Xin YUAN Postdoctoral Associate Duke University June 15, 2014

CONTACT INFORMATION

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PROFILE

- Recent research with Prof. Lawrence Carin focus on the applied statistics and machine learning, by developing Nonparametric Bayesian models for diverse applications.

- I am working on the coded aperture X-ray imaging (CAXI) project with Prof. Robert Calderbank, Prof. Lawrence Carin and Prof. David Brady by developing reconstruction algorithms for the compressive X-ray scatter imaging and compressive X-ray computed tomography.

- I am also developing Bayesian models for Big data, (the biomedical applications), particularly to analyze the genetic data from Lovelace Respiratory Research Institute.

- Since May, 2012 in Duke University, I focus on the coded-aperture video compressive sensing (CACTI) and hyperspectral compressive sensing (CASSI) technique, working with Prof. David Brady, Prof. Lawrence Carin and Prof. Guillermo Sapiro, including the hardware development, reconstruction algorithms and theoretical analysis, affiliated to the DARPA, KECoM (Knowledge Enhanced Compressive Measurement) project. I am now applying the compressive sensing strategy and reconstruction algorithms to the microscopy imaging system with Pacific Northwest National Laboratory (PNNL).

- I also developed the advanced "leave-bag-behind" detection algorithm with Prof. Guillermo Sapiro and Prof. Lawrence Carin for the Department of Homeland Security (DHS).

- During my Ph.D in the Hong Kong Polytechnic University (2.5 years, 09/2009-03/2012), I was working on sensor array signal processing, including direction-of-arrival estimation, beamforming, polarization estimation, with focus on diversely polarized antenna arrays (Electromagnetic vector-sensor), and acoustic vector-sensor arrays.

- When I was a Master and undergraduate student in Xidian University, I developed several prototypes of Radar Signal Processing systems and other electronic products with A/D, D/A converters and DSP, FPGA, ARM, MCU electronic chips.

CURRENT RESEARCH TOPICS

Machine Learning, Applied Statistics, Computational Photography, Computer Vision,
Image/Video/Hyperspetral-image compressive sensing, X-ray compressive sensing,
Sensor array signal processing, Radar signal processing, Acoustic signal processing, Polarization.

ACADEMIC EMPLOYMENT

Duke University, Durham, NC, U.S.A, May 2012 - now
Research Scientist / Postdoctoral Associate Mentor: Prof. Lawrence Carin

EDUCATION

The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong SAR

Ph.D., September 2009 - April 2012 Electronic and Information Engineering

- Thesis Topic: *Diversely Polarized Antenna-Array Signal Processing*
- Supervisor: Dr. Kainam Thomas Wong (Associate Professor)

Xidian University, Xi'an, Shaanxi, China
M.Eng. August 2007 - June 2009
National Lab of Radar Signal Processing, School of Electronic Engineering

- Thesis Topic: *Design and Implementation of Monopulse Tracking Radar Signal Processing System*
- Supervisor: Prof. Linrang Zhang

B.Eng. August 2003 - June 2007
School of Electronic Engineering

- Thesis Topic: *The Design of High Performance Real-time Signal Processing Platform*

BOOK CHAPTER	P. Llull, **X. Yuan**, X. Liao, J. Yang, D. Kittle, L. Carin, G. Sapiro, and D. J. Brady, "Coded Aperture Compressive Temporal Color Imaging" for *compressed sensing and its application* (Gitta Kutyniok Edits), 2014.
PATENT	D.J. Brady, L. Carin, P. Llull and **X. Yuan**, "Image Translation for Computational imaging", submitted.

JOURNAL PAPERS

1. **X. Yuan**, "Coherent Sources Direction Finding and Polarization Estimation with Various Compositions of Spatially Spread Polarized Antenna Arrays," *Signal Processing*, vol. 102, pp. 265-281, 2014.

2. J. Yang, **X. Yuan**, X. Liao, P. Llull, D. J. Brady, G. Sapiro and L. Carin "Video Compressive Sensing Using Gaussian Mixture Models," *IEEE Transactions on Image Processing*, 2014.

3. **X. Yuan**, "Spatially Spread Dipole/Loop Quads/Quints: for Direction Finding and Polarization Estimation," *IEEE Antennas and Wireless Propagation Letters*, vol. 12, pp. 1081-1084, 2013.

