

# Juan Julia LIU

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## EDUCATION

Ph.D. October 2001

Electrical Engineering, University of Illinois, Urbana-Champaign

M.S. October 1998

Electrical Engineering, University of Illinois, Urbana-Champaign

B.Engr. July 1995

Electrical Engineering, Tsinghua University, Beijing, China

## PROJECT EXPERIENCE

### 1. *Ad hoc sensor networks and collaborative information processing*

- Information processing based on diverse sensing models --- I have been a key contributor to information processing algorithms for sensor networks. The application includes detection, classification, and target tracking. The key method is Bayesian inference.
- Resource management in sensor networks --- the challenge in this problem is to achieve a suitable balance between the need to gather and process a vast amount sensor data to infer about underlying phenomenon of interest and the reality that sensor network is often constrained in sensing, processing, and communication resources. How to achieve best information processing performance without over-tasking the sensor network is a major challenge. My work along this theme focuses on developing estimation and information theoretic methods to characterize the performance of sensor tasking choices, and then using optimization techniques to decide optimal or nearly optimal solutions.
- Node localization in ad hoc networks ---- location information of nodes is critical to many applications such as routing and sensor tasking. I have designed localization schemes for a variety of sensing modalities. I have proposed a unique error characterization and control method to limit error propagation in sensor network localization.
- Information dissemination in ad hoc sensor networks --- designing efficient routing mechanism for sensor networks, which jointly optimize communication routes balancing the need for information gathering and delivery.

- Other issues ---- programming methodology, middleware, and user interface issues in sensor networks.
2. *Vehicle-based computation/communication and Intelligent Transportation System (ITS)*
    - Information dissemination --- designed push-based information dissemination architecture for VANETs (Vehicle Ad Hoc Networks) by allowing applications to model potential usefulness of information using utility functions; designed dynamic packet prioritizing scheme to handle the dynamic and unreliable nature of VANETs communication. This works better than traditional geocast-like information dissemination schemes because multiple data sources can trade their communication resources to maximize overall benefit.
    - Collision avoidance --- designed computationally efficient statistical inference mechanism for collision avoidance. The computation is centered at the primary vehicle, incorporating sensing evidence to monitor all surrounding vehicles and pedestrians and provide early collision warning.
  3. *Statistical modeling and inference based on acoustic, image, and video signals.*  
The emphasis is mainly on statistical modeling of various types of signals and applications to estimation problems. Research interest include: Bayesian estimation, optimization, model selection, wavelets and multi-resolution signal processing, information theoretic methods, regularization, and adaptive methods and learning.
  4. *Pattern recognition and computer vision*  
The focus is on developing computer vision and pattern recognition techniques for various applications. Example projects include clothes recognition for an interactive fashion recommender system (PARC project), recognition of natural cursive handwriting (internship at IBM T.J Watson Research Center), and classification of grains based on image data (joint work with Agriculture Engineering Department of UIUC). Research interests include: image analysis and feature extraction, Bayesian classification, and machine learning techniques.

#### **AWARDS AND PROFESSIONAL ACTIVITIES**

- Member of IEEE and ACM.
- Recipient of PARC Excellence Award (2002, 2006) in Science and Technology for the teamwork on sensor networks.
- Recipient of IEEE Signal Processing Society Young Author Best Paper Award (2002) for the paper "Information-Theoretic Analysis of Interscale and Intrascale Dependencies Between Image Wavelet Coefficients", coauthored with Pierre Moulin.
- Guest editor of IEEE Signal Processing Magazine, special issue on distributed signal processing in sensor networks.
- Technical Program Committee (TPC) member of various workshops and conferences, including IPSN 2004 and 2006 (Workshop on Information Processing in Sensor Networks), SensorFusion 2005, ICIP (International Conference on Image Processing) 2003 and 2004.

- Reviewer for various journal and magazine, including IEEE Transactions on Image Processing, IEEE Transactions on Signal Processing, IEEE Signal Processing Magazine, IEEE Pattern Recognition Letter, ACM Transactions on Sensor networks, EuraSip Journal on Applied Signal Processing, Signal Processing of Elsevier Science.

## **PUBLICATIONS**

### **Publication on Collaborative Information Processing in Sensor Networks**

#### Book chapters

- "Collaborative In-Network Processing for Target Tracking", by Juan Liu, James Reich, and Feng Zhao, to appear in Sensor Network Handbook, edited by Richard Brooks, soon to be published.
- "Information-directed routing in sensor networks using Reinforcement Learning", by Ying Zhang, Juan liu, and Feng Zhao, in Combinatorial Optimization in Communication Networks, Ed. Maggie Cheng, Yingshu Li, and Ding-Zhu Du, Kluwer Academic Publishers, 2006.

