KISHOR SAITWAL

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Objective: To pursue research and development in Computer Vision and Machine Learning

Research Interests: Computer Vision, Pattern Recognition, Digital Image/Video Processing, Machine Learning, Artificial Intelligence

Education:

PhD, ECE Department (Major: Computer Vision) — Graduation: May 2006
CSU (Colorado State University), Fort Collins, CO, USA — **GPA = 3.91 / 4.00**

MS, ECE Department (Major: Digital Image Processing) — Graduation: Dec. 2001
CSU, Fort Collins, CO, USA — **GPA = 3.86 / 4.00**

BE, Instrumentation & Controls — Graduation: May 1998
Pune University, India — **GPA = 3.76 / 4.00**

Research & Work Experience:

Computer Vision Scientist (BRS, Inc., Houston, TX) — May 2006 – Present

Research and development of company's multiple award-winning AISight™ Behavioral Analytics™ software through:

- Research literature in the areas of image processing, computer vision, pattern recognition, and machine learning
- Perform individual and team research through effective communication
- Apply theoretical expertise to create or apply new behavioral learning technology
- Perform theoretical research and develop algorithms to solve video analysis problems
- Test and validate the results of the proposed algorithms (in MATLAB/Lisp)
- Write commercial-grade software (in Lisp/C/C++) for the developed prototypes
- Support development team for their understanding of different algorithms
- Write white papers for proposed algorithms and present results in monthly meetings
- Support patent lawyers for preparation and submission of patents to USPTO [P1] – [P22]
- Work with quality and test engineers to identify and fix bugs in the end-product
- Add new features and fix defects in the software based on customer expectations
- Support product deployments through cross-functional deployment teams

Graduate Research Assistant (ECE Department, CSU) — Aug. 1999 – May 2006

- **PhD Dissertation:** Fast Eigenspace Decomposition of Correlated Image using their Spatial and Temporal Properties [B1], [J2] – [J4], [C3] – [C9] {sponsored by NIMA (National Imagery and Mapping Agency), USA and ARL (Army Research Lab), USA}
- **MS Thesis:** A Multi-Channel Temporally Adaptable System for Continuous Cloud Classification from Satellite Imagery [J1], [C1] – [C2] {sponsored by DOD (Department of Defense), USA}

Instructor (ECE Department, CSU)

- Junior level course, **Introduction to Communication Principles** (Fall 2001)
  - Course objective: to develop the probabilistic framework required for modeling and analyzing the basic communication system with an elementary understanding of probability, random variables, and statistical communication
- Senior level course, **Digital Controls & Digital Filters** (Spring 2000)
  - Course objective: to analyze and design digital controllers and digital filters for linear systems, including both direct digital design techniques and mappings from continuous time to discrete time

Graduate Teaching Assistant (ECE Department, CSU)

- Sophomore level course, **Introduction to Microprocessors** (Spring 2002 – Fall 2004)
  - Author of a lab manual for 68HC12 micro-controller development board
  - Duties: to teach microprocessor organization, assembly language, I/O techniques, real-time interfaces, and applications in lab environment
- Junior level course, **Electronic Principles II** (Spring 2001)
  - Duties: to teach discrete and integrated-circuit amplifiers-frequency response, negative feedback, and digital logic circuits in lab environment

Design Engineer (Tata Honeywell Ltd., India) Jul. 1998 – Jul. 1999

- Coordinated in a team of six for engineering and commissioning of power plants in India
- Lead bought-out engineering for instrumentation and control of two power plants in India

Honors / Awards:

- Awarded for extraordinary accomplishments for two straight years at BRS, Inc. (2007 – 2008)
- Awarded full research/teaching assistantship while at CSU (Aug. 1999 – May 2006)
- Nominated for the best student paper award for my paper submitted to IEEE International Conference on Intelligent Robots and Systems (IROS) 2004 [C5]
- Ranked in top 2% in university for the undergraduate studies
- Awarded with National Talent Search (NTS) scholarship at junior college level
- Ranked 1st in the school in 10th Grade

Professional Activities:

