DANIEL R. FUHRMANN

Department of Electrical and Computer Engineering
Michigan Technological University
1400 Townsend Drive
Houghton, MI 49931
(tel) 906-487-2871
(fax) 906-487-2949
(e-mail) fuhrmann@mtu.edu

Education

Ph.D., Princeton University, 1984. Department of Electrical Engineering and Computer Science, program in Information Science and Systems. Dissertation title: *Fast Eigenvector Methods for Digital Signal Processing*. Advisor: Prof. Bede Liu.

M.S.E., M.A., Princeton University, 1982.

B.S.E.E. *cum laude*, Washington University, 1979.

Employment History

2008-Present. Professor and Chair, Department of Electrical and Computer Engineering, Michigan Technological University, Houghton, MI. Administration of academic department with 28 full-time faculty members, 600 undergraduate students, 160 graduate students, and annual research expenditures of approximately $3.0M. Regular communication and interaction with all stakeholders in the department's success, including faculty, students, university and college administration, development, alumni, external advisory board, industry representatives, and research sponsors. Research and teaching in statistical signal and image processing and related topics.

2005-2008. Professor, Department of Electrical and Systems Engineering, Washington University, St. Louis, MO. Taught undergraduate and graduate courses in introductory electrical and computer engineering, communication theory, signal processing, probability and stochastic processes, statistical signal processing and related topics; conducted and supervised research in statistical signal and image processing and related topics; service to department and to Washington University.

1990-2005. Associate Professor, Department of Electrical Engineering (now Department of Electrical and Systems Engineering since 2003).

2000-2001. Sabbatical leave, Departamento Electrotecnica, Universidad Nacional de La Plata, La Plata, Argentina. Teaching and research in signal and image processing under the auspices of a Fulbright Scholarship.

1984-1990. Assistant Professor, Department of Electrical Engineering, Washington University, St. Louis, MO.

Summer 1987. ASEE/Navy Summer Faculty Research Fellow, Naval Underwater Systems Center, New London, CT. Comparison and evaluation of adaptive beamforming algorithms

using towed-array sea-test data. Supervisor: Dr. Norman Owsley.

1984-1987. Research Associate, Biomedical Computer Laboratory, Washington University School of Medicine, St. Louis, MO. Conducted and supervised research in graphics and image processing for biomedical applications.

1982-1984. Assistant Master, Princeton Inn College, Princeton University. Live-in position, assistance in general administration of residential college with 450 undergraduates.

Summer 1981. Tektronix, Inc., Beaverton, OR. Implementation of maximum-entropy spectrum estimation algorithms for digital spectrum analyzer.

1979-1980. Electrical Engineer, Telex Computer Products, Tulsa, OK. Digital circuit design and development of tape drive and tape drive formatter products.

Summer 1978. McDonnell-Douglas Astronautics Co., St. Louis, MO. Student co-op position in Laser Communications program.

Honors and Awards

IEEE Fellow, "for contributions to adaptive radar signal processing"

Distinguished Lecturer, 2006 IEEE Workshop on Sensor Array and Multichannel Processing, July 2006

Fulbright Scholarship, Universidad National de La Plata, Argentina, 2000-2001

IEEE SSAP-98 Recognition Award, 1998

Outstanding Professor, Eta Kappa Nu (Washington University Chapter), 1988

Schlumberger Foundation Fellowship, 1980-1981

Eta Kappa Nu

Tau Beta Pi

Daniel R. Fuhrmann
Publications

Journal Articles

D. Fuhrmann, "On an Approximate Subspace Method for Eigenfilter Computation", *IEEE Trans. Acoustics, Speech, and Signal Processing*, vol. ASSP-34, pp. 205-207, February 1986.

D. Fuhrmann and B. Liu, "Rotational Search Methods for Adaptive Pisarenko Harmonic Retrieval", *IEEE Trans. Acoustics, Speech, and Signal Processing*, vol. ASSP-34, pp. 1550-1565, December 1986.

M. Miller, B. Roysam, J. Saffitz, K. Larson, D. Fuhrmann, and L. Thomas, Jr., "A New Method for the Analysis of Electron Microscopic Autoradiographs", *Biotechniques*, vol. 5, no. 4, May 1987.

D. Fuhrmann, M. Brown, M. Miller, B. Roysam, J. Saffitz, and L. Thomas, Jr., "A Data Acquisition System for Maximum-Likelihood Analysis of Electron Microscope Autoradiographs", *J. Electron Microscopy Techniques*, vol. 7, no. 3, pp. 199-204, November 1987.

D. Fuhrmann, "An Algorithm for Subspace Computation, with Applications in Signal Processing", *SIAM J. Matrix Analysis and Applications*, April 1988, also in *SIAM Proc. Linear Algebra in Signals, Systems, and Control*, B. N. Datta, ed., SIAM, 1988.

D. Fuhrmann and M. Miller, "On the Existence of Positive Definite Maximum Likelihood Estimates of Structured Covariance Matrices", *IEEE Trans. Information Theory*, vol. 34, no. 4, pp. 722-729, July 1988 (with correction, *IEEE Trans. Information Theory*, to appear).

D. Fuhrmann, "Quadtree Traversal Algorithms for Pointer-Based and Depth-First Representations", *IEEE Trans. Pattern Analysis and Machine Intelligence*, vol. 10, no. 6, pp. 955-960, November 1988.

