

# Brynmor J. Davis

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## RESEARCH INTERESTS

- Stochastic Signal Processing
- Electromagnetics and Acoustics
- Microscopy
- Inverse Problems
- Statistical Optics
- Spectroscopy
- Computed Imaging
- Ultrafast Optics
- Nanotechnology

## EDUCATION

**Ph.D. – Boston University**, Boston, Massachusetts, USA March 2006  
▪ Electrical and Computer Engineering  
▪ 4.0/4.0 Grade Point Average

**M.S. – The University of Arizona**, Tucson, Arizona, USA July 2001  
▪ Electrical and Computer Engineering with an Optical Sciences minor  
▪ 4.0/4.0 Grade Point Average

**B.E. – The University of Canterbury**, Christchurch, New Zealand December 1998  
▪ Electrical and Electronic Engineering  
▪ First Class Honors

### Related Graduate Courses

Image Reconstruction and Restoration	Random Processes	Statistical Pattern Recognition
Recursive Estimation and Optimal Filtering	Computer Vision	Advanced DSP
Diffraction and Interferometry	Medical Optics	Information Theory and Coding
Non-linear and Ultrafast Optics	Fourier Optics	Detection and Estimation
Subsurface Sensing and Imaging	Quantum Optics	Advanced Discrete Mathematics
Discrete Stochastic Models	Error-Control Codes	Digital Image Processing

## EXPERIENCE

**Creare, Inc.** Hanover, New Hampshire, USA October 2009-Present  
*Research and Development Engineer*

**The University of Illinois**, Urbana-Champaign, Illinois, USA May 2006 – September 2009  
*Postdoctoral Researcher - Optical Inverse Problems, Imaging, Spectroscopy, and Coherence Theory*

- Designed data inversion algorithms
- Derived physical models for optical microscopy systems
- Developed coherence theory for pulsed-light sources

**The University of Illinois**, Urbana-Champaign, Illinois, USA February 2007 – February 2008  
*Guest Lecturer - Advanced Coherence Theory, Nonlinear Optics, and Diffraction, Coherence and Information*

- Designed and delivered lectures in upper-level graduate courses



16. **B. J. Davis**, R. W. Schoonover, “*Computationally efficient coherent mode representations*,” Optics Letters, Vol. 34, 2009, pp 923-925
15. R. W. Schoonover, **B. J. Davis**, P. S. Carney, “*The generalized Wolf shift for cyclostationary fields*,” Optics Express, Vol. 17, 2009, pp 4705-4711
14. D. L. Marks, **B. J. Davis**, S. A. Boppart, P. S. Carney, “*Partially coherent illumination in full-field interferometric synthetic aperture microscopy*,” Journal of the Optical Society of America A, Vol. 26, 2009, pp 376-386
13. **B. J. Davis**, P. S. Carney, “*Robust determination of the anisotropic polarizability of nanoparticles using coherent confocal microscopy*,” Journal of the Optical Society of America A, Vol. 25, 2008, pp 2102-2113
12. R. W. Schoonover, **B. J. Davis**, R. A. Bartels, P. S. Carney, “*Optical interferometry with pulsed fields*,” Journal of Modern Optics, Vol. 55, 2008, pp 1541-1556
11. **B. J. Davis**, D. L. Marks, T. S. Ralston, P. S. Carney, S. A. Boppart, “*Interferometric synthetic aperture microscopy: computed imaging for scanned coherent microscopy*,” (invited review), Sensors, Vol. 8, 2008, pp. 3903-3931
10. **B. J. Davis**, M. Dogan, B. B. Goldberg, W. C. Karl, M. S. Ünlü, A. K. Swan, “*4Pi spectral self-interference microscopy*,” Journal of the Optical Society of America A, Vol. 24, 2007, pp 3762-3771
9. **B. J. Davis**, A. K. Swan, M. S. Ünlü, W. C. Karl, B. B. Goldberg, J. C. Schotland, P. S. Carney, “*Spectral self-interference microscopy for low-signal nanoscale axial imaging*,” Journal of the Optical Society of America A, Vol. 24, 2007, pp. 3587-3599
8. **B. J. Davis**, “*Observable coherence theory for statistically periodic fields*,” Physical Review A, Vol. 74, 2007, 043843
7. **B. J. Davis**, S. C. Schlachter, D. L. Marks, T. S. Ralston, S. A. Boppart, P. S. Carney, “*Nonparaxial vector-field modeling of optical coherence tomography and interferometric synthetic aperture microscopy*,” Journal of the Optical Society of America A, Vol. 24, 2007, pp. 2527-2542
6. **B. J. Davis**, T. S. Ralston, D. L. Marks, S. A. Boppart, P. S. Carney, “*Autocorrelation artifacts in optical coherence tomography and interferometric synthetic aperture microscopy*,” Optics Letters, Vol. 32, 2007, pp. 1441-1443
5. **B. J. Davis**, “*Simulation of vector fields with arbitrary second-order correlations*,” Optics Express, Vol. 15, 2007, pp. 2837-2846
4. **B. J. Davis**, W. C. Karl, A. K. Swan, M. S. Ünlü, B. B. Goldberg, “*Capabilities and limitations of pupil-plane filters for superresolution and image enhancement*,” Optics Express, Vol. 12, 2004, pp. 4150-4156
3. **B. J. Davis**, S. H. Nawab, “*The relationship of transform coefficients for differing transforms and/or differing sub-block sizes*,” IEEE Transactions on Signal Processing, Vol. 52, 2004, pp. 1458-1461
2. **B. J. Davis**, E. Kim, J. R. Piepmeier, “*Stochastic modeling and generation of partially polarized or partially coherent electromagnetic waves*,” Radio Science, Vol. 39, RS1001, 2004
1. A. K. Swan, L. A. Moiseev, C. R. Cantor, **B. J. Davis**, S. B. Ippolito, W. C. Karl, B. B. Goldberg, M. S. Ünlü, “*Toward nanometer-scale resolution in fluorescence microscopy using spectral self-interference*,” IEEE Journal of Selected Topics in Quantum Electronics, Vol. 9, 2003, pp. 294-300

