

## Saurabh Prasad, PhD

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CONTACT INFORMATION	Dept. of Electrical and Computer Eng., N 308 Engineering Building 1, Houston, Texas 77004-4005,	<i>Phone:</i> +1-662-268-2114 <i>Fax:</i> +1-662-325-7692 <i>E-mail:</i> saurabh.prasad@ieee.org
RESEARCH INTERESTS	Statistical Learning, Pattern Classification; Adaptive Signal Processing; Hyperspectral Image Analysis; Remote Sensing.	
EDUCATION	<b>Mississippi State University</b> , Mississippi State, Mississippi USA Doctor of Philosophy, Electrical and Computer Engineering, December 2008 <ul style="list-style-type: none"><li>• Thesis Topic: <i>Multi-Classifiers and Decision Fusion for Robust Statistical Pattern Recognition with Applications to Hyperspectral Target Recognition</i></li><li>• Advisor: Professor Lori M. Bruce</li><li>• Area of Study: Signal and Image Processing, Statistical Pattern Classification</li><li>• Related Work Experience: Graduate Research Assistant at the High Performance Computing Collaboratory</li></ul> <b>Old Dominion University</b> , Norfolk, Virginia USA Master of Science, Electrical and Computer Engineering, August 2005 <ul style="list-style-type: none"><li>• Thesis Topic: <i>Nonlinear and Linear Transformations of Features for Robust Speech Recognition and Speaker Identification</i></li><li>• Advisor: Professor Stephen A. Zahorian</li><li>• Area of Study: Signal Processing for Speech and Speaker Recognition</li><li>• Related Work Experience: Graduate Research Assistant at the Speech Communication Lab; Teaching Assistant for <i>Digital Logic Design</i></li></ul> <b>Jamia Millia Islamia</b> , New Delhi, India. Bachelor of Technology, Electrical Engineering, August 2003 <ul style="list-style-type: none"><li>• Senior Design Project: <i>Hardware Design and Realization of the Huffman Codec</i></li><li>• Project Advisor: Professor M. Balakrishnan, Indian Institute of Technology, Delhi</li><li>• Related Work Experience: Summer intern at the <i>TENET</i> group at the Indian Institute of Technology, Chennai in Summer'2002</li></ul>	
ACADEMIC APPOINTMENTS	<b>Assistant Professor</b> Electrical and Computer Engineering, University of Houston	January 2012 to present
	<b>Assistant Research Professor</b> Geosystems Research Institute, Mississippi State University	January 2009 to January 2012
	<b>Adjunct Assistant Professor</b> Electrical and Computer Engineering, Mississippi State University	January 2009 to January 2012
	Key Activities <ul style="list-style-type: none"><li>• Perform research, publish in peer-reviewed journals and conferences, seek and acquire extramural funding from competitive programs</li><li>• Advise graduate students; Teach classes at the Electrical and Computer Engineering Department</li></ul>	

EXTRAMURAL  
FUNDING SECURED

### **Co-Principal Investigator, Technical Lead and Lead Author of the Proposal**

- Sponsor: *National Geospatial Intelligence Agency*
- Project Title: Redundant Wavelet Transforms and Information Fusion for Robust Hyperspectral ATR
- Award Amount (August 2009-August 2011): **\$300,000**
- Level of Involvement:
  - Lead author of the proposal and
  - Technical lead for the research team
  - Manage graduate students, research associates and oversee financial aspects
- Technical Accomplishments:
  - Developed kernel based dimensionality reduction algorithms within a multi-classifier decision fusion framework for robust statistical pattern recognition of hyperspectral imagery under severe pixel-mixing conditions
  - Developed a robust statistical pattern recognition framework based on redundant wavelet transforms and multi-classifiers for noise-robust classification of hyperspectral imagery under adverse SNR conditions

### **Principal Investigator, Technical Lead and Lead Author of the Proposal**

- Sponsor: *National Aeronautics and Space Administration*
- Project Title: Applying NASA HypsIRI Satellite Observations to Precision Vegetation Mapping for Ecological Forecasting Applications
- Award Amount (August 2009-August 2011): **\$106,415**
- Level of Involvement:
  - Lead author of the proposal
  - Technical lead for the research team
  - Manage graduate students, research associates and oversee financial aspects
- Technical Accomplishments:
  - Created synthetic/simulated HypsIRI data from existing hyperspectral libraries and performed feasibility studies for various classification tasks using NASA's upcoming HypsIRI sensor