M. Miller and D. Fuhrmann, "Maximum-Likelihood Narrowband Direction-Finding and the EM Algorithm", *IEEE Trans. Acoustics, Speech, and Signal Processing*, vol. 38, no. 9, pp. 1560-1577, September 1990.

Q. Wu and D. Fuhrmann, "A Parametric Method for Determining the Number of Signals in Narrowband Direction-Finding", *IEEE Trans. Signal Processing*, vol. 39, no. 8, pp. 1848-1857, August 1991.

D. Fuhrmann, "Application of Toeplitz Covariance Estimation to Adaptive Beamforming and Detection", *IEEE Trans. Signal Processing*, vol. 39, no. 10, pp. 2194-2198, October 1991.

F. Robey, D. Fuhrmann, E. Kelly, and R. Nitzberg, "A CFAR Adaptive Matched Filter Detector", *IEEE Trans. Aerospace and Electronic Systems*, vol. 28, no. 1, pp. 208-216, January 1992.

A. Kumar, D. Fuhrmann, M. Frazier, and B. Jawerth, "A New Transform for Time-Frequency Analysis", *IEEE Trans. Signal Processing*, vol. 40, no. 7, pp. 1697-1707, July 1992.

T. Barton and D. Fuhrmann, "Covariance Structures for Multidimensional Data", *Multidimensional Systems and Signal Processing*, vol. 4, pp. 111-123, 1993.

D. Fuhrmann, "Estimation of Sensor Gain and Phase", *IEEE Trans. Signal Processing*, vol. 42, no. 1, pp. 77-87, January 1994.

D. Fuhrmann, J. Baro, and J. Cox, "Experimental Evaluation of Psychophysical Distortion Metrics for JPEG-Encoded Images", *J. Electronic Imaging*, vol. 4, no. 4, pp. 397-406, October 1995.

W. Huang, Z. Yin, D. Fuhrmann, D. States, and L. Thomas, Jr., "A New Method to Determine the Matrix in 4-Dye Fluorescence-based DNA Sequencing", *Electrophoresis*, vol. 18, no. 1, pp. 23-25, January 1997.

M. Bakshi and D. Fuhrmann, "Improving the Visual Quality of JPEG-Encoded Images via Companding", *J. Electronic Imaging*, vol. 6, no. 2, April 1997.

W. Huang, D. Fuhrmann, D. Politte, D. States, and L. Thomas, Jr., "Filter-Matrix Estimation in Automated DNA Sequencing", *IEEE Trans. Biomedical Engineering*, vol. 45, no. 4, pp. 422-428, April 1998.

D. Fuhrmann *et al.*, "Software for Automated Analysis of DNA Fingerprinting", *Genome Research*, vol. 13, no. 5, pp. 940-953, May 2003.

D. Fuhrmann and W. Smith, "Empirical Modeling and Calibration of Fourier Transform Spectrometers", *Optical Engineering*, vol. 42, no. 8, pp. 2268-2276, August 2003.

D. Fuhrmann *et al.*, "Spectrum Estimation from Quantum-Limited Interferograms", *IEEE Trans. Signal Processing*, vol. 52, no. 4, pp. 950-961, April 2004.

D. Rieken and D. Fuhrmann, "Generalizing MUSIC and MVDR for Multiple Noncoherent Arrays", *IEEE Trans. Signal Processing*, vol. 52, no. 4, pp. 2396-2406, September 2004.

G. San Antonio, D. Fuhrmann, and F. Robey, "MIMO Radar Ambiguity Functions," *IEEE J. Selected Topics in Signal Processing*, vol. 1, no. 1, pp. 167-177, June 2007.

D. Fuhrmann, "Numerically Stable Implementations of the Structured Covariance EM Algorithm," *SIAM J. Matrix Analysis and Applications*, vol. 29, no. 3, pp. 855-869, August 2007

A. Roncagliolo, J. Garcia, P. Mercader, D. Fuhrmann, C. Muravchik, "Maximum-Likelihood Attitude Estimation using GPS Signals," *Digital Signal Processing*, vol. 17, pp. 1089-1100, November 2007.

D. Fuhrmann and G. San Antonio, "Transmit Beamforming for MIMO Radar Systems using Signal Cross-Correlation," *IEEE Trans. Aerospace and Electronic Systems*, vol. 44, no. 1, pp. 1-16, January 2008.

D. Fuhrmann, J. P. Browning, and M. Rangaswamy, "Signaling Strategies for the Hybrid MIMO Phased-Array Radar," *IEEE J. Selected Topics in Signal Processing*, vol. 4, no. 1, pp. 66-78, February 2010.

Book Chapters

M. Miller, D. Fuhrmann, J. O'Sullivan, and D. Snyder, "Maximum-Likelihood Methods for Toeplitz Covariance Estimation and Radar Imaging", in *Advances in Spectrum Estimation and Array Processing*, S. Haykin, ed., Prentice-Hall, New Jersey, 1991.

D. Fuhrmann, "Complex Random Variables and Stochastic Processes", in V. Madisetti and D. Williams, eds., *Digital Signal Processing Handbook*, CRC Press, 1998.

G. San Antonio, D. Fuhrmann, and F. Robey, "MIMO Ambiguity Functions," in *MIMO Radar Signal Processing*, J. Li and P. Stoica, eds., Wiley, 2008.

Peer-Reviewed Conference Presentations

D. Fuhrmann and B. Liu, "Approximating the Eigenvectors of a Symmetric Toeplitz Matrix", *Proc. 21st Allerton Conf. on Communication, Control, and Computing*, University of Illinois, October 1983.