4. P. Llull, X. Liao, **X. Yuan**, J. Yang, D. Kittle, L. Carin, G. Sapiro and D.J. Brady, "Coded Aperture Compressive Temporal Imaging", *Optics Express*, vol. 21, Issue 9, pp. 10526-10545, 2013. (Top Downloaded Article in Image Processing from OSA Journals).

5. **X. Yuan**, "Estimating the DOA and the Polarization of a Polynomial-Phase Signal Using a Single Polarized Vector-Sensor," *IEEE Transactions on Signal Processing*, vol. 60, no. 3, pp. 1270-1282, March 2012.

6. **X. Yuan**, "Direction-Finding with a Misoriented Acoustic Vector Sensor," *IEEE Transactions on Aerospace and Electronic Systems*, vol. 48, no. 2, pp. 1809-1815, April 2012.

7. **X. Yuan**, K. T. Wong and K. Agrawal, "Polarization Estimation with a Dipole-Dipole Pair, a Dipole-Loop Pair, or a Loop-Loop Pair of Various Orientations," *IEEE Transactions on Antennas and Propagation*, vol. 60, no. 5, pp. 2442 - 2452, May 2012.

8. F. Luo & **X. Yuan**, "Enhanced "Vector-Cross-Product" Direction-Finding Using a Constrained Sparse Triangular-Array", *EURASIP Journal on Advances in Signal Processing*, 2012:115 doi:10.1186/1687-6180-2012-115, May 2012.

9. Y. I. Wu, K. T. Wong, **X. Yuan**, S.-K. Lau and S. K. Tang, "A Directionally Tunable but Frequency-Invariant Beamformer on an Acoustic Velocity-Sensor Triad to Enhance Speech Perception," *Journal of the Acoustical Society of America*, vol. 131, no. 5, pp. 3891-3902, May 2012.

10. **X. Yuan**, K. T. Wong, Z. Xu and K. Agrawal, "Various Compositions to Form a Triad of Collocated Dipoles/Loops, for Direction Finding & Polarization Estimation," *IEEE Sensors Journal*, vol. 12, no. 6, pp. 1763 - 1771, June 2012.

11. **X. Yuan**, "Direction-Finding Wideband Linear FM Sources with Triangular Arrays," *IEEE Transactions on Aerospace and Electronic Systems*, vol. 48, no. 3, pp. 2416-2425, July 2012.

12. **X. Yuan**, "Coherent Source Direction-Finding Using a Sparsely-Distributed Acoustic Vector-Sensor Array," *IEEE Transactions on Aerospace and Electronic Systems*, vol. 48, no. 3, pp. 2710-2715, July 2012.

13. **X. Yuan**, "Cramer-Rao Bounds of Direction-of-Arrival and Distance Estimation of a Near-Field Incident Source for an Acoustic Vector-Sensor: Gaussian Source and Polynomial-Phase Source," *IET Radar, Sonar and Navigation*, vol. 6, no. 7, pp. 638-648, July 2012.

14. **X. Yuan**, "Quad Compositions of Collocated Dipoles and Loops: for Direction Finding and Polarization Estimation," *IEEE Antennas and Wireless Propagation Letters*, vol. 11, pp. 1044-1047, 2012.

15. Z. Xu and **X. Yuan**, "Cramer-Rao Bounds of Angle-of-Arrival & Polarisation Estimation for Various Triads," *IET Microwaves, Antennas & Propagation*, vol. 6, no. 15, pp. 1651-1664, 2012.

16. K. T. Wong and **X. Yuan**, "Vector Cross-Product Direction-Finding With an Electromagnetic Vector-Sensor of Six Orthogonally Oriented but Spatially Noncollocating Dipoles/Loops", *IEEE Transactions on Signal Processing*, vol. 59, no. 1, pp. 160-171, January 2011.

CONFERENCE PAPERS

17. **X. Yuan**, P. Llull, X. Liao, J. Yang, G. Sapiro, D. J. Brady, and L. Carin, "Low-Cost Compressive Sensing for Color Video and Depth," ***IEEE Conference on Computer Vision and Pattern Recognition (CVPR)***, Columbus, Ohio, USA, June, 2014.