### **Co-Principal Investigator**

- Sponsor: *Department of Homeland Security via the Oak Ridge National Laboratory*
- Project Title: Screening of Levees by Synthetic Aperture Radar
- Award Amount (August 2009-August 2011): **\$747,000**
- Level of Involvement:
  - Technical lead for the feature extraction and classification team
  - Manage graduate students, research associates
- Technical Accomplishments:
  - Developed and optimized feature extraction and pattern recognition algorithms for classifying the health of levees using airborne (*UAVSAR*) and spaceborne (*TERRASAR-X*) imagery

**Doctor of Philosophy Students, Electrical Engineering**

6. *Minshan Cui*, Starting January 2012 (*As major professor and dissertation director*), University of Houston
  - Tentative Dissertation Topic: Statistical Pattern Classification for Multi-Sensor Remote Sensing
5. *Wei Li*, December 2011 (*As co-major professor and dissertation co-director*), Mississippi State University
  - Dissertation Title: Pattern Classification and Reconstruction for Hyperspectral Imagery
4. *Sathishkumar Samiappan*, 2012 (*As co-major professor and dissertation co-director*), Mississippi State University
  - Tentative Dissertation Topic: Semi-supervised Machine Learning for Hyperspectral Image Classification
3. *Matthew A Lee*, 2012 (*As committee member*), Mississippi State University
  - Tentative Dissertation Topic: Applying Cellular Automata for Hyperspectral Image Analysis
2. *Tao Ma*, December 2010 (*As major professor and dissertation director for Fall'2010 after original advisor left the university*), Mississippi State University
  - Dissertation Title: Linear Dynamic Model for Continuous Speech Recognition
1. *Sundararajan Srinivasan*, December 2010 (*As major professor and dissertation director for Fall'2010 after original advisor left the university*), Mississippi State University
  - Dissertation Title: A Nonlinear Mixture Autoregressive Model for Speaker Verification

**Master of Science Students, Electrical Engineering**, at MSU unless otherwise indicated

3. *Minshan Cui*, December 2011 (*As co-major professor and committee co-chair*), Mississippi State University
  - Thesis Title: Genetic Algorithms based Feature Selection and Decision Fusion for Robust Remote Sensing Image Analysis
2. *Vishal Jain*, May 2011 (*As co-major professor with Dr. S.D. Joshi*), Indian Institute of Technology - Delhi
  - Thesis Title: Class Dependent Dimensionality Reduction and Ensemble Classification for Hyperspectral Data in a Noise Robust Redundant Wavelet domain
1. *Hemanth Kalluri*, December 2009 (*As co-major professor and committee co-chair*), Mississippi State University
  - Thesis Title: Fusion of Spectral Reflectance and Derivative Information for Robust Hyperspectral Land Cover Classification

HONORS AND  
AWARDS

Recipient of the

- **State Pride Faculty Award** for academic contributions, Mississippi State University, 2010
- **Graduate Student Research Award**, Mississippi State University, 2008
- **Best Student Paper Award** at IGARSS, 2008
- **Graduate Research Assistant of the Year Award** at Geosystems Research Institute, Mississippi State University, 2007

PUBLICATIONS

**Books and Book Chapters**

4. **S. Prasad**, L.M. Bruce, J. Chanussot (*Editors*), *Optical Remote Sensing - Advances in Signal Processing and Exploitation Techniques*. Springer Verlag, Germany, March 2011. (ISBN: 978-3-642-14211-6)
3. **S. Prasad**, L.M. Bruce, J. Chanussot, "Introduction - Signal Processing and Exploitation for Optical Remote Sensing," Chapter 1 in *Optical Remote Sensing - Advances in Signal Processing and Exploitation Techniques*, Edited by: S. Prasad, L.M. Bruce, J. Chanussot. Springer Verlag, Germany, March 2011. (ISBN: 978-3-642-14211-6)
2. **S. Prasad**, L.M. Bruce, "A Divide-and-Conquer Paradigm for Hyperspectral Classification and Target Recognition," Chapter 7 in *Optical Remote Sensing - Advances in Signal Processing and Exploitation Techniques*, Edited by: S. Prasad, L.M. Bruce, J. Chanussot. Springer Verlag, Germany, March 2011. (ISBN: 978-3-642-14211-6)
1. **S. Prasad**, L.M. Bruce, J.E. Ball, "Information Fusion in a High Dimensional Feature Space for Robust Computer Aided Diagnosis using Digital Mammograms," Chapter 9 in *New Developments in Biomedical Engineering*, Edited by: D. Campolo. January 2010, InTech Publishers, Croatia, January 2010. (ISBN: 978-953-7619-57-2)