D. Fuhrmann and B. Liu, "An Iterative Algorithm for Finding the Minimum Eigenvalue of a Symmetric Matrix", *Proc. IEEE ICASSP 84*, San Diego, CA, April 1984.

D. Fuhrmann and B. Liu, "A Perturbation Approach to Improving Pisarenko Harmonic Retrieval", *Proc. 22nd Ann. Allerton Conf. on Communication, Control, and Computing*, University of Illinois, October 1984.

D. Fuhrmann, "Application of Rotational Search Methods to Adaptive Pisarenko Harmonic Retrieval", *1985 Intl. Symp. Information Theory*, Brighton, England, June 1985.

D. Fuhrmann, "Iterative Methods for Subspace Computation", *Proc. 23rd Allerton Conf. on Communication, Control, and Computing*, University of Illinois, October 1985.

D. Fuhrmann, "An Algorithm for Subspace Computation, with Applications in Signal Processing", *SIAM Conf. on Linear Algebra in Signals, Systems, and Control*, Boston, MA, August 1986.

D. Fuhrmann, "Encoding Biomedical Images with Quadtrees", *Proc. 24th Allerton Conf. on Communication, Control, and Computing*, University of Illinois, October 1986.

D. Fuhrmann and M. Miller, "On the Existence of Positive Definite Maximum Likelihood Estimates of Structured Covariance Matrices", *Proc. 1987 Conf. Information Science and Systems*, Johns Hopkins University, March 1987.

M. Miller and D. Fuhrmann, "Maximum Likelihood Direction-of-Arrival Estimation for Multiple Narrowband Signals in Noise", *Proc. 1987 Conf. Information Science and Systems*, Johns Hopkins University, March 1987.

D. Fuhrmann, "Adaptive MUSIC", *SPIE Proc.*, vol. 826, San Diego, CA, August 1987.

D. Fuhrmann and M. Miller, "An EM Algorithm for Estimating the Directions-of-Arrival of Multiple Narrowband Signals in Noise", *SPIE Proc.*, vol. 826, San Diego, CA, August 1987.

D. Fuhrmann and N. Owsley, "Comparison and Evaluation of Adaptive Beamforming Algorithms Using Towed Array Sea Test Data", *EEE Workshop on Underwater Acoustic Signal Processing*, University of Rhode Island, September 1987.

D. Fuhrmann, M. Turmon, and M. Miller, "Efficient Implementation of the EM Algorithm for Toeplitz Covariance Estimation", *Proc. 1988 Conf. Information Science and Systems*, Princeton University, March 1988.

D. Fuhrmann, "Progress in Structured Covariance Estimation", *Proc. 4th Annual ASSP Workshop on Spectrum Estimation and Modeling*, Minneapolis, MN, August 1988.

Q. Wu and D. Fuhrmann, "A Parametric Method for Determining the Number of Signals", *Proc. 26th Allerton Conf. on Communication, Control, and Computing*, University of Illinois, September 1988.

D. Fuhrmann, A. Kumar, and J. Cox, "Compact Functions and the Frazier-Jawerth Transform", *Proc. IEEE 6th Multidimensional Signal Processing Workshop*, Pacific Grove, CA, September 1989.

D. Fuhrmann and M. Miller, "Maximum-Likelihood Wideband Direction-of-Arrival Estimation", *Proc. IEEE 6th Multidimensional Signal Processing Workshop*, Pacific Grove, CA, September 1989.

Q. Wu and D. Fuhrmann, "A Robust Estimator for Direction Finding with Hierarchical Prior", *Proc. IEEE 6th Multidimensional Signal Processing Workshop*, Pacific Grove, CA, September 1989.

D. Fuhrmann and S. Jacobs, "Application of Structured Covariance Estimation to Adaptive Beamforming", *IEEE ASSP Workshop on Underwater Acoustic Signal Processing*, University of Rhode Island, October 1989.

F. Robey and D. Fuhrmann, "Structured Covariance and Signal Estimation Adaptive Beamforming and Detection", *Proc. 1990 Conf. Information Science and Systems*, Princeton University, March 1990.

A. Kumar and D. Fuhrmann, "The Frazier-Jawerth Transform", *Proc. ICASSP 90*, Albuquerque, NM, April 1990.

D. Fuhrmann and A. Kumar, "The Discrete Frazier-Jawerth Transform", *SIAM Annual Meeting*, Chicago, IL, July 1990.

D. Fuhrmann and T. Barton, "Estimation of Block-Toeplitz Covariance Matrices", *24th Asilomar Conf. Signals, Systems, and Computers*, Pacific Grove, CA, November 1990.

D. Fuhrmann, "Estimation of Sensor Gain and Phase Using Known Field Covariance", *Proc. ICASSP 91*, Toronto, Ontario, May 1991.

F. Robey and D. Fuhrmann, "Structured Covariance Estimation via Maximal Representation of Convex Sets", *Proc. ICASSP 91*, Toronto, Ontario, May 1991

D. Fuhrmann, "Characterization and Estimation of Angular Parameters", *IEEE Workshop on Underwater Acoustic Signal Processing*, University of Rhode Island, October 1991.

T. Barton and D. Fuhrmann, "Covariance Structures for Multidimensional Data", *25th Asilomar Conf. Signals, Systems, and Computers*, Pacific Grove, CA, November 1991.

M. Koerber and D. Fuhrmann, "Array Calibration by Fourier Series Parameterization: Deterministic Maximum Likelihood Solution", *1992 Conf. Information Science and Systems*, Princeton University, March 1992.

