CURRICULUM VITAE

Karl Foster Warnick

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EDUCATION

Postdoc Electrical Engineering, 1998-2000
University of Illinois at Urbana-Champaign

Ph.D. Electrical Engineering, Aug. 1997
Brigham Young University, Provo, UT
Dissertation: "A Differential Forms Approach to Electromagnetics in Anisotropic Media"

B.S. Electrical Engineering and Mathematics, with University Honors, Dec. 1993
Brigham Young University

EXPERIENCE

6/06 to present	Associate Professor, Brigham Young University Department of Electrical and Computer Engineering
8/00 to 6/06	Assistant Professor, Brigham Young University Department of Electrical and Computer Engineering
6/98 to 8/00	Visiting Assistant Professor, University of Illinois Department of Electrical and Computer Engineering
1/98 to 8/00	Research Associate, University of Illinois Center for Computational Electromagnetics Department of Electrical and Computer Engineering
8/97 to 12/97	Research Associate, Brigham Young University Department of Electrical and Computer Engineering
5/97 to 6/97	Instructor, Brigham Young University, ECE Dept.
8/94 to 8/97	National Science Foundation Graduate Fellow, Brigham Young University

8/95 to 12/95	Teaching Assistant, Brigham Young University, ECE Dept.
4/92 to 8/94	Research Assistant, BYU Microwave Earth Remote Sensing Laboratory

BOOKS AND BOOK CHAPTERS

K. F. Warnick and P. Russer, *Problem Solving in Electromagnetics, Microwave Circuits, and Antenna Design for Communications Engineering*, Norwood, MA: Artech House, 372 pages, 2006.

K. F. Warnick and W. C. Chew, "Error analysis of surface integral equation methods," in W. C. Chew, J.-M. Jin, E. Michielssen, and J. Song, eds., *Fast and Efficient Algorithms in Computational Electromagnetics*, Norwood, MA: Artech House, pp. 203-278, 2001.

JOURNAL PAPERS

B. D. Jeffs and K. F. Warnick, "Unbiased PSD estimation for an adaptive array with moving interference," *IEEE Transactions on Signal Processing*, in review, 2007.

S. Lin, Y. Li, A. T. Woolley, M. L. Lee, H. D. Tolley, and K. F. Warnick, "Programmed elution and peak profiles in electric field gradient focusing, *Electrophoresis*, in review, 2007.

J. R. Nagel, K. F. Warnick, B. D. Jeffs, J. R. Fisher, and R. Bradley, "Experimental verification of RFI mitigation with an array feed," Radio Science, accepted, 2007.

J. T. Johnson, K. F. Warnick, P. Xu, and L. Tsang, "On the geometrical optics and physical optics approximations for scattering from exponentially correlated surfaces," *IEEE Transactions on Geoscience and Remote Sensin*, to appear, 2007.

K. F. Warnick and M. A. Jensen, "Optimal noise matching for mutually-coupled arrays," *IEEE Transactions on Antennas and Propagation*, to appear, 2007.

K. F. Warnick and B. D. Jeffs, "Gain and aperture efficiency for a reflector antenna with an array feed," *IEEE Antennas and Wireless Propagation Letters*, Vol. 5, No. 1, pp. 499-502, 2006.

K. F. Warnick and P. Russer, "Green's theorem in electromagnetic field theory," *Proceedings of the European Microwave Association*, Vol. 2, No. 2, pp. 141-146, June 2006.

K. F. Warnick and P. Russer, "Two, three, and four-dimensional electromagnetics using differential forms," *Turkish Journal of Electrical Engineering and Computer Sciences*, Vol. 14, No. 1, pp. 153-172, 2006.

F. W. Millet, K. F. Warnick, J. R. Nagel, and D. V. Arnold, "Physical optics-based electromagnetic bias theory with surface height-slope cross-correlation and hydrodynamic modulation," *IEEE Transactions on Geoscience and Remote Sensing*, Vol. 44, No. 6, pp. 1470-1483, June 2006.

K. F. Warnick, "An intuitive error analysis for FDTD and comparison to MOM," *IEEE Antennas and Propagation Magazine*, Vol. 47, No. 6, pp. 111-115, Dec. 2005.