18. P. Llull, **X. Yuan**, X. Liao, J. Yang, L. Carin, G. Sapiro and D.J. Brady, "Compressive Extended Depth of Field Using Image Space Coding," *Computational Optical Sensing and Imaging (COSI)*, Hawaii, USA, June, 2014, (Oral).

19. T.-H. Tsai, **X. Yuan**, L. Carin, and D.J. Brady, "Spatial Light Modulator Based Spectral Polarization Imaging," *Computational Optical Sensing and Imaging (COSI)*, Hawaii, USA, June, 2014, (Oral).

20. **X. Yuan**, J. Yang, P. Llull, X. Liao, G. Sapiro, D. J. Brady and L. Carin, "Adaptive Temporal Compressive Sensing for Video," *International Conference on Image Processing (ICIP)*, Melbourne, Australia, September, 2013, (Oral).

21. J. Yang, **X. Yuan**, X. Liao, P. Llull, G. Sapiro, D. J. Brady and L. Carin, "Gaussian Mixture Model for Video Compressive Sensing," *International Conference on Image Processing (ICIP)*, Melbourne, Australia, September, 2013, (Oral).

22. P. Llull, X. Liao, **X. Yuan**, J. Yang, D. Kittle, L. Carin, G. Sapiro and D.J. Brady, "Compressive Sensing for Video Using a Passive Coding Element," *Computational Optical Sensing and Imaging (COSI)*, Arlington, VA, June, 2013. (Best paper award).

23. **X. Yuan**, "Polynomial-Phase Signal Source-Tracking Using an Electromagnetic Vector-Sensor," *IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, Kyoto, Japan, March 2012.

24. **X. Yuan**, "Cramer-Rao Bound of The Direction-of-Arrival Estimation Using a Spatially Spread Electromagnetic Vector-Sensor," *IEEE Statistical Signal Processing Workshop (SSP)*, Nice, France, June 2011.

25. K. T. Wong, Y. I. Wu, **X. Yuan**, S.-K, Lau & S.-K. Tang, "A Directionally Tunable but Frequency-Invariant Beamformer on an Acoustic Velocity-Sensor Triad to Enhance Speech Perception", *the 8th International Conference on Networked Sensing Systems*, 2011.

SUBMITTED/ UNDER-REVIEW PAPERS/ TECHNICAL REPORTS

26. **X. Yuan**, V. Rao, S. Han and L. Carin, "Hierarchical Infinite Divisibility for Multiscale Shrinkage," under revision by the *IEEE Transactions on Signal Processing*.

27. J. Huang, **X. Yuan**, K. Krishnamurthy, D. J. Brady, L. Carin and R. Calderbank, "Collaborative Compressive X-Ray Image Reconstruction," submitted to DHS for approval.

28. J. Huang, **X. Yuan**, K. Krishnamurthy, D. J. Brady, L. Carin and R. Calderbank, "Multiscale Bayesian Reconstruction of Compressive X-Ray Image," submitted to DHS for approval.

29. **X. Yuan**, K. Ulrich, J. Yang, M. Tepper, Q. Qiu, G. Sapiro, and L. Carin, "Robust Principal Component Analysis based Leave-Bag-Behind Detection," Technical Report sent to DHS.

30. R. Henao, **X. Yuan** and L. Carin, "Bayesian Nonlinear Support Vector Machines and Supervised Factor Modeling," submitted.

31. **<u>X. Yuan</u>**, P. Llull, D. Brady, G. Sapiro and L. Carin, "Bayesian Shrinkage Dictionary Learning and Compressive Dynamic Range Imaging," submitted.

32. J. Yang, X. Liao, **<u>X. Yuan</u>**, P. Llull, D. J. Brady, G. Sapiro and L. Carin, "Compressive Sensing by Learning a Gaussian Mixture Model from Measurements," under revision by the *IEEE Transactions on Image Processing.*

33. **<u>X. Yuan</u>**, R. Henao, and L. Carin, "Non-Gaussian Discriminative Factor Models via the Max-Margin Rank Likelihood," submitted.

34. L. Wang, J. Huang **<u>X. Yuan</u>**, K. Krishnamurthy, D. J. Brady, R. Calderbank and L. Carin, "Signal Recovery and System Calibration from Multiple Compressive Poisson Measurements," submitted.