D. Fuhrmann, "Covariance Estimation Problems in Signal Processing", *7th Int. Symposium on Multivariate Statistics*, The Pennsylvania State University, May 1992.

M. Koerber and D. Fuhrmann, "Array Calibration by Fourier Series Parameterization: Stochastic Maximum Likelihood Solution", *6th IEEE SP Workshop on Statistical Signal and Array Processing*, Victoria, BC, October 1992.

D. Fuhrmann and T. Barton, "New Results in the Existence of Complex Covariance Estimates", *26th Asilomar Conf. Signals, Systems, and Computers*, Pacific Grove, CA, November 1992.

D. Fuhrmann, J. Baro, and J. Cox, "Experimental Evaluation of Psychophysical Distortion Metrics for JPEG-Encoded Images", *Human Vision, Visual Processing, and Digital Display IV*, B. Rogowitz and J. Allebach, Eds., Proc. SPIE 1913, February 1993.

M. Koerber and D. Fuhrmann, "Array Calibration by Fourier Series Parameterization: Scaled Principal Components Method", *Proc. ICASSP 93*, Minneapolis, MN, April 1993.

D. Michal and D. Fuhrmann, "Multiple Target Detection for an Antenna Array Using Outlier Rejection Methods", *Proc. ICASSP 93*, Minneapolis, MN, April 1993.

T. Barton and D. Fuhrmann, "Covariance Estimation for Multidimensional Data Using the EM Algorithm", *Proc. 27th Asilomar Conf. Signals, Systems, and Computers*, Pacific Grove, CA, November 1993.

D. Fuhrmann, "Covariance Estimation in Non-Stationary Interference", *Proc. 27th Asilomar Conf. Signals, Systems, and Computers*, Pacific Grove, CA, November 1993.

D. Fuhrmann, "Beamforming for Sensor Arrays with Polarization Diversity", *Proc. 2nd Workshop on Adaptive Sensor Array Processing*, MIT Lincoln Laboratory, Lexington, MA, March 1994.

F. Robey, D. Fuhrmann, and S. Krich, "Array Calibration Utilizing Clutter Scattering", *Proc. 7th IEEE SP Workshop on Statistical Signal and Array Processing*, Quebec City, Canada, June 1994.

M. Koerber and D. Fuhrmann, "Radar Antenna Calibration Using Range-Doppler Data", *Proc. 7th IEEE SP Workshop on Statistical Signal and Array Processing*, Quebec City, Canada, June 1994.

D. Fuhrmann, "The Quadratic Data-Fitting Problem: Estimation of Linear Model Parameters from Observations in Multiplicative Noise", *Proc. 3rd Workshop on Adaptive Sensor Array Processing*, MIT Lincoln Laboratory, Lexington, MA, March 1995.

J. Pierre and D. Fuhrmann, "Considerations in the Autocalibration of Quadrature Receivers", *Proc. ICASSP 95*, Detroit, MI, May 1995.

D. Fuhrmann, H. Moon, and A. Srivastava, "Subspace Tracking via Rigid Body Dynamics", *Proc. 8th IEEE SP Workshop on Statistical Signal and Array Processing*, Corfu, Greece, June 1996.

S. Kwon and D. Fuhrmann, "Identifiability Problem in Blind Separation of Synchronous BPSK Signals in Digital Wireless Communication", *Proc. 35th Allerton Conf. Communications, Control and Computing*, University of Illinois, September 1997.

D. Fuhrmann, "A Geometric Approach to Subspace Tracking", *Proc. 31st Asilomar Conf. Signals, Systems, and Computers*, Pacific Grove, CA, November 1997.

D. Fuhrmann, "The Subspace Tracking Loop", *Proc. 6th Workshop on Adaptive Sensor Array Processing*, MIT Lincoln Laboratory, Lexington, MA, March 1998.

S. Kwon and D. Fuhrmann, "Sampling Theorems for Linear Time-Varying Systems with Bandlimited Inputs", *Proc. ICASSP 99*, Phoenix, AZ, March 1999.

D. Snyder, J. O'Sullivan, and D. Fuhrmann, "Estimation of Overlapping Spectral Signatures from Hyperspectral Data", in *Automatic Target Recognition IX*, F. Sadjadi, ed., Proc. SPIE vol. 3718, pp. 470-479, April 1999.

D. Fuhrmann, "A Simplex Shrink-Wrap Algorithm", in *Automatic Target Recognition IX*, F. Sadjadi, ed., Proc. SPIE vol. 3718, pp. 501-511, April 1999.

D. Harres, D. Fuhrmann, and W. Smith, "Compensation for Optical Distortion in Fourier Transform Spectrometers", in *Imaging Spectrometry V*, M. Descour, S. Shen, eds., Proc. SPIE vol. 3753, pp. 142-151, July 1999.

D. Fuhrmann and D. Rieken, "Array Calibration for Circular-Array STAP Using Clutter Scattering and Projection-Matrix Fitting", *Proc. 8th Workshop on Adaptive Sensor Array Processing*, MIT Lincoln Laboratory, Lexington, MA, March 2000.

D. Rieken and D. Fuhrmann, "Interferometric Imaging of Rotating Objects Using Synthetic Aperture Techniques", *Proc. 1st IEEE SP Workshop on Sensor Array and Multichannel*, Cambridge, MA, March 2000.