A. J. Poulsen, B. D. Jeffs, K. F. Warnick, and J. R. Fisher, "Programmable real-time cancellation of GLONASS interference with the Green Bank Telescope," *Astronomical Journal*, Vol. 130, pp. 2916-2927, Dec. 2005.

F. W. Millet, K. F. Warnick, and D. V. Arnold, "Electromagnetic bias at off-nadir incidence angles," *Journal of Geophysical Research-Oceans*, Vol. 110, No. C09017, doi:10.1029/2004JC002704, 13 pages, 2005.

C. K. Hansen, K. F. Warnick, B. D. Jeffs, J. R. Fisher, and R. Bradley, "Interference mitigation using a focal plane array," *Radio Science*, Vol. 40, No. 5, doi:10.1029/2004RS003138, 14 pages, June 2005.

K. F. Warnick and M. A. Jensen, "Effect of mutual coupling on interference mitigation with a focal plane array," *IEEE Transactions on Antennas and Propagation*, Vol. 53, No. 6, pp. 2490-2498, Aug. 2005.

C. P. Davis and K. F. Warnick, "On the physical meaning of the Sobolev norm in error estimation," *Journal of the Applied Computational Electromagnetics Society*, Vol. 20, No. 2, pp. 144-150, July 2005.

K. F. Warnick, F. W. Millet, and D. V. Arnold, "Physical and geometrical optics for 2D rough surfaces with power-law height spectra," *IEEE Transactions on Antennas and Propagation*, Vol. 53, No. 3, pp. 922-932, Mar. 2005.

B. D. Jeffs, L. Li, and K. F. Warnick, "Auxiliary assisted interference mitigation for radio astronomy arrays," *IEEE Transactions on Signal Processing*, Vol. 53, No. 2, pp. 439-451, Feb. 2005.

C. P. Davis and K. F. Warnick, "Error analysis of 2D MoM for MFIE/EFIE/CFIE based on the circular cylinder," *IEEE Transactions on Antennas and Propagation*, Vol. 53, no. 1, pp. 321-331, Jan. 2005.

K. F. Warnick, S. J. Francom, Paul H. Humble, R. T. Kelly, A. T. Woolley, M. L. Lee, and H. D. Tolley, "Field gradient electrophoresis," *Electrophoresis*, Vol. 26, No. 2, pp. 405-414, Jan. 2005.

K. F. Warnick and W. C. Chew, "Error analysis of the moment method," *IEEE Antennas and Propagation Magazine*, Vol. 46, No. 6, Dec., 2004 (invited).

C. P. Davis and K. F. Warnick, "High order convergence with a low order discretization of the 2D MFIE," *IEEE Antennas and Wireless Propagation Letters*, Vol. 3, No. 1, pp. 355-358, 2004.

M. A. Jensen and K. F. Warnick, "Comment on 'Coulomb torque---a general theory for electrostatic forces in many body systems,'" *Journal of Physics A: Mathematical and General*, Vol. 37, No. 24, pp. 6415-6417, 2004.

F. W. Millet and K. F. Warnick, "Validity of rough surface backscattering models," *Waves in Random Media*, Vol. 14, No. 3, pp. 327-347, July 2004. Listed on featured articles webpage, http://www.iop.org/EJ/journal/-page=featured/0959-7174/1, 6/29/2004.

F. W. Millett, D. V. Arnold, K. F. Warnick, and J. Smith, "Electromagnetic bias estimation using *in situ* and satellite data part I: RMS long wave slope," *Journal of Geophysical Research-Oceans*, Vol. 108, No. C2, 3040, 10 pages, 2003.

F. W. Millett, D. V. Arnold, P. Gaspar, K. F. Warnick, and J. Smith, "Electromagnetic bias estimation using *in situ* and satellite data part II: A nonparametric approach," *Journal of Geophysical Research-Oceans*, Vol. 108, No. C2, 3041, 10 pages, 2003.

Q. Wang, S. Lin, K. F. Warnick, and M. L. Lee, "Voltage controlled separation of proteins by electric field gradient focusing in a dialysis hollow fiber," *Journal of Chromatography A*, Vol. 985, pp. 455-462, Jan. 2003.

N. Shelton and K. F. Warnick, "Behavior of the regularized sampling inverse scattering method at internal resonance frequencies," *Progress in Electromagnetic Research*, vol. 38, pp. 29-45, 2002.