#### Journal Publications

- "Error control in distributed node self-localization", by Juan Liu and Ying Zhang, accepted for publication on EuraSip Journal on Advances in Signal Processing, Special Issue on Cooperative Localization in Wireless Ad Hoc and Sensor Networks, 2008.
- "Resource-Aware Multi-target Tracking in Distributed Sensor Networks", by Juan Liu, Maurice Chu, and James Reich, IEEE Signal Processing Magazine, special issue on distributed signal processing, 2007.
- "Tradeoff Between Estimation Performance and Sensor Usage in Distributed Localization Problem", the International Journal of Ad Hoc and Ubiquitous Computing, Vol.2, No.1, 2006.
- "Information-directed Routing in Sensor Networks", by Juan Liu, Feng Zhao, and Dragan Petrovic, IEEE Journal on Selected Area in Communications (JSAC), vol. 23, number 4, pp. 851-861, April 2005.
- "Collaborative Signal and Information Processing: An Information Directed Approach." by Feng Zhao, Jie Liu, Juan Liu, Leonidas Guibas, and James Reich, Proceedings of the IEEE, pp.1199-1209, vol. 91, number 8, August 2003.
- "State-Centric Programming for Sensor-Actuator Network Systems." By Jie Liu, Maurice Chu, Juan Liu, James Reich, and Feng Zhao, IEEE Pervasive Computing, October, 2003, pp.50-62.
- "Distributed Group Management for Track Initiation and Maintenance in Target Localization Applications," Juan Liu, Jie Liu, James Reich, Patrick Cheung, and Feng Zhao, in Telecommunication Systems Journal, Kluwer Academic Publishers, 2004.
- "Collaborative In-Network Processing for Target Tracking", by Juan Liu, James Reich, and Feng Zhao, EuraSip Journal of Applied Signal Processing, Special Issue on Sensor Networks, 2001.

#### Conference Papers

- "Automatic composition over physical location - a design methodology to enable extensibility in sensing systems", by M. Chu, J. Liu, and J. E. Reich, submitted to IPSN SPOTS track, 2008.
- "Sequential Localization Algorithm for Active Sensor Network Deployment", by Y. Zhang, Q. Huang and J. Liu, in the Proceedings of the IEEE International Workshop on Pervasive Computing and Ad Hoc Communications (PCAC/AINA), April 18-20, 2006, Vienna, Austria.
- "Robust Distributed Node Localization with Error Management", by Juan Liu, Ying Zhang and Feng Zhao, MobiHoc 2006.
- "Distributed State Representation for Tracking Problems in Sensor Networks," by Juan Liu, Maurice Chu, Jie Liu, James Reich, and Feng Zhao, presented at the 3rd International Symposium on Information Processing in Sensor Networks (IPSN04), Berkeley, CA, April, 2004.
- "Information-driven routing in ad hoc sensor networks," by Juan Liu, Feng Zhao, and Dragan Petrovic, presented at the ACM International Workshop on Wireless Sensor Networks and Applications (WSNA), Network Applications (WSNA03), in conjunction with MobiCom.
- "Estimation Risk of Transformation-Averaged Estimators", by Juan Liu and Pierre Moulin, SPIE03.
- "Sensing Field: Coverage Characterization in Distributed Sensor Networks", by Juan Liu, Xenofon Koutsoukos, James Reich, and Feng Zhao, ICASSP03.
- "Multi-Step Information-Directed Sensor Querying in Distributed Sensor Networks", by Juan Liu, Dragan Petrovic, and Feng Zhao, ICASSP03.
- "Distributed Group Management for Track Initiation and Maintenance in Target Localization Applications", by Juan Liu, James Reich, Jie Liu, Feng Zhao, and Patrick Cheung, Proc of 2nd International Workshop on Information Processing in Sensor Networks (IPSN) 2003.

### **Publication on ITS**

- "Collision Early Warning System", by J. Liu, D. Greene, J. Reich, Y. Hirokawa, and A. Shinagawa, under preparation.
- "Using Utility and Microutility for Information Dissemination in VANETS", by D. Greene, J. Liu, M. Mosko, J. Reich, Y. Hirokawa, T. Mikami, and T. Takebayashi, submitted to IEEE Intelligent Vehicle Symposium, 2008.
- "Utility-Driven Information Dissemination in VANETS", by D. Greene, J. Liu, M. Mosko, J. Reich, Y. Hirokawa, T. Mikami, and T. Takebayashi, ITS World Congress, Oct 11-14, Beijing, China.
- "Variable Resolution Information Dissemination", by Arpita Ghosh, Dan Greene, Qingfeng Huang, and Juan Liu, the Second IEEE International Conference on Sensor and Ad Hoc Communications and Networks (SECON) 2005.

### **Publication on Statistical Modeling and Inference based on Image and Audio Signals**

#### Journal Papers

- "Information-theoretic analysis of interscale and intrascale dependencies between image wavelet coefficients", by Juan Liu and Pierre Moulin, IEEE Transactions on Image Processing, vol 10, No.11, pg. 1647-1658, Nov. 2001. This paper is awarded the IEEE Signal Processing Society Best Paper by Young Authors Award 2001.