D. Fuhrmann, J. O'Sullivan, D. Snyder, and W. Smith, "Spectrum Estimation from Quantum-Limited Interferograms", *Proc. 1st IEEE SP Workshop on Sensor Array and Multichannel*, Cambridge, MA, March 2000.

D. Rieken, D. Fuhrmann, and A. Lanterman, "Spatial Spectrum Estimation for Time-Varying Arrays using the EM Algorithm", *Proc. 38th Ann. Allerton Conf. Communications, Control, and Computing*, University of Illinois, October 2000.

D. Rieken and D. Fuhrmann, "Constrained Maximum-Likelihood Covariance Estimation for Time-Varying Arrays", *Proc. 9th Workshop on Adaptive Sensor Array Processing*, MIT Lincoln Laboratory, Lexington, MA, March 2001.

P. Roncagliolo, J. Areta, D. Fuhrmann, and C. Muravchik, "Attitude Estimation with GPS: Steepest Descent Algorithms on SO(3)", Proc. 2nd IEEE South American Workshop on Circuits and Systems, Rio de Janeiro/Buenos Aires, November 2001.

D. Rieken and D. Fuhrmann, "Statistical Signal Processing for Time-Varying Arrays", *Proc. 10th Workshop on Adaptive Sensor Array Processing*, MIT Lincoln Laboratory, Lexington, MA, March 2002.

P. Roncagliolo, J. Areta, D. Fuhrmann, and C. Muravchik, "Planteo Geometrico de la Estimacion de Orientacion con Senales de GPS", Actas del XVIII Congreso Argentino de Control Automatico (AADECA 2002), Buenos Aires, September 2002.

D. Fuhrmann, "Automated Image Analysis for DNA Fingerprinting", *Proc. Workshop on Genomics, Signal Processing and Statistics*, Raleigh, NC, October 2002.

D. Fuhrmann, "Detection of Multiple Overlapping Bands of Known Amplitude, with Application to DNA Fingerprinting", *Proc. 36th Asilomar Conf. on Signals, Systems and Computers*, Pacific Grove, CA, November 2002.

D. Rieken and D. Fuhrmann, "Generalizing MVDR and MUSIC for Distributed Arrays", *Proc. 36th Asilomar Conf on Signals, Systems, and Computers*, Pacific Grove, CA, November 2002.

D. Fuhrmann, "Active-Testing Surveillance Systems, or, Playing Twenty Questions with a Radar", *Proc. 11th Workshop on Adaptive Sensor Array Processing*, MIT Lincoln Laboratory, Lexington, MA, March 2003.

D. Fuhrmann, "Toward A New Paradigm for Airborne Surveillance Radar," *Proc. 2nd Ann. DARPA Workshop on Knowledge-Aided Sensor Signal Processing and Expert Reasoning (KASSPER)*, Las Vegas, NV, April 2003.

L. Boggio and D. Fuhrmann, "Active-Testing Surveillance for Multiple Target Detection with Multiple Hypotheses", *Proc. 2003 IEEE Workshop on Statistical Signal Processing*, St. Louis, MO, September 2003.

D. Fuhrmann and L. Boggio, "Radar Imaging from Multiple Viewpoints and Multiple Noncoherent Datasets", *Proc. 2004 Conf. Information Science and Systems*, Princeton University, March 2004.

D. Fuhrmann and G. San Antonio, "Transmit Beamforming for MIMO Radar Systems using Partial Signal Correlation," *Proc. 38th Asilomar Conf. on Signals, Systems, and Computers*, Pacific Grove, CA, November 2004.

G. San Antonio and D. Fuhrmann, "Minimax Beampattern Synthesis for MIMO Radar Systems," *Proc. 2nd Tr-Service Waveform Diversity Workshop*, Huntsville, AL, March 2005.

D. Fuhrmann, L. Boggio, J. Maschmeyer, and R. Chamberlain, "Clutter Scattering Function Estimation and Ground Moving Target Detection from Multiple STAP Datacubes," *Proc. 2005 IEEE Intl. Conf. Acoustics, Speech, and Signal Processing (ICASSP)*, Philadelphia, PA, March 2005.

D. Fuhrmann, "Structured Covariance Estimation and Radar Imaging using Sparse Linear Models," *Proc. 1st IEEE Workshop on Computational Advances in Multi-Sensor Array Processing (CAMSAP)*, Puerto Vallarta, Mexico, December 2005.

G. San Antonio and D. Fuhrmann, "Beampattern Synthesis for Wideband MIMO Radar Systems," *Proc. 1st IEEE Workshop on Computational Advances in Multi-Sensor Array Processing (CAMSAP)*, Puerto Vallarta, Mexico, December 2005.

G. San Antonio, D. Fuhrmann, and F. Robey, "MIMO Radar Ambiguity Functions," *Proc. 40th Asilomar Conf. on Signals, Systems, and Computers*, Pacific Grove, CA, November 2006.

G. San Antonio and D. Fuhrmann, "Ambiguity Functions and Signal Design for MIMO Radar Systems with Arbitrary Target Covariance," *Proc. 15th Workshop on Adaptive Sensor Array Processing (ASAP)*, MIT Lincoln Laboratory, Lexington, MA, June 2007.

D. Fuhrmann, "One-Step Optimal Measurement Selection for Linear Gaussian Estimation Problems," *Proc. 3rd Intl. Conf. Waveform Diversity and Design (WDD)*, Pisa, Italy, June 2007.

D. Fuhrmann, "Kalman Filter and Extended Kalman Filter Using One-Step Optimal Measurement Selection,", *Proc. 3rd Intl. Conf. Waveform Diversity and Design (WDD)*, Pisa, Italy, June 2007.