M. A. Jensen, R. H. Selfridge, and K. F. Warnick, "System-level microwave design projects," *IEEE Antennas and Propagation Magazine*, Vol. 43, No. 5, pp. 138-142, Oct. 2001.

M. Brandfass, A. D. Lanterman, and K. F. Warnick, "A comparison of the Colton-Kirsch inverse scattering methods with linearized tomographic inverse scattering," *Inverse Problems*, Vol. 17, No. 6, pp. 1797-1816, Dec. 2001.

K. F. Warnick and W. C. Chew, "Numerical simulation methods for rough surface scattering," Invited topical review, *Waves in Random Media*, Vol. 11, pp. R1-R30, 2001 (invited). This article is one of the most frequently downloaded papers for this journal.

K. F. Warnick and W. C. Chew, "On the spectrum of the electric field integral equation and the convergence of the moment method," *International Journal for Numerical Methods in Engineering*, Vol. 51, No. 1, pp. 31-56, May 2001.

K. F. Warnick and W. C. Chew, "Accuracy of the method of moments for scattering by a cylinder," *IEEE Transactions on Microwave Theory and Techniques*, Vol. 48, No. 10, pp. 1652-1660, Oct. 2000.

K. F. Warnick and W. C. Chew, "Convergence of moment method solutions of the EFIE for a 2D open cavity," *Microwave Optical Technology Letters*, Vol. 23, No. 4, pp. 212-218, Nov. 1999.

K. F. Warnick and D. V. Arnold, "Generalization of the geometrical optics scattering limit for a rough conducting surface," *Journal of the Optical Society of America A*, Vol. 15, pp. 2355-2361, 1998.

K. F. Warnick and D. V. Arnold, "Secondary dark rings of internal conical refraction," *Physical Review E*, Vol. 55, No. 5, pp. 6092-6096, 1997.

K. F. Warnick and D. V. Arnold, "Green forms for anisotropic, inhomogeneous media," *Journal of Electromagnetic Waves and Applications*, Vol. 11, pp. 1145-1164, 1997.

K. F. Warnick, R.H. Selfridge and D.V. Arnold, "Teaching electromagnetic field theory using differential forms," *IEEE Transactions on Education*, Vol. 40, No. 1, pp. 53-68, 1997.

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K. F. Warnick, R.H. Selfridge, and D.V. Arnold, "Electromagnetic boundary conditions and differential forms," *IEE Proceedings H—Microwaves, Antennas and Propagation*, Vol. 142, No. 4, pp. 326-332, Aug 1995.

CONFERENCE PRESENTATIONS

K. F. Warnick and A. F. Peterson, “3D MFIE accuracy improvement using regularization,” Proceedings of IEEE Antennas and Propagation Society International Symposium, Honolulu, HI, June 10-15, 2007.

K. F. Warnick and M. A. Jensen, “Optimal noise matching condition for mutually coupled antenna arrays,” Proceedings of IEEE Antennas and Propagation Society International Symposium, Honolulu, HI, June 10-15, 2007.

T. Sorensen and K. F. Warnick, “Inverse scattering image quality as a function of SNR,” Proceedings of IEEE Antennas and Propagation Society International Symposium, Honolulu, HI, June 10-15, 2007.

J. R. Nagel, M. A. Lillrose, K. F. Warnick, and B. D. Jeffs, “Prototype platform for array feed development,” Proceedings of USNC/URSI National Radio Science Meeting, Albuquerque, NM, July 9-14, 2006.

K. F. Warnick and P. Russer, “Solving Maxwell’s equations using fractional wave equations,” Proceedings of IEEE Antennas and Propagation Society International Symposium, Albuquerque, NM, July 9-14, 2006.

K. F. Warnick and M. A. Jensen, “Mutual coupling analysis of a focal plane array feed,” Proceedings of IEEE Antennas and Propagation Society International Symposium, Washington, D.C., July 3-8, 2005.

C. P. Davis and K. F. Warnick, “3D MFIE solution improvement by regularization,” Proceedings of IEEE Antennas and Propagation Society International Symposium, Washington, D.C., July 3-8, 2005.