**Refereed Journal Publications**

8. **S. Prasad**, W. Li, J. Fowler, L.M. Bruce, "Information Fusion in the Redundant Wavelet Transform Domain for Noise Robust Hyperspectral Classification," accepted for publication in the *IEEE Transactions on Geoscience and Remote Sensing*, 2011.
7. W. Li, **S. Prasad**, J. Fowler, L.M. Bruce, "Locality Preserving Discriminant Analysis and Classification for Hyperspectral Image Analysis," accepted for publication in the *IEEE Transactions on Geoscience and Remote Sensing*, 2011.
6. W. Li, **S. Prasad**, J. Fowler, L. M. Bruce, "Locality-Preserving Discriminant Analysis in Kernel-Induced Feature Spaces for Hyperspectral Classification," to appear in the *IEEE Geoscience and Remote Sensing Letters*. 2011.
5. H.Kalluri, **S. Prasad**, L. M. Bruce, "Decision Level Fusion of Spectral Reflectance and Derivative Information for Hyperspectral Classification and Target Recognition," in the *IEEE Transactions on Geoscience and Remote Sensing*. Vol. 48, no. 11, pp.4047-4058, November 2010.
4. **S. Prasad**, L. M. Bruce, "Information Fusion in Kernel Induced Spaces for Robust Sub-Pixel Hyperspectral ATR," in the *IEEE Geoscience and Remote Sensing Letters*. Vol. 6 no. 3 - pp 572-576, July 2009.

3. G. Licciardi, F. Pacifici, D. Tuia, **S. Prasad**, T. West, F. Giacco, C. Thiel, J. Inglada, E. Christophe, J. Chanussot, P. Gamba, "Decision Fusion for the Classification of Hyperspectral Data: Outcome of the 2008 GRS-S Data Fusion Contest," *in the IEEE Transactions on Geoscience and Remote Sensing*. Vol. 47 no. 11 - pp 3857-3865, November 2009.
2. **S. Prasad**, L. M. Bruce, "Decision Fusion with Confidence based Weight Assignment for Hyperspectral Target Recognition," *in the IEEE Transactions on Geoscience and Remote Sensing*. Vol. 46, No. 5, May 2008.
1. **S. Prasad**, L. M. Bruce, "Limitations of Principal Components Analysis for Hyperspectral Target Recognition," *in the IEEE Geoscience and Remote Sensing Letters*. Vol. 5, Issue 4, pp 625-629, October 2008.