D. Fuhrmann, "On Adaptive Sensing of Complex Communication Channels," *Proc. 2nd IEEE Workshop on Computational Advances in Multi-Sensor Array Processing (CAMSAP)*, St. Thomas, U.S. Virgin Islands, December 2007.

D. Fuhrmann, "Steady-State Behavior of Discrete-Time Kalman Filter with One-Step Optimal Measurement Selection," *Proc. Workshop on Sensor, Signal, and Information Processing (SenSIP)*, Sedona, AZ, May 2008.

D. Fuhrmann, "Adaptive Sensing of Target Signature with Unknown Amplitude," *Proc. 42nd Asilomar Conf. on Signals, Systems, and Computers*, Pacific Grove, CA, October 2008.

Z. Zhang and D. Fuhrmann, "Complex Point Target Model for Multistatic Radar," *Proc. 42nd Asilomar Conf. on Signals, Systems, and Computers*, Pacific Grove, CA, October 2008.

P. Browning, D. Fuhrmann, and M. Rangaswamy, "A Hybrid MIMO Phased-Array Concept for Arbitrary Spatial Beampattern Synthesis," *Proc. 2009 IEEE DSP Workshop*, Marco Island, FL, January 2009.

D. Fuhrmann, P. Browning, and M. Rangaswamy, "Constant Modulus Partially Correlated Signal Design for Uniform Linear and Rectangular MIMO Radar Arrays," *Proc. 4th Intl. Conf. Waveform Diversity and Design (WDD)*, Orlando, FL, February 2009.

D. Fuhrmann, P. Browning, and M. Rangaswamy, "Ambiguity Function Analysis for the Hybrid MIMO Phased-Array Radar," *Proc. 2009 IEEE Radar Conf.*, Pasadena, CA, May 2009.

D. Fuhrmann, P. Browning, and M. Rangaswamy, "Advanced Signaling Strategies for the Hybrid MIMO Phased-Array Radar," *Proc. 2010 IEEE Radar Conf.*, Washington, DC, May 2010.

D. Fuhrmann and J. van der Laan, "Detection of Complex Point Targets in a MIMO Radar Systems with Distributed Assets and Partially Correlated Signals," *Proc. 2010 IEEE Radar Conf.*, Washington, DC, May 2010.

D. Fuhrmann, P. Browning, and M. Rangaswamy, "Adapting a MIMO/Phased-Array Radar Transmit Beampattern to Target Location," *Proc. 2nd Workshop on Cognitive Information Processing (CIP)*, Elba Island, Italy, June 2010.

Recent Conference Presentations without Proceedings

D. Fuhrmann *et al.*, "Automated Image Analysis for DNA Restriction-Fragment Mapping", *2000 Meeting on Genome Sequencing and Biology*, Cold Spring Harbor Laboratory, Cold Spring Harbor, NY, May 2000.

M. Marra *et al.*, "Fingerprinted BAC Clones for Sequencing the Mouse Genome", *2000 Meeting on Genome Sequencing and Biology*, Cold Spring Harbor Laboratory, Cold Spring Harbor, NY, May 2000.

J. Schein *et al.*, "Physical Map of the Mouse Genome", *2001 Meeting on Genome Sequencing and Biology*, Cold Spring Harbor Laboratory, Cold Spring Harbor, NY, May 2001.

S. Ness *et al.*, "Developing Computational Strategies for Constructing and Analyzing Physical Maps of Large Genomes", *2001 Meeting on Genome Sequencing and Biology*, Cold Spring Harbor Laboratory, Cold Spring Harbor, NY, May 2001.

D. Fuhrmann, "Structured Clutter Covariance Estimation for STAP using Digital Terrain Elevation Data", *1st Ann. DARPA Workshop on Knowledge-Aided Sensor Signal Processing and Expert Reasoning (KASSPER)*, Washington, DC, April 2002.

D. Fuhrmann, L. Boggio, J. Maschmeyer, R. Chamberlain, and J. O'Sullivan, "Clutter Scattering Function Estimation and Moving Target Detection from Multiple STAP Datacubes", *3rd Ann. DARPA Workshop on Knowledge-Aided Sensor Signal Processing and Expert Reasoning (KASSPER)*, Clearwater, FL, April 2004.

R. Chamberlain, D. Fuhrmann, J. Maschmeyer, and L. Boggio, "Parallel MATLAB Computation for Clutter Scattering Function Estimation and Moving Target Detection", *8th Ann. Workshop on High-Performance Embedded Computing (HPEC)*, MIT Lincoln Laboratory, Lexington, MA, September 2004.

D. Fuhrmann, "Optimal Linear Measurements for Multivariate Gaussian Estimation," *13th Workshop on Adaptive Sensor Array Processing (ASAP)*, MIT Lincoln Laboratory, Lexington, MA, June 2005.

D. Fuhrmann, "Structured Covariance Estimation: Theory, Applications, and Recent Results," Distinguished Lecture, *2006 IEEE Workshop on Sensor Array and Multichannel Processing (SAM-2006)*, Boston, MA, July 2006.

Daniel R. Fuhrmann
Funded Research Projects

"Application of Structured Covariance Estimation to Adaptive Detection", MIT Lincoln Laboratory, 1/6/88-5/31/89.

"Comparison of Direction-Finding Algorithms in Multi-Target Scenario", Naval Underwater Systems Center, 6/1/88-8/31/88.