- Chairman of the Student Branch Chapter for IEEE Robotics and Automation Society at CSU (2005 – 2006)
- Judge for the FIRST Lego League tournament held in Fort Collins, CO (2003 – 2004)
- Involved as a mentor for high-school students participating in USFirst Robotics championship 2005
- **Current Professional Memberships:**
  - Institute of Electrical and Electronics Engineers (IEEE) - Member
  - Upsilon Pi Epsilon (UPE) – At-Large Member
  - Eta Kappa Nu (HKN) – Professional Member
  - Sigma Xi – Full Member
  - Society of Industrial and Applied Mathematics (SIAM) – Member
  - International Linear Algebra Society (ILAS) – Member
- **Current Activities as a Reviewer:**
  - International Journal of Computer Vision
  - IEEE Transactions on Image Processing
  - IEEE Transactions on Neural Networks
  - IEEE Transactions on Circuits and Systems for Video Technology
  - Neural Networks
  - Neurocomputing
  - Pattern Recognition
  - Pattern Recognition Letters
  - Pattern Analysis and Applications
  - Machine Vision and Applications
  - Image and Vision Computing

Research Books:

[B1] ISBN: 3838303156 **K. Saitwal**, "Compressing High-Res Images Correlated in Multiple Dimensions," *LAP Lambert Academic Publishing*, Germany, 152 pages, Aug. 13, 2009.

Serial Journal Articles:

[J1] PDF **K. Saitwal**, M. R. Azimi, and D. Reinke, “A Multi-Channel Temporally Adaptive System For Continuous Cloud Classification From Satellite Imagery,” *IEEE Trans. Geosciences and Remote Sensing*, Vol. 41, No. 5, pp 1098-1104, May 2003. (Cited by 5)

[J2] PDF **K. Saitwal**, A. A. Maciejewski, R. G. Roberts, and B. A. Draper, “Using the Low-Resolution Properties of Correlated Images to Improve the Computational Efficiency of Eigenspace Decomposition,” *IEEE Transactions on Image Processing*, Vol.15, No. 8, pp. 2376-2387, Aug. 2006. (Cited by 7)

[J3] PDF C-Y. Chang, A. A. Maciejewski, V. Balakrishnan, R. G. Roberts, and **K. Saitwal**, “Quadtree-Based Eigendecomposition for Pose Detection in the Presence of Occlusion and Background Clutter,” *Pattern Analysis and Applications (PAA)*., Vol. 10, No. 1, pp. 15-31, Feb. 2007. (Cited by 2)

[J4] PDF **K. Saitwal**, A. A. Maciejewski, and R. G. Roberts, "Computationally Efficient Eigenspace Decomposition of Correlated Images Characterized by Three Parameters," *Pattern Analysis and Applications*, Vol. 12, No. 4, pp 391-406, Dec. 2009. (Cited by 3)

Conference Proceedings and Presentations:

[C1] **K. Saitwal**, M. R. Azimi, J. Wang, and D. Reinke, “Study of a Multi-Channel Temporally Adaptable System for Continuous Cloud Classification from GOES Imagery,” presented at Battlefield Atmospheric and Cloud Impacts on Military Operations (BACIMO) conference, Cooperative Institute for Research in Atmosphere (CIRA), Fort Collins, CO, July 9-12, 2001

[C2] PDF M. R. Azimi, J. Wang, **K. Saitwal**, and D. Reinke, “A Multi-Channel Temporally Adaptable System for Continuous Cloud Classification from Satellite Imagery,” *IEEE International Joint Conference on Neural Networks (IJCNN)*, Vol. 3, pp 1625-1630, Washington D.C., July 15 – 19, 2001. (Cited by 1)

[C3] PDF R. G. Roberts, **K. Saitwal**, H. Yu, E. DuPont, and A. A. Maciejewski, "A Performance Evaluation of a Quad Tree Eigenspace Technique for Automatic Target Recognition," presented at *23rd Army Science Conference (ASC)*, Orlando, FL, Dec. 2-5, 2002.