35. **<u>X. Yuan</u>**, "Polynomial-Phase Signal Direction-Finding & Source-Tracking with an Acoustic Vector Sensor," arXiv preprint arXiv:1308.0075.

36. **<u>X. Yuan</u>**, "Joint DOA and Polarization Estimation with Sparsely Distributed and Spatially Non-Collocating Dipole/Loop Triads," arXiv preprint arXiv:1308.0072.

Publications
(In Chinese)

37. **<u>X. Yuan</u>**, F. Luo, and L. R. Zhang, "Study of the implementation of data communication in the real-time digital circuit", *Electronic Science and Technology*, vol. 22, no. 6, pp. 49-51, June 2009.

38. **<u>X. Yuan</u>**, L. Cao, F. Luo, and L. R. Zhang, "Study of compensation of ship speed in ship-borne radar", *Ship Science and Technology*, vol. 32, no. 2, pp. 48-50, February 2010.

Talks

1. P. Llull, **<u>X. Yuan</u>**, X. Liao, J. Yang, L. Carin, G. Sapiro, and D. J. Brady, "Compressive Sensing for Video With a Passive Coding Element", *Duke Workshop on Sensing and Analysis of High-Dimensional Data*, July, 2013.

2. **<u>X. Yuan</u>**, J. Yang, G. Sapiro, and L. Carin, "Robust Principle Component Analysis based Real-Time Leave-Bag-Behind Detection", *Duke Workshop on Sensing and Analysis of High-Dimensional Data*, July, 2013.

3. T.-H.Tsai, R. Zhu, **<u>X. Yuan</u>**, and D. J. Brady, "Spatial Light Modulator Based Spectral Polarization Imaging", *Frontiers in Optics*, October, 2013.

4. Y. Xie, T.-H. Tsai, **<u>X. Yuan</u>**, D. J. Brady and S. Cumber, "Compressive Acoustic Imaging with Metamaterials", *Duke ECE Graduate Workshop*, January, 2014.

5. T.-H.Tsai, R. Zhu, **<u>X. Yuan</u>**, and D. J. Brady, "Spatial Light Modulator Based Spectral Polarization Imaging", *Duke ECE Graduate Workshop*, January, 2014.

6. P. Llull, **<u>X. Yuan</u>**, G. Sapiro, D. J. Brady, L. Carin, J. Yang and X. Liao, "Adaptive Sensing and Reconstruction Techniques for CS-Video Applications", *SIAM Conference on Imaging Science*, Hong Kong, May, 2014.

7. A. Stevens, **<u>X. Yuan</u>**, L. Carin, N. Browning, "Machine Learning and Compressive Sensing for Electron Microscopy", *Imaging and Modeling in Electron Microscopy - Recent Advances, Bnaff International Research Station (Birds)*, May, 2014.

8. **<u>X. Yuan</u>**, "Low-Cost Compressive Sensing for Color Video and Depth", *Gordon Research Conference on Imaging Science*, June, 2014.

WORKING PROJECTS	1) "Multi-task Compressive Sensing with Model Error";
	2) "Bayesian Reconstruction Algorithms for Coded Aperture X-ray Imaging";
	3) "Coded Aperture Compressive Depth Imaging";
	4) "High Dimensional Compressive Sensing of Microscope Imaging";
	5) Book Chapter: "Inference of Gene Networks Associated with the Host Response to Infectious Disease", for book "Big Data Over Networks" (Zhiquan Tom Luo, Alfred Hero, Jose Moura and Shuguang Cui Edit).

ADVISING EXPERIENCE	- Jiaji Huang, PhD student of Prof. Robert Calderbank, developing the Bayesian reconstruction algorithms for coded aperture X-ray imaging (2013-now).
	- Yunchen Pu, PhD student of Prof. Lawrence Carin, developing Bayesian algorithms for genetic data (2014-now).
	- Zhe Gan, PhD student of Prof. Lawrence Carin, developing Bayesian algorithms for genetic data (2014-now).
	- Zixin Xu, Master student of Dr. Kainam Thomas Wong, in the Hong Kong Polytechnic University (2010-2011).