"A Wideband Compensation Filter", McDonnell Aircraft Company (Joseph A. O'Sullivan, co-PI), 9/1/88-5/31/89.

"Advanced Techniques for Adaptive Detection", MIT Lincoln Laboratory, 6/1/89-10/31/90.

"Multiple Target Direction-of-Arrival Estimation", E-Systems, Inc. (Michael I. Miller, co-PI), 8/15/89-12/15/89.

"Detection and Estimation Problems for Sensor Arrays", Office of Naval Research, 01/01/90-01/31/93.

"Image-Estimation Methods for Automated DNA Sequencing", National Institutes of Health (David States, co-PI), 12/01/93-11/30/96.

"Geometric Methods for Subspace Tracking", Office of Naval Research, 7/01/97-9/30/99.

"Sequencing the Human Genome" (Robert Waterston, WU Genome Sequencing Center, PI) and "Sequencing the Mouse Genome" (Richard Wilson, WU Genome Sequencing Center, PI), National Institutes of Health, 4/1/98-3/30/03.

"Statistical Signal Processing Methods for Hyperspectral Imaging", The Boeing Corporation, Washington University Graduate Education and Research Partnership (Donald L. Snyder, co-PI), 7/1/98-6/30/00.

"Nonstationary Covariance Estimation and Array Calibration for Circular-Array STAP", Office of Naval Research, 5/1/99-12/31/99.

"Radar Studies", MIT Lincoln Laboratory, 5/1/99-4/30/01.

"Stuctured Clutter Covariance for STAP Using Terrain Elevation Data", Defense Advance Research Projects Agency, through a subcontract with SAIC, 8/20/02-11/30/02.

"Active-Testing Surveillance for Ground Moving Target Detection with Precise Geolocation", Defense Advanced Research Projects Agency, through a subcontract with the Air Force Research Laboratory, 2/14/03-8/31/04.

"Improvements in BAC Fingerprinting and End Sequencing", National Institutes of Health, subcontract with British Columbia Genome Sciences Centre, 4/01/03-3/31/06.

"Distributed Aperture Radar", MIT Lincoln Laboratory, 8/1/03-12/31/07.

"Adaptive Signal Processing and Waveform Design for Hybrid MIMO (ASP-WD)", Dynetics (Air Force prime), 12/16/08-12/15/10.

"Adaptive Sensing and Target Tracking for MIMO Radar Systems," Office of Naval Research, 2/1/09-9/30/11.

Daniel R. Fuhrmann

Doctoral Dissertations Supervised (Washington University)

Qianq Wu, *Array Signal Processing at Low Signal-to-Noise Ratio*, 1989

Arun Kumar, *Time-Frequency Analysis and Transform Coding*, 1990

Frank C. Robey, *A Covariance Modeling Approach to Adaptive Beamforming and Detection*, 1990

Michael A. Koerber, *Characterization and Calibration of Antenna Arrays for High-Resolution Direction-of-Arrival Estimation*, 1992

Debra P. Michal, *Multiple Target Detection for an Antenna Array*, 1993

Timothy A. Barton, *Covariance Estimation for Multidimensional Data*, 1993

Soonman Kwon, *Wireless Communication Channels and Blind Signal Separation*, 1999

David W. Rieken, *Statistical Signal Processing for Time-Varying Sensor Arrays*, 2002

Geoffrey A. San Antonio, *Waveform Design for Multiple-Input Multiple-Output Radar Systems*, 2007

Master's Theses Supervised (Washington University)

Weian Huang, *Preprocessing of Gel Images for Automated DNA Sequencing*, 1996

Lisandro Boggio, *Clutter Scattering Function Estimation and Multiple Ground Moving Target Detection from STAP Datacubes and Site-Specific Knowledge*, 2004

Christopher Wright, *Sparse Linear Transformations for Covariance Estimation*, 2007

Daniel R. Fuhrmann
Michigan Tech Teaching Experience

EE 2150 Introduction to Signal Processing (SP09)

EE 5500 Statistical Signal Processing (FL09, FL10)

Daniel R. Fuhrmann
Washington University Teaching Experience

*Indicates courses developed by Prof. Fuhrmann

***ESE 102 (formerly EE 180) Introduction to Electrical and Computer Engineering** (SP99, SP02, SP03, FL03, SP04, SP05, SP06, SP07). This is a new course representing a major shift in the undergraduate EE curriculum away from using EE 280, Introduction to Electrical Networks, as the entry point, and emphasizing the breadth of the electrical and computer engineering as it is practiced today. Combines theoretical work in electronic circuits, signals and systems, computer engineering, and communication systems with weekly laboratory exercises and a final design project. Developed in cooperation with the EE Undergraduate Committee and Prof. Richard Grodsky and first taught as EE 201, Introduction to Electrical Engineering, in the SP99 semester. Further developed by *ad hoc* committee in EE, and taught again on experimental basis in SP02 semester. Added as a required course in BSEE curriculum, replacing EE 250, Electrical Engineering Laboratory I, beginning in the 2002-03 academic year. Co-taught with Affiliate Prof. Chrysanthe Preza in the SP03 semester. Wrote course textbook covering all theoretical material and laboratory exercises.

***ESE 105 Introduction to Electrical and Systems Engineering** (FL07). A combined version of ESE 102 (above) and the introductory course in systems science and engineering.