#### Refereed Conference Publications

29. W. Li, **S. Prasad**, J. Fowler, L.M. Bruce, "Class Dependent Compressive-Projection Principal Component Analysis for Hyperspectral Image Reconstruction," *Proceedings of the 3<sup>d</sup> IEEE Workshop on Hyperspectral Signal and Image Processing: Evolution in Remote Sensing*, Lisbon, Portugal, 2011.
28. W. Li, **S. Prasad**, J. Fowler, L.M. Bruce, "A Multi-Modal Pattern Classification Framework for Hyperspectral Image Analysis," *Proceedings of the 3<sup>d</sup> IEEE Workshop on Hyperspectral Signal and Image Processing: Evolution in Remote Sensing*, Lisbon, Portugal, 2011.
27. M.A. Lee, L.M. Bruce, **S. Prasad**, "Concurrent Spatial-Spectral Band Grouping: Providing a Spatial Context for Spectral Band Grouping," *Proceedings of the 3<sup>d</sup> IEEE Workshop on Hyperspectral Signal and Image Processing: Evolution in Remote Sensing*, Lisbon, Portugal, 2011.
26. S. Samiappan, **S. Prasad**, L.M. Bruce, E. Hansen "Branch and Bound based Feature Elimination for Support Vector Machine based Classification of Hyperspectral Images," accepted for publication in *the IEEE Geoscience and Remote Sensing Symposium*, 2011.
25. S. Samiappan, **S. Prasad**, L.M. Bruce, "Automated Hyperspectral Imagery Analysis via Support Vector Machines based Multi-Classifer System with Non-Uniform Random Feature Selection," accepted for publication in *the IEEE Geoscience and Remote Sensing Symposium*, 2011.
24. M. Cui, **S. Prasad**, M. Mahrooghy, L.M. Bruce, J. Aanstoos, "Genetic Algorithms and Linear Discriminant Analysis based Dimensionality Reduction for Remotely Sensed Image Analysis," accepted for publication in *the IEEE Geoscience and Remote Sensing Symposium*, 2011.
23. W. Li, **S. Prasad**, J.E. Fowler, L.M. Bruce, "Classification and Random Projections for Hyperspectral Imagery," accepted for publication in *the IEEE Geoscience and Remote Sensing Symposium*, 2011.
22. H. Kalluri, **S. Prasad**, L.M. Bruce, S. Samiappan Data Dependant Adaptation for Improved Classification of Hyperspectral Imagery, *Proceedings of the IEEE Geoscience and Remote Sensing Symposium*, Honolulu, Hawaii, 2010.
21. S. Samiappan, **S. Prasad**, and L.M. Bruce, NASAs Upcoming HypSIRI Mission Precision Vegetation Mapping with Limited Ground Truth, *Proceedings of the IEEE Geoscience and Remote Sensing Symposium*, Honolulu, Hawaii, 2010.

20. M. A. Lee, **S. Prasad**, L. M. Bruce, T. R. West, D. Reynolds, T. Irby, and H. Kalluri, "Sensitivity of Hyperspectral Classification Algorithms to Training Sample Size," *Proceedings of the IEEE Workshop on Hyperspectral Image and Signal Processing: Evolution in Remote Sensing*, Grenoble, France, 2009.
19. H. Kalluri, **S. Prasad**, L.M. Bruce, "Fusion of Spectral Reflectance and Derivative Information for Robust Hyperspectral Land Cover Classification," *Proceedings of the IEEE Workshop on Hyperspectral Image and Signal Processing: Evolution in Remote Sensing*, Grenoble, France, 2009.
18. **S. Prasad**, L. M. Bruce, H. Kalluri, Data Exploitation of HypSIRI Observations for Precision Vegetation Mapping, *Proceedings of IEEE Geoscience and Remote Sensing Symposium*, Cape Town, South Africa, 2009.
17. T. R. West, **S. Prasad**, L. M. Bruce, D. Reynolds, "Utilization of Local and Global Hyperspectral Features via Wavelet Packets and Multiclassifiers for Robust Target Recognition," *Proceedings of IEEE Geoscience and Remote Sensing Symposium*, Cape Town, South Africa, 2009.
16. T. R. West, **S. Prasad**, L. M. Bruce, D. Reynolds, T. Irby, "Rapid Detection of Agricultural Food Crop Contamination via Hyperspectral Remote Sensing," *Proceedings of IEEE Geoscience and Remote Sensing Symposium*, *Proceedings of IEEE Geoscience and Remote Sensing Symposium*, Cape Town, South Africa, 2009.
15. **S. Prasad**, L.M. Bruce, J.E. Ball, "A Multi-Classifer and Decision Fusion Framework for Robust Classification of Mammographic Masses," *Proceedings of IEEE Engineering in Medical Biology Conference*, Vancouver, Canada, 2008.
14. **S. Prasad**, L.M. Bruce, "Multiple Kernel Discriminant Analysis and Decision Fusion for Robust Sub-pixel Hyperspectral Target Recognition," *Proceedings of the IEEE Geoscience and Remote Sensing Symposium*, Boston, MA, July 2008.
13. **S. Prasad**, L.M. Bruce, "Overcoming the Small Sample Size Problem in Hyperspectral Classification and Detection Tasks," *Proceedings of the IEEE Geoscience and Remote Sensing Symposium*, Boston, MA, July 2008.
12. **S. Prasad**, L.M. Bruce, H. Kalluri "A Robust Multi-Classifer Decision Fusion Framework for Hyperspectral, Multi-Temporal Classification," *Proceedings of the IEEE Geoscience and Remote Sensing Symposium*, Boston, MA, July 2008.
11. T. West, L.M. Bruce, **S. Prasad**, "Wavelet Packet Tree Pruning Metrics for Hyperspectral Feature Extraction," *Proceedings of the IEEE Geoscience and Remote Sensing Symposium*, Boston, MA, July 2008.
10. **S. Prasad**, L.M. Bruce, "Hyperspectral Feature Space Partitioning via Mutual Information for Data Fusion ," *Proceedings of the IEEE Geoscience and Remote Sensing Symposium*, Barcelona, Spain, July 2007.
9. **S. Prasad**, L.M. Bruce, "Limitations of Subspace LDA in Hyperspectral Target Recognition Applications," *Proceedings of the IEEE Geoscience and Remote Sensing Symposium*, Barcelona, Spain, July 2007.
8. T. West, L.M. Bruce, **S. Prasad**, "Multiclassifiers and Decision Fusion in the Wavelet Domain for Exploitation of Hyperspectral Data," *Proceedings of the IEEE Geoscience and Remote Sensing Symposium*, Barcelona, Spain, July 2007.