C. P. Davis and K. F. Warnick, “2D MFIE solution improvement by regularization,” IEEE/ACES International Conference on Wireless Communications and Applied Computational Electromagnetics, Honolulu, Hawaii, April 3-7, 2005.

C. K. Hansen, K. F. Warnick, B. D. Jeffs, J. R. Fisher, and R. Bradley, “Interference mitigation using an array feed,” Workshop on Mitigation of Radio Frequency Interference in Radio Astronomy, Penticton, BC, Canada, July, 2004.

C. K. Hansen, K. F. Warnick, and B. D. Jeffs, “Interference cancellation using an array feed design for radio telescopes,” Proceedings of IEEE Antennas and Propagation Society International Symposium, Monterey, CA, pp. 539-542, June 20-25, 2004.

C. P. Davis and K. F. Warnick, “The physical meaning of the Sobolev norm in error estimation,” Proceedings of IEEE Antennas and Propagation Society International Symposium, Monterey, CA, pp. 3377-3380, June 20-25, 2004.

C. P. Davis and K. F. Warnick, “Error analysis of moment method solutions for 3D scattering problems,” Proceedings of USNC/URSI National Radio Science Meeting, Monterey, CA, p. 280, June 20-25, 2004.

K. F. Warnick, F. W. Millet, and D. V. Arnold, “Validity of backscattering models for Gaussian and power-law rough surfaces,” Proceedings of Progress in Electromagnetics Research Symposium, Pisa, Italy, March 28-31, 2004.

K. F. Warnick and D. V. Arnold, “Experimental measurements of off-nadir EM bias,” Topex/Poseidon-Jason-1 Science Working Team Meeting, poster/presentation, Arles, France, Nov. 18-21, 2003.

K. F. Warnick and D. V. Arnold, “Correlation of residual EM bias error with sea surface parameters,” Topex/Poseidon-Jason-1 Science Working Team Meeting, poster/presentation, Arles, France, Nov. 18-21, 2003.

C. Hansen, K. F. Warnick, and B. D. Jeffs, “Adaptive interference cancellation using an array feed design for radio telescopes,” Proceedings of the USNC/CNC/URSI North American Radio Science Meeting, Columbus, OH, p. 642, June 22-27, 2003.

A. Poulsen, B.D. Jeffs, C. Hansen, K. F. Warnick, and R. Fisher, “Real-time adaptive cancellation of GLONASS interference in OH signal observations at the Green Bank telescope,” Proceedings of the USNC/CNC/URSI North American Radio Science Meeting, Columbus OH, p. 641, June 22-27, 2003.

C. P. Davis and K. F. Warnick, “Convergence rates of 2D moment method solutions for the MFIE and EFIE,” Proceedings of IEEE Antennas and Propagation Society International Symposium, Columbus, OH, Vol. 2, pp. 1080-1083, June 22-27, 2003.

F. W. Millet and K. F. Warnick, “Validity study of rough surface scattering models,” Proceedings of IEEE Antennas and Propagation Society International Symposium, Columbus, OH, pp. 565-568, June 22-27, 2003.

B. D. Jeffs, K. F. Warnick, and L. Li, “Improved interference cancellation in synthesis array radio astronomy imaging using auxiliary antennas,” Proceedings of IEEE International Conference on Acoustics, Speech, and Signal Processing, Hong Kong, pp. V77-V80, May, 2003.

Q. Wang, Y. Liu, S-L. Lin, J. Liu, H. D. Tolley, K. F. Warnick and M. L. Lee, “Electromobility focusing of proteins in small channels,” 26th International Symposium on Capillary Chromatography and Electrophoresis, Las Vegas, NV, May 18-22, 2003.

K. F. Warnick and D. V. Arnold, “Verification of nonparametric SSB models and progress in theoretical bias studies,” Jason-1/TOPEX/Poseidon Scientific Working Team Meeting, New Orleans, LA, p, 55, 21-23 October, 2002.

F. W. Millet, K. F. Warnick and D. V. Arnold, “Refining electromagnetic bias estimation,” Proceedings of IEEE Geoscience and Remote Sensing Symposium, June, 2002, Vol. 4, pp. 1980-1982.

