers Discover Better Way to Embed, Remove Hidden Data in Digital Images,” featured article on www.xeroxtechnology.com, September 23, 2002.