### Intellectual Property

3. **B. J. Davis**, P. S. Carney, “*Robust determination of the anisotropic polarizability of nanoparticles using coherent confocal microscopy*,” Pending Patent US12/405,711, 2009
2. **B. J. Davis**, J. Sun, J. C. Schotland, P. S. Carney, “*Spectral near-field optical tomography*,” Pending Patent US12/402,177, 2009

1. D. L. Marks, **B. J. Davis**, S. A. Boppart, P. S. Carney, “*Partially coherent illumination for inverse scattering full-field interferometric synthetic aperture microscopy*,” Continuation-in-Part of Pending Patent US11/775,572, 2008

### Conference Papers

18. R Bhargava, **B. J. Davis**, “*Histologic models for optical tomography and spectroscopy of tissues*,” SPIE Photonics West, San Jose, California, USA, 2009
17. **B. J. Davis**, P. S. Carney, “*Characterization of scattering from nanoparticles using far-field interferometric microscopy*,” OSA Frontiers in Optics, Rochester, New York, USA 2008
16. R. W. Schoonover, **B. J. Davis**, R. A. Bartels, P. S. Carney, “*Partially coherent cyclostationary pulses in Young’s interference experiment*,” OSA Frontiers in Optics, Rochester, New York, USA 2008
15. D. L. Marks, T. S. Ralston, **B. J. Davis**, P. S. Carney, S. A. Boppart, “*Interferometric synthetic aperture microscopy: tissue structure inferred by computed imaging techniques*,” (invited), SPIE Photonics West, San Jose, California, USA, 2008
14. R. W. Schoonover, **B. J. Davis**, R. A. Bartels, P. S. Carney, “*Optical interferometry with pulsed fields*,” OSA Frontiers in Optics, San Jose, California, USA, 2007
13. **B. J. Davis**, T. S. Ralston, D. L. Marks, S. A. Boppart, P. S. Carney, “*Interferometric synthetic aperture microscopy: physics-based image reconstruction from optical coherence tomography data*,” IEEE International Conference on Image Processing, San Antonio, Texas, USA, 2007
12. R. W. Schoonover, **B. J. Davis**, R. A. Bartels, P. S. Carney, “*Optical interferometry with pulsed fields*,” OSA Rochester Conference on Coherence and Quantum Optics, Rochester, New York, USA, 2007
11. **B. J. Davis**, P. S. Carney, A. K. Swan, M. S. Ünlü, W. C. Karl, B. B. Goldberg, “*Fluorescence imaging with nanometer precision using spectral self-interference microscopy*,” IEEE International Conference on Electromagnetic Near-Field Characterization and Imaging, St. Louis, Missouri, USA, 2007
10. P. S. Carney, **B. J. Davis**, T. S. Ralston, D. L. Marks, S. A. Boppart, “*Interferometric synthetic aperture microscopy*,” (invited), OSA Computational Optical Sensing and Imaging, Vancouver, British Columbia, Canada, 2007
9. **B. J. Davis**, T. S. Ralston, D. L. Marks, S. A. Boppart, P. S. Carney, “*Polarimetric interferometric synthetic aperture microscopy: vectorial computed imaging from optical coherence tomography data*,” OSA Computational Optical Sensing and Imaging, Vancouver, British Columbia, Canada, 2007
8. **B. J. Davis**, W. C. Karl, A. K. Swan, M. S. Ünlü, B. B. Goldberg, “*Making use of rejected light — improved imaging with multi-channel detection in confocal and 4Pi microscopy*,” OSA Frontiers in Optics, Rochester, New York, USA, 2006
7. **B. J. Davis**, M. S. Ünlü, A. K. Swan, B. B. Goldberg, W. C. Karl, “*Using multi-element detectors to create optimal apertures in confocal microscopy*,” Annual Meeting of the IEEE Lasers and Electro-Optics Society, Sydney, Australia, 2005
6. **B. J. Davis**, W. C. Karl, B. B. Goldberg, A. K. Swan, M. S. Ünlü, “*Using out-of-focus light to improve image acquisition time in confocal microscopy*,” SPIE Photonics West, San Jose, California, USA, 2005
5. **B. J. Davis**, W. C. Karl, B. B. Goldberg, A. K. Swan, M. S. Ünlü, “*Sampling below the Nyquist rate in interferometric fluorescence microscopy with multi-wavelength measurements to remove aliasing*,” IEEE Digital Signal Processing Workshop, Santa Fe, New Mexico, USA, 2004
4. **B. J. Davis**, W. C. Karl, A. K. Swan, B. B. Goldberg, M. S. Ünlü, M. B. Goldberg, “*Reconstruction of objects with a limited number of non-zero components in fluorescence microscopy*,” SPIE Photonics West, San Jose, California, 2004
3. B. B. Goldberg, A. K. Swan, L. Moiseev, M. Dogan, W. C. Karl, **B. J. Davis**, C. R. Cantor, S. B.