K. F. Warnick and W. C. Chew, “Error analysis of scattering amplitudes and RCS,” Proceedings of URSI National Radio Science Meeting, San Antonio, TX, p. 598, June 16-21, 2002.

K. F. Warnick, F. W. Millett, and D. V. Arnold, “Verification of nonparametric crossover difference SSB models,” Jason-1 Scientific Working Team Meeting, Biarritz, France, 10-12 June, 2002.

K. F. Warnick, F. W. Millett, and D. V. Arnold, “Theoretical sea state bias model based on RMS slope,” poster presentation, Jason-1 Scientific Working Team Meeting, Biarritz, France, 10-12 June, 2002.

K. F. Warnick, F. W. Millett, and D. V. Arnold, “Incidence angle dependence of EM bias,” poster presentation, Jason-1 Scientific Working Team Meeting, Biarritz, France, 10-12 June, 2002.

S-L. Lin, Q. Wang, H. D. Tolley, K. F. Warnick and M. L. Lee, “Electromobility focusing of proteins in a Dialysis Hollow Fiber,” 25th International Symposium on Capillary Chromatography, Riva del Garda, Italy, May 13-17, 2002.

K. F. Warnick and W. C. Chew, “High frequency asymptotic representation of the fast multipole method translation operator,” Proceedings of URSI National Radio Science Meeting, Boston, MA, p. 328, July 8-13, 2001.

M. Brandfass, A. D. Lantermann, N. B. Shelton, and K. F. Warnick, “Comparison of Colton-Kirsch linear sampling with linearized tomographic inverse scattering,” Proceedings of URSI National Radio Science Meeting, Boston, MA, p. 286, July 8-13, 2001.

Q. Wang, R. S. Shah, K. F. Warnick, F. R. Callejas, and M. L. Lee, “Hollow fiber-based electromobility focusing for proteins,” 24th International Symposium on Capillary Chromatography and Electrophoresis, Las Vegas, Nevada, May 20-24, 2001.

K. F. Warnick and W. C. Chew, “Regulated kernel for the electric field integral equation,” Proceedings of IEEE Antennas and Propagation Symposium, Salt Lake City, UT, vol. 4, p. 2310-2313, July 16-21, 2000.

F. Millett, D. V. Arnold, K. F. Warnick, and W. K. Melville, “Electromagnetic bias estimation using *in situ* and satellite data,” TOPEX/Poseidon Jason-1 Scientific Working Team Meeting, Miami Beach, FL, 15-17 Nov., 2000.

K. F. Warnick and W. C. Chew, “Accuracy of the higher order moment method,” Proceedings of IEEE Antennas and Propagation Symposium, Salt Lake City, UT, vol. 1, p. 464-467, July 16-21, 2000.

K. F. Warnick and W. C. Chew, “A pedestrian introduction to the accuracy and convergence of integral equation methods,” Proceedings of URSI National Radio Science Meeting, Salt Lake City, UT, p. 351, July 16-21, 2000.

K. F. Warnick and W. C. Chew, “Accuracy of the method of moments for the cylinder,” Proceedings of URSI National Radio Science Meeting, Orlando, FL, p. 84, Jul. 11-16, 1999.

K. F. Warnick and W. C. Chew, “Spectral multigrid for the electric field integral equation,” Proceedings of URSI National Radio Science Meeting, Orlando, FL, p. 9, Jul. 11-16, 1999.

K. F. Warnick and W. C. Chew, “Accuracy and conditioning of the method of moments for the 2D EFIE,” 15th Annual Review of Progress in Applied Computational Electromagnetics, Monterey, CA, Mar. 15-20, 1999.

K. F. Warnick and D. V. Arnold, “Generalization of the geometrical optics scattering limit for a rough conducting surface,” Proceedings of International Geoscience and Remote Sensing Symposium, Seattle, WA, July 6-10, 1998.

K. F. Warnick and D. V. Arnold, “Finite frequency generalization of the geometrical optics rough surface scattering coefficient,” Proceedings of IEEE Antennas and Propagation Symposium, Atlanta, GA, pp. 1078-1080, June 21-26, 1998.

K. F. Warnick and D. V. Arnold, “Green forms for anisotropic, inhomogeneous media,” Proceedings of Progress in Electromagnetics Research Symposium, p. 475, Cambridge, Mass., July 7-11, 1997.