7. J.E. Ball, L.M. Bruce, **S. Prasad**, T.R. West, "Level Set Hyperspectral Image Segmentation using Spectral Information Divergence (SID) based Best Band Selection," *Proceedings of the IEEE Geoscience and Remote Sensing Symposium*, Barcelona, Spain, July 2007.
6. **S. Prasad**, L.M. Bruce, "Information Theoretic Partitioning and Confidence based Weight Assignment for Multi-Classifer Decision Level Fusion in Hyperspectral Target Recognition Applications," *Proceedings of the SPIE Defense and Security Symposium*, Orlando, Florida, USA, April 2007.
5. **S. Prasad**, S. Srinivasan, M. Pannuri, G. Lazarou and J. Picone, "Nonlinear Dynamical Invariants for Speech Recognition," *Proceedings of the Ninth International Conference on Spoken Language Processing*, pp. 2518-2521, Pittsburgh, Pennsylvania, USA, September 2006.
4. **S. Prasad**, S. Srinivasan, G. Lazarou and J. Picone, "Reconstructed Phase Space of a Vector Time Series," accepted for presentation at *European Signal Processing Conference*, Florence, Italy, September 2006.
3. S. Srinivasan, **S. Prasad**, S. Patil, G. Lazarou and J. Picone, "Estimation of Lyapunov Spectra From a Time Series," *Proceedings of the IEEE SoutheastCon*, pp. 192-195, Memphis, Tennessee, USA, March 2006.
2. S. Patil, S. Srinivasan, **S. Prasad**, R. Irwin, G. Lazarou and J. Picone, "Sequential State-Space Filters for Speech Enhancement," *Proceedings of the IEEE SoutheastCon*, pp. 240-243, Memphis, Tennessee, USA, March 2006.
1. **S. Prasad**, S.A. Zahorian, "Nonlinear and Linear Transformations of speech features to compensate for Channel and Noise effects," *Proceedings of EUROSPEECH'2005*, pp 969-972, Lisbon, Portugal, September 2005.

#### Non Refereed Papers, Reports, Invited Talks

10. **S. Prasad**, "Signal Processing and Statistical Pattern Classification for High Dimensional Optical Remote Sensing Open Issues and Current State-of-the-Art," *IEEE Computational Intelligence Society Seminar at the Electrical Engineering Department, Indian Institute of Technology, New Delhi*, India, December 2010.
9. **S. Prasad**, "Hyperspectral Image Analysis - Current state-of-the-art and future directions," *Geosystems Research Institute Seminar Series*, Mississippi State University, May 2010.
8. **S. Prasad**, L. M. Bruce, W. Robles, "Data Exploitation of HypsIRI Observations for Precision Vegetation Mapping," *NASA Biodiversity and Ecological Forecasting Team Meet*, Washington D.C., May 2010.
7. **S. Prasad**, "Statistical Pattern Recognition for Remote Sensing Systems Operating under small sample size conditions," *Seminar at the Electrical and Computer Engineering Department*, MS-State University, MS, 2009.
6. **S. Prasad**, "Statistical Modeling of Chaotic Attractors," *Review paper, Intelligent Electronic Systems (IES)*, MS-State University, MS, May 2006.
5. **S. Prasad**, "Estimating Kolmogorov Entropy from Acoustic Attractors from a Recognition Perspective," *IES Spring'06 Seminar Series*, MS-State University, MS, March 2006.
4. **S. Prasad**, "Dynamical Invariants from a Time Series," *IES Spring'06 Seminar Series*, MS-State University, MS, February 2006.