[C4] PDF **K. Saitwal**, A. A. Maciejewski, and R. G. Roberts, "A Comparison of Eigendecomposition for Sets of Correlated Images at Different Resolutions ," *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS),* pp. 1011-1017, Las Vegas, NV, Oct. 27 – 31, 2003. (Cited by 2)

[C5] PDF **K. Saitwal**, A. A. Maciejewski, and R. G. Roberts, "Analysis of Eigendecomposition for Sets of Correlated Images at Different Resolutions," *IEEE International Conference on Robotics and Automation (IROS),* pp. 1393-1398, New Orleans, LA, April 26 – May 1, 2004. (Cited by 2)

[C6] PDF **K. Saitwal**, A. A. Maciejewski, and R. G. Roberts, "Fast Eigenspace Decomposition of Correlated Images Using Their Low-Resolution Properties," *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS),* pp. 2707-2712, Sendai, Japan, Sept. 28 – Oct. 2, 2004. (Cited by 2)

[C7] **K. Saitwal**, A. A. Maciejewski, and R. G. Roberts, "Fast Eigenspace Decomposition of Correlated Images Using Their Low-Resolution Properties," presented at Information Science and Technology Colloquium (ISTeC), Fort Collins, CO, April 13 – 14, 2005.

[C8] PDF **K. Saitwal**, A. A. Maciejewski, and R. G. Roberts, "The Effect of Spatial Resolution Reduction Techniques on the Temporal Properties of Video Sequences," *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS),* pp. 4049-4054, Edmonton, Alberta, Canada, Aug. 2 – 6, 2005. (Cited by 1)

[C9] PDF **K. Saitwal**, A. A. Maciejewski, and R. G. Roberts, "Eigendecomposition of Correlated Images Characterized by Three Parameters," *2006 IEEE Southwest Symposium on Image Analysis and Interpretation,* pp. 203-207, Denver, CO, Mar. 26 – 28, 2006.

Patents:

[P1] Online E. Eaton, W. Cobb, D. Urech, B. Blythe, D. Friedlander, R. Gottumukkal, L. Risinger, **K. Saitwal**, M. Seow, D. Solum, G. Xu, and T. Yang, "Behavioral Recognition System," *US Patent App. 20080193010*, Feb. 8, 2008.

[P2] Online E. Eaton, W. Cobb, B. Blythe, **K. Saitwal**, T. Yang, and M. Seow, "Background-Foreground Module for Video Analysis System," *US Patent App. 20090087096*, May 29, 2008.

[P3] Online E. Eaton, W. Cobb, **K. Saitwal**, and B. Blythe, "Dark Scene Compensation in a Background-Foreground Module of a Video Analysis System," *US Patent App. 20090087093*, May 29, 2008.

[P4] Online E. Eaton, W. Cobb, **K. Saitwal**, and B. Blythe, "Identifying Stale Background Pixels in a Video Analysis System," *US Patent App. 20090087086*, May 29, 2008.

[P5] Online E. Eaton, W. Cobb, R. Gottumukkal, **K. Saitwal**, M. Seow, T. Yang, and B. Blythe, "Tracker Component for Behavioral Recognition System," *US Patent App. 20090087085*, Sept. 11, 2008.

[P6] Online E. Eaton, W. Cobb, B. Blythe, R. Gottumukkal, and **K. Saitwal**, "Context Processor for Video Analysis System," *US Patent App. 20090087024*, Apr. 30, 2008.

[P7] Online E. Eaton, W. Cobb, R. Gottumukkal, M. Seow, T. Yang, and **K. Saitwal**, "Estimator Identifier Component for a Behavioral Recognition System," *US Patent App. 20090087027*, Sept. 11, 2008.

[P8] Online E. Eaton, W. Cobb, D. Urech, D. Friedlander, G. Xu, M. Seow, L. Risinger, D. Solum, T. Yang, R. Gottumukkal, and **K. Saitwal**, "Semantic Representation Module of a Machine-Learning Engine in a Video Analysis System," *US Patent App. 20090016599*, July 9, 2008.

[P9] Online E. Eaton, W. Cobb, D. Urech, D. Friedlander, G. Xu, M. Seow, L. Risinger, D. Solum, T. Yang, R. Gottumukkal, and **K. Saitwal**, "Cognitive Model for a Machine-Learning Engine in a Video Analysis System," *US Patent App. 20090016600*, July 9, 2008.