- "Statistical Imaging and Complexity Regularization", by Pierre Moulin and Juan Liu, IEEE Transactions on Information Theory, Special Issue on information-theoretic imaging, pg. 1762-1777, Vol. 46, No. 5, August 2000.
- "Complexity-Regularized Image Denoising", by Juan Liu and Pierre Moulin, IEEE Transactions on Image Processing, vol.10, No.6, pp.841-851, June 2001.
- "Analysis of Multiresolution Image Denoising Schemes Using Generalized-Gaussian and Complexity Priors", by Pierre Moulin and Juan Liu, IEEE Transactions on Information Theory, Special Issue on Multiscale Analysis, pg. 909--919, Vol. 45, No. 3, April 1999.

#### Conference Papers

- "Translation-Invariant Wavelet Denoising of Poisson Data", by Juan Liu and Pierre Moulin, Proc. of 35th Conference on Information Sciences and Systems, Baltimore, MD, March 2001.
- "Image Restoration Using Statistical Wavelet Models", by Juan Liu and Pierre Moulin, Proc. of SPIE, vol. 4478, Wavelets: Application in Signal and Image Processing IX, San Diego, CA, August 2001.
- "Approximation-theoretic Analysis of Translation Invariance wavelet expansions", by Juan Liu and Pierre Moulin, Proc. of ICIP, vol.1, pp.622-625, Thessaloniki, Greece, Oct. 2001.
- "Statistical Image Restoration Based on Adaptive Wavelet Models", by Juan Liu and Pierre Moulin, Proc. of ICIP, vol.2, pp.21-24, Thessaloniki, Oct. 2001.
- "Blind Deconvolution of Reverberated Speech Signals via Regularization", by Juan Liu and Henrique Malvar, Proceedings of ICASSP, vol.5, pp.3037-3040, Salt Lake City, Utah, June 2001.
- "Statistical Imaging and Complexity Regularization", by Pierre Moulin and Juan Liu, Proc. of International Symposium on Information Theory, pp.54, Sorrento, Italy, June 2000.
- "Complexity-Regularized Denoising of Poisson-Corrupted Data", by Juan Liu and Pierre Moulin, Proceedings of ICIP'2000, vol.3, pp.254-257, Vancouver, Sept. 2000.
- "Analysis of Interscale and Intrascale Dependencies Between Image Wavelet Coefficients", by Juan Liu and Pierre Moulin, Proceedings of ICIP'2000, vol.1, pp. 669-672, Vancouver, Sept. 2000.
- "Analysis of Wavelet Image Denoising Schemes Using Robust Priors", by Pierre Moulin and Juan Liu, Proceedings of IEEE workshop on Detection, Estimation, Classification, and Imaging, pp.75, Santa Fe, NM, Feb. 1999.
- "Image Denoising Based on Scale-Space Mixture Modeling of Wavelet Coefficients", by Juan Liu and Pierre Moulin, Proceedings of ICIP'99, pg. I: 386--390, Kobe, Japan, Oct. 1999.
- "Complexity-Regularized Image Restoration", by Juan Liu and Pierre Moulin, Proceedings of ICIP'98, pg. I: 555-559, Chicago, IL, Oct. 1998.
- "Analysis of Multiresolution Image Denoising Schemes Using Generalized-Gaussian Priors", by Pierre Moulin and Juan Liu, Proceedings of IEEE workshop on Time-Frequency Time-Scale Analysis, Pittsburgh, pg. 633--636, PA, Oct. 1998.
- "A New Complexity Prior for Multiresolution Image Denoising", by Juan Liu and Pierre Moulin, Proceedings of IEEE workshop on Time-Frequency Time-Scale Analysis, pg. 637--640, Pittsburgh, PA, Oct. 1998.

- "Complexity-Regularized Image Denoising", by Juan Liu and Pierre Moulin, Proceedings of ICIP'97, pg. II: 370--373, Santa Barbara, Oct. 1997.

Ph.D. Dissertation

"Wavelet-Based Statistical Modeling and Image Estimation", by Juan Liu, University of Illinois at Urbana-Champaign, Electrical and Computer Engineering Department, Oct. 2001.

### **Publication on Pattern Recognition and Computer Vision**

Journal Papers

- "Measurement and removal of garlic in wheat", by M. R. Paulsen, S.R. Eckhoff, L. Obaldo, E. Jones, D. Eustace, B. Ye, and J. Liu, Applied Engineering in Agriculture. 18(3): 313-324. 2002.
- "Corn whiteness measurement and classification using machine vision," by Juan Liu and Marvin Paulsen. 2000. Transactions of ASAE. 43(3): 757-763.

Conference papers

- "Intelligent fitting room: connecting interactive physical fit with social fashion contents", by W. Zhang, T. Matsumoto, J. Liu, M. Chu, and J. Begole, submitted to IUI workshop, 2008.
- "Responsive Mirror: Reflecting the physical and social fit of garments", by Wei Zhang, T. Matsumoto, J. Liu, M. Chu, and J. Begole, submitted to ACM CHI, 2008.
- "Augmented Fashion Exploration Based on Clothes Recognition", by W. Zhang, J. Liu, M. Chu, J. Begole, and N. Yee, submitted to CVPR, 2008.