D. V. Arnold, K. F. Warnick, and R. H. Selfridge, “Differential forms as a tool for electromagnetic theory,” Proceedings of Progress in Electromagnetics Research Symposium, p. 466, Cambridge, Mass., July 7-11, 1997.

K. F. Warnick, D. V. Arnold, and R. H. Selfridge, "Electromagnetics made easy: differential forms as a teaching tool," Frontiers in Education Proceedings, Salt Lake City, UT, Nov. 1996.

K. F. Warnick, D. V. Arnold, and R. H. Selfridge, "Differential forms in electromagnetic field theory," Proceedings of IEEE Antenna Propagation Symposium, pp. 1474-1477, Baltimore, Maryland, July, 1996.

R. H. Selfridge, K. F. Warnick, D. V. Arnold, "Enhancing the teaching of electromagnetics using differential forms," Annual Conference Proceedings of the ASEE, Washington, D.C., June, 1996.

K. F. Warnick and D. V. Arnold, "Electromagnetic Green functions using differential forms," Proceedings of Progress in Electromagnetics Research Symposium, p. 943, Seattle, Washington, July 24-28, 1995.

K. F. Warnick, R. H. Selfridge and D. V. Arnold, "Electromagnetic boundary conditions using differential forms," Proceedings of Progress in Electromagnetics Research Symposium, p. 1106, Seattle, Washington, July 24-28, 1995.

D. V. Arnold, R. H. Selfridge and K. F. Warnick, "Teaching electrodynamics using differential forms," Proceedings of Progress in Electromagnetics Research Symposium, p. 939, Seattle, Washington, July 24-28, 1995.

R. H. Selfridge, D. V. Arnold and K. F. Warnick, "Teaching electrostatics and magnetostatics using differential forms," Proceedings of Progress in Electromagnetics Research Symposium, p. 940, Seattle, Washington, July 24-28, 1995.

GRANTS

NASA, Principal Investigator: D. V. Arnold. 8/98-8/01: $557,000. "Improved Estimation of Electromagnetic Bias for the JASON-1 Altimeter. Experimental and theoretical study to determine causes of the EM bias and development of improved bias correction algorithm." Co-Investigators: W. K. Melville, M. A. Jensen, D. G. Long, K. F. Warnick. Two year renewal awarded, 9/01-9/03: $300,000.

NSF, Principal Investigator: Brian D. Jeffs. 9/00 – 8/03: $504,000. "Real-Time Adaptive Cancellation of non-Stationary Interference in Radio Astronomy." Co-Investigator: K. F. Warnick.

Lawrence Livermore National Laboratory, Principal Investigator: K. F. Warnick. 3/01-8/02: $33,356. "Numerical Methods for Electromagnetic Radiation and Scattering Problems."

National Institutes of Health, Principle Investigator: M. L. Lee. 1/03-12/05: $1,039,000. "Electromobility Focusing for Separation of Proteins." Co-Investigators: P. B. Farnsworth, B. C. Stack, D. H. Tolley, K. F. Warnick, A. T. Woolley.

NSF, Principal Investigator: J. R. Fisher. 9/04 – 8/07: (BYU subcontract, $117,900). "Development of Real Time Interference Mitigation Platform." Co-Investigators: B. D. Jeffs, K. F. Warnick, and R. Bradley

NSF, Principal Investigator: Brian D. Jeffs. 9/04 – 8/07: $573,664. "RFI Mitigation for Radio Astronomy with Emphasis on Array Feeds." Award #0352705. Co-Investigators: K. F. Warnick, R. Fisher, R. Bradley, and M. A. Jensen.

HONORS

Outstanding Faculty Member, Department of Electrical and Computer Engineering, BYU (2005)
National Science Foundation Graduate Research Fellowship (8/94 to 8/97)
NASA Rocky Mountain Space Grant Fellowship (8/93 to 8/94)

OTHER PROFESSIONAL ACTIVITIES

Technical Program Co-Chair for IEEE International Antennas and Propagation Symposium, Honolulu, Hawaii, June 2007.

BYU ECEn Department Coordinator for Accreditation Activities, 2002-present.

Consultant, Microwave systems, antennas, electromagnetic analysis, and signal processing.

5/1/2007