- Ippolito, S. A. Thorne, M. G. Eraslan, Z. Liu, M. B. Goldberg, M. S. Ünlü, Y. Leblebici, “*Seeing inside chips and cells: high-resolution subsurface imaging of integrated circuits, quantum dots and subcellular structures*,” IEEE Quantum Electronics Conference, San Francisco, California, USA, 2004
2. **B. J. Davis**, P. Gough, B. Hunt, “*Sea surface simulator for testing a synthetic aperture sonar*,” Impact of Littoral Environmental Variability on Acoustic Predictions and Sonar Performance (Kluwer), La Spezia, Italy, 2002
  1. **B. J. Davis**, E. Kim, J. R. Piepmeier, “*Stochastic modeling of correlation radiometer signals*,” IEEE Antennas and Propagation Society International Symposium, Boston, Massachusetts, USA, 2001

#### **Magazine and News Articles**

1. T. S. Ralston, S. G. Adie, D. L. Marks, **B. J. Davis**, P. S. Carney, S. A. Boppart, “*Real-time interferometric synthetic aperture microscopy for clinical applications*,” Optics and Photonics News, Vol. 19, 2008, p. 32

#### **Book Chapters**

1. S. G. Adie, **B. J. Davis**, T. S. Ralston, D. L. Marks, P. S. Carney, S. A. Boppart, “*Interferometric Synthetic Aperture Microscopy*,” in *Biomedical Applications of Light Scattering*, McGraw-Hill, (in press)

#### **Invited Talks**

7. “*Computational microscopy: using modeling and inference to improve optical sensing*,” May 2009, University of Wisconsin, Milwaukee
6. “*Examining tissue with infrared microspectroscopy: challenges and opportunities*,” May 2009, Synchrotron Radiation Center, Stoughton, Wisconsin
5. “*Computational imaging using optical interference*,” March 2009, University of Arkansas at Little Rock, and April 2009, University of Massachusetts, Amherst
4. “*Interference and computed imaging*,” October 2008, University of Illinois at Urbana-Champaign, Signal Processing Seminar, and University of California, Merced, Applied Math and Physics Seminar
3. “*Characterizing nanoparticles using scattering and coherent confocal microscopy*,” October 2008, Frontiers of Nanoscale Spectroscopy and Tomography Workshop, Inlet, New York
2. “*New directions in coherent microscopy: nanoparticle polarizability determination and interferometric synthetic aperture microscopy*,” March 2008, University of Central Florida, and April 2008, Colorado State University
1. “*Computed optical imaging and inference from interferometric spectroscopic data*,” March 2008, Colorado School of Mines