EE 280 Introduction to Electrical Networks (SP94, SP95)

ESE/MATH 309 Matrix Algebra (SP07)

EE 350 Electrical Laboratory II (SP92, co-taught with Prof. Robert Gregory)

EE 379 Signal Analysis for Electronic Systems and Circuits (SP91, FL92, FL93, SP97)

EE 421 Communication Theory and Systems (SP85, SP86, SP87, SP88, SP89, SP90, SP96)

***EE 437 Signals and Systems Laboratory** (SP95, FL95, FL96, FL97, FL98, FL99, FL01). Developed in response to the need for a laboratory course in the signals and systems area to be included in the menu of laboratory courses used to satisfy BSEE degree requirements (two lab courses are required). Complements theoretical courses in signal and systems, control theory, digital signal processing, communication theory, and includes significant design experience. Initial planning and equipment acquisition with Prof. Robert Morley and Affiliate Prof. William Murphy, first co-taught with Prof. Murphy in the SP95 semester.

EE 445 Digital Signal Processing (FL92, FL93)

EE 455 Digital Systems Laboratory (FA88, co-taught with Mr. Russ Hermes)

EE 480 Senior Design Projects (SP88, SP96)

***E75 521 Matrix Computations in Signal Processing** (FA89, SP92). An advanced graduate course in numerical linear algebra, with applications in statistical signal processing. Efficient implementations of basic matrix-vector calculations, solutions of systems of linear equations, least-squares problems, eigenvalue and singular value decompositions. Based primarily on the text *Matrix Computations* by Golub and Van Loan.

EE 551A Probability and Stochastic Processes (FA84, FA85, FA86, FA87, FL91, FL94, FL02, FL06, FL07)

EE 552A Detection and Estimation Theory (SP93, SP95, SP00)

***EE 564 Statistical Signal Processing for Sensor Arrays** (FL87, FL90, SP94, FL97, FL05). An advanced graduate course in Prof. Fuhrmann's primary area of research. Covers complex multivariate statistical theory, adaptive detection and beamforming, direction finding, spatial spectrum estimation, eigenstructure techniques, selected special topics. First offered as E75 516, Advanced Topics in Signal and Image Processing, and co-taught with Prof. Martin Arthur in the FL87 semester.

ESE 581 Radar Systems (FL04)

***EE/CS 592 Digital Representation of Signals** (SP98, SP99). A graduate course in the theory of analog-to-digital conversion and data compression. Came out of joint work with Prof. Jerome Cox of the CS Department in wavelet-based image compression. Although taught several times previously by Prof. Cox, Prof. Fuhrmann's course development and treatment of the material is largely original and shaped the course as it is taught today by adjunct instructor James Meany.

Daniel R. Fuhrmann
Professional Service

Member, IEEE Signal Processing Society, Sensor Array and Multichannel Processing Technical Committee, 2005-present. Responsibilities include reviewing submissions to the IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP) and several smaller workshops.

Associate Editor, IEEE Transactions on Signal Processing, 2004-2007. Coordination of review of technical papers. Second term in this position.

Technical Program Committees

2011 IEEE Radar Conference, Kansas City, MO (Tutorials Chair)
2009 Workshop on Waveform Diversity and Design, Orlando, FL (Special Sessions Chair)
2007 Workshop on Adaptive Sensor Array Processing (ASAP), MIT Lincoln Laboratory
2007 Workshop on Waveform Diversity and Design, Pisa, Italy
2006 Asilomar Conf. Signals, Systems and Computers (Track Chair), Pacific Grove, CA
2006 Workshop on Adaptive Sensor Array Processing (ASAP), MIT Lincoln Laboratory
2005 Workshop on Adaptive Sensor Array Processing (ASAP), MIT Lincoln Laboratory
2001 Workshop on Adaptive Sensor Array Processing (ASAP), MIT Lincoln Laboratory
1994 Asilomar Conf. Signals, Systems and Computers, Pacific Grove, CA

General Chairman, 2003 IEEE Workshop on Statistical Signal Processing, St. Louis, MO. Primary responsibility for organization of 3-day technical workshop with 230 registered participants and budget of over $100K (including $67K of external support).

Guest Editor, Journal of the Franklin Institute, 2003. Special Issue on Genomics, Signal Processing, and Statistics.

Member, IEEE Signal Processing Society, Signal Processing Theory and Methods Technical Committee, 1999-2005. Responsibilities include reviewing multiple submissions to the IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP) and several smaller workshops.

Publications Chair, 1st Workshop on Genomics, Signal Processing, and Statistics, Raleigh, NC, 2002.

Consultant, Biotechniques (now Singulex), St. Louis, MO, 2000, 2003. Signal processing methods for single molecule detection.

Technical Program Chairman, 1998 IEEE Workshop on Statistical Signal and Array Processing, Portland, OR. Responsibility for selection of technical committee, coordination of reviews of contributed papers, selection of invited speakers, and setting final agenda.

Consultant, NewStar Collaborative Technologies, St. Louis, MO, 1995-96. Development of vocoder software based on Code Excited Linear Predication (CELP) standard.

Member, IEEE Signal Processing Society, Statistical Signal and Array Processing Technical Committee, 1992-1995.

Associate Editor, IEEE Transactions on Signal Processing, 1992-94. Coordination of reviews for about 30 technical papers over two-year period.

Consultant, MIT Lincoln Laboratory, 1987-1996. Advanced radar signal processing techniques for adaptive detection and space-time adaptive processing.

Reviewer, 1984-present. *IEEE Transactions on Signal Processing*, *IEEE Transactions on Aerospace and Electronic Systems*, and related or similar archival journals.