PROFESSIONAL ACTIVITIES SINCE 2009	IEEE Member
	Reviewer of the *IEEE Transactions on Signal Processing*
	Reviewer of the *IEEE Transactions on Image Processing*
	Reviewer of the *IEEE Transactions on Aerospace and Electronic Systems*
	Reviewer of the *SIAM Journal on Imaging Science*
	Reviewer of the *IEEE Transactions on Vehicular Technology*
	Reviewer of the *IEEE Sensors Journal*
	Reviewer of the *Signal Processing*
	Reviewer of the *Digital Signal Processing*
	Reviewer of the *IET Signal Processing*
	Reviewer of the *Progress In Electromagnetics Research (PIER)*
	Reviewer of the *EUSIPCO, IEEE SSP, IEEE GLOBECOM, IEEE ICASSP*

HARDWARE RESEARCH EXPERIENCE 2005 - 2009	**National Key Lab of Radar Signal Processing, Xidian University**

- November 2006 - June 2009   Signal processing system of a tracking radar

  Designed the signal processing board (one FPGA & four DSP);
  Designed the communication-programs between FPGA and DSP (ADSP-TS101/TS201);
  Designed the programs of DSP to implement Pulse Compression, MTD, CFAR etc.;
  Designed the communication-programs among A/D board, signal processing board and time-sequence-producing board;
  Completed systematic test and implementation.

- April 2008 - December 2008   Signal processing system of a meteorological radar

  Designed the signal processing board (one FPGA & one DSP);
  Designed the communication-programs between FPGA and DSP(ADSP-TS101);
  Designed the logic of FPGA to implement DDC;
  Designed the programs of DSP to implement MTD, CFAR and so on;
  Used the PCI9054 to communicate with PC.

- December 2007 - March 2009   Hardware-in-loop radar simulation system

  Designed the signal processing board;
  Finished systematic test.

Autonomously Small Research Projects

- December 2006 - May 2007   The monitor of capacitive device

  Designed the hardware with FPGA (EP1C6);

Developed the software with NIOS II.

- November 2007 - May 2008   The monitor of switch-state

  Implemented the hardware & software with MCU (C8051F020).

- November 2007 - March 2008   Detector of the cross-polarity between the railways

  Implemented the hardware & software with MCU (MSP430).

Contests Awards

- First-Prize of ADI University Design Competition   May 2008

  Implemented the "Multi-function Olympics Dragoman" based on ADSP-Blackfin 533.

- Freescale Cup Smart-Car Contest   August 2006

  Designed and implemented the smart-car using the MCU (HCS12).

- Second-Prize of Xidian Sparking Cup Contest   August 2006

- Second-Prize of Xidian Sparking Cup Contest   August 2005

HONOURS AND AWARDS

Scholarship for Gordon Research Conference on Imaging Science, 2014
Best paper award, Computational Optical Sensing and Imaging (COSI), 2013
Top Downloaded Article in Image Processing from OSA Journals, Optics Express, 2013

Excellent Student Leader, March 2004 and May 2005
Excellent Graduate Student Leader, June 2007
First-Prize of "Telecom" Scholarship, December 2006
Second-Prize of R&S scholarship, May 2008
Second-Prize of "Zhen Tai" Scholarship, October 2005
Outstanding Student Award, 2004-2009

REFEREES

- Robert Calderbank, Professor, Director of the Information Initiative at Duke
  Department of Computer Science, Mathematics, Electrical and Computer Engineering,
  Duke University
  Box 90291, Durham, NC 27708-0291, USA
  Email: robert.calderbank@duke.edu

- Lawrence Carin, Professor, Vice Provost of Duke
  Department of Electrical and Computer Engineering, Duke University
  Box 90291, Durham, NC 27708-0291, USA
  Email: lcarin@duke.edu

- Guillermo Sapiro, Edmund T. Pratt, Jr. School Professor
  Department of Electrical and Computer Engineering, Duke University
  Box 90291, Durham, NC 27708-0291, USA
  Email: guillermo.sapiro@duke.edu

- David J. Brady, Bass Fellow
  Department of Electrical and Computer Engineering, Duke University
  Box 90291, Durham, NC 27708-0291, USA
  Email: dbrady@duke.edu