3. **S. Prasad**, "Implementation issues in the design of Kalman filters - notes on factors leading to ill-posed Kalman filter problems," *Review paper, Intelligent Electronic Systems*, MS-State University, MS, December 2005.
2. **S. Prasad**, M. Adams, "Altering speech rate without affecting intelligibility," *Review paper, Old Dominion University*, Norfolk, VA, December 2003.
1. **S. Prasad**, "A performance analysis and simulation of algorithms for combating the problem of Multi-User detection in DS-CDMA systems," *Review paper, Old Dominion University*, Norfolk, VA, December 2004.

COMPUTER  
KNOWLEDGE

**Programming, Design and Markup Languages**

- MATLAB, C++, C, Perl, VHDL, HTML

**Programming Environments and Packages**

- Linux, Solaris, gcc, gdb, UNIX Shell Scripting, Portable Batch System
- T<sub>E</sub>X (L<sup>A</sup>T<sub>E</sub>X, B<sub>I</sub>B<sub>T</sub>E<sub>X</sub>), Microsoft Office
- Adobe Design Suite (Photoshop, Dreamweaver, Acrobat)

PROFESSIONAL  
EXPERIENCE

**Professional Society Memberships**

- Member of the Institute of Electrical and Electronics Engineering (IEEE), and member of the following IEEE societies
  - Geoscience and Remote Sensing (GRSS)
  - Signal Processing Society (SPS)
  - Engineering in Medicine and Biology (EMB)
- Member of the Data Fusion Committee of IEEE-GRSS

**Reviewer and Technical Committee Member**

- Active reviewer for various IEEE and Elsevier Journals, including
  - IEEE Transactions on Geoscience and Remote Sensing
  - IEEE Geoscience and Remote Sensing Letters
  - Elsevier, Pattern Recognition Letters
  - Elsevier, Information Fusion
  - Elsevier, Pattern Recognition
- Reviewer of Grant Proposals for various international funding agencies, including The Icelandic Research Fund, The Belgian Earth Observation Program (Belgian Science Policy Office etc.)
- Technical committee member and reviewer for various international conferences, including IEEE WHISPERS and IGARSS

TEACHING  
EXPERIENCE

**Mississippi State University**, Mississippi State, MS, USA

*Professor of Record, Statistical Pattern Recognition (ECE-8443)* Spring 2010-Current

- Developed all lecture material for this course, including lecture slides, handouts, homework, exams and course projects
- Graded homeworks and exams
- Sample graded material and student evaluations available upon request

EXPERTISE AND  
INTERESTS

Mathematics:

- Applied Mathematics, Real and Complex Analysis, Linear Algebra, Graph Theory

Signal Processing:

- Probability, Random Variables, Stochastic Processes, Wavelets and Filter Banks, Information Theory, Statistical Signal Processing, Digital Image Processing

Statistical Pattern Classification and Machine Learning:

- Parametric and Non-Parametric Pattern Classification, Kernel Methods, Manifold Learning, Graph-Theoretic Learning Algorithms, Convex Optimization, Data Clustering, Regression

Remote Sensing Technologies:

- Optical Remote Sensing Modalities: Hyperspectral, Multispectral and Panchromatic images
- Active Remote Sensing Modalities: SAR images (Currently, I am getting acclimated to LiDAR data in anticipation of planned research projects where it will be used in conjunction with hyperspectral imagery)
- Analysis: Spectral pixel unmixing, Spatial-Spectral Feature Extraction for Ground Cover Classification, Morphological Processing