[P10] W. Cobb and **K. Saitwal**, "Hierarchical Sudden Illumination Change Detection using Radiance Consistency within a Spatial Neighborhood," *US Patent App. 12336382*, Dec. 16, 2008.

[P11] W. Cobb, **K. Saitwal**, T. Yang, and B. Blythe, "Adaptive Update of Background Pixel Thresholds using Sudden Illumination Change Detection," *US Patent App. 12388409*, Feb. 18, 2009.

[P12] W. Cobb, D. Urech, B. Blythe, R. Gottumukkal, **K. Saitwal**, T. Yang, and L. Risinger, "Field-of-View Change Detection," *US Patent App. 12543281*, Aug. 18, 2009.

[P13] W. Cobb, B. Blythe, R. Gottumukkal, **K. Saitwal**, G. Xu, and T. Yang, "Scene Preset Identification Using Quadtree Decomposition Analysis," *US Patent App. 12543223*, Aug. 18, 2009.

[P14] W. Cobb, R. Gottumukkal, **K. Saitwal**, M. Seow, G. Xu, L. Risinger, and J. Graham, "Pixel-Level Based Micro-Feature Extraction," *US Patent App. 12543141*, Aug. 18, 2009.

[P15] W. Cobb, D. Friedlander, **K. Saitwal**, M. Seow, and G. Xu, "Clustering Nodes in a Self-Organizing Map Using an Adaptive Resonance Theory Network," *US Patent App. 12551154*, Aug. 31, 2009.

[P16] W. Cobb, B. Blythe, D. Friedlander, R. Gottumukkal, **K. Saitwal**, M. Seow, and G. Xu, "Visualizing and Updating Classifications in a Video Surveillance System," *US Patent App. 12551332*, Aug. 31, 2009.

[P17] W. Cobb, D. Friedlander, **K. Saitwal**, M. Seow, and G. Xu, "Video Surveillance System Configured to Analyze Complex Behaviors using Alternating Layers of Clustering and Sequencing," *US Patent App. 12561977*, Sept. 17, 2009.

[P18] W. Cobb, B. Blythe, D. Friedlander, **K. Saitwal**, and G. Xu, "Adaptive Voting Experts for Incremental Segmentation of Sequences with Prediction in a Video Surveillance System," *US Patent App. 12543379*, Aug. 18, 2009.

[P19] W. Cobb, D. Friedlander, and **K. Saitwal**, "Intra-Trajectory Anomaly Detection Using Adaptive Voting Experts in a Video Surveillance System," *US Patent App. 12543307*, Aug. 18, 2009.

[P20] W. Cobb, D. Friedlander, and **K. Saitwal**, "Inter-Trajectory Anomaly Detection Using Adaptive Voting Experts in a Video Surveillance System," *US Patent App. 12543318*, Aug. 18, 2009.

[P21] W. Cobb, B. Blythe, D. Friedlander, R. Gottumukkal, and **K. Saitwal**, "Visualizing and Updating Sequences and Segments in a Video Surveillance System," *US Patent App. 12543351*, Aug. 18, 2009.

[P22] W. Cobb, D. Friedlander, **K. Saitwal**, M. Seow, and G. Xu, "Classifier Anomalies for Observed Behaviors in a Video Surveillance System," *US Patent App. 12561956*, Sept. 17, 2009.

Computer Skills:

- **Languages:** MATLAB, Lisp, C, C++, Assembly, HTML
- **Platforms:** Windows, Linux, Unix
- **Libraries:** OpenCV, Intel IPP, Intel MKL, Matlisp, ffmpeg, Virtual dub
- **Tools & API's:** Emacs, ScrumWorks, Bugzilla, SVN, CLIPS, JFLAP
- **Softwares:** Latex, Microsoft Office, Hugin Lite

Personal Skills:

- Independent researcher with innovative problem solving capabilities
- Excellent communication and interpersonal skills with strong work ethic
- Excellent analytical abilities required for abstract problem solving
- Appropriately open, honest and flexible with team needs
- Strictly committed to meet expected deadlines
- Perfectionist, self-motivated and detail-oriented individual

References:

Available on request.