

Curriculum Vitae

BRIAN D. JEFFS

Associate Professor
Department of Electrical and Computer Engineering
Brigham Young University

459 CB, BYU
Provo, UT 84602
email: bjeffs@ee.byu.edu
web page: <http://www.ece.byu.edu/faculty/bjeffs/>

1.0 Education

Ph.D., Electrical Engineering, University of Southern California, May 1989.
Emphasis in signal and image processing, biomedical imaging, and digital image reconstruction. Dissertation title: "Maximally Sparse Constrained Optimization for Signal Processing Applications." Hughes Aircraft Ph.D. Fellow. Major advisor: Richard M. Leahy.

M.S., Electrical Engineering, Brigham Young University, Dec. 1982
Emphasis in digital signal processing and speech encoding and recognition. Thesis title: "An Algorithm for Feature Change Detection in Speech Using Cepstral Coefficients." Major advisor: Douglas M. Chabries.

B.S., Electrical Engineering, Brigham Young University, Aug. 1978, Magna Cum Laude. Computer option.

2.0 Employment

Brigham Young University, Provo Utah, 1996 to present, Associate Professor; 1990 to 1996 Assistant Professor, Department of Electrical and Computer Engineering. Instructor of graduate and undergraduate courses in digital signal processing, digital image processing, signals and systems, introductory circuits, and linear systems theory. Current primary research emphasis is signal processing for radio astronomy, including interference mitigation, focal plane array feeds for large radio telescopes, and low frequency self calibration algorithms. Other research activities include signal processing for MIMO wireless communications systems and statistically optimal methods for image restoration and reconstruction. Co director of the BYU Radio Astronomy, RFI Mitigation Research Laboratory.

Hughes Aircraft Company, Fullerton California, Oct. 1982 to Dec. 1989
Staff Engineer, Signal and Sonar Processing, Anti-Submarine Warfare Division. Responsibilities include theoretical analysis, system engineering, and signal processing algorithm design for military sonar systems. Major project involvement included: 1) Signal Processing and acoustic array analysis for the ADCAP Mark 48 torpedo system, 2) lead system engineer for signal processing on the advanced low

frequency (ALFS) helicopter-borne dipping sonar system, 3) system engineering and signal processing design and analysis for towed array sonar systems.

Eyring Research Institute, Provo Utah, Apr. 1978 to Oct. 1982.

Digital Systems Engineer. Responsibilities included system and logic design of custom military and commercial computer hardware. Project leader for several large hardware design projects including a Minute Man III ballistic missile flight computer simulation system.

Eyring Research Institute, Provo Utah, Feb. 1976 to Apr. 1978.

Digital Electronics Technician. Responsibilities included construction, maintenance, and repair of custom minicomputer systems and interfaces.

3.0 Publications

Downloadable PDF file copies are available from the author's web site at:

<http://www.ece.byu.edu/faculty/bjeffs/publications.phtml>

(Note: * Indicates student co-authors)

Journal articles

1. B.D. Jeffs, K.F. Warnick, J. Landon*, J. Waldron*, D. Jones*, J.R. Fisher, and R.D. Norrod, "Signal processing for phased array feeds in radio astronomical telescopes," to appear, *IEEE Journal of Selected Topics in Signal Processing*, Sept., 2008.
2. K. F. Warnick and B. D. Jeffs, "Beam efficiencies and system temperature for a focal plane array," to appear, *IEEE Antennas and Wireless Propagation Letters*, 2008.
3. B.D. Jeffs and K.F. Warnick, "Bias corrected PSD estimation for an adaptive array with moving interference," *IEEE Transactions on Signal Processing*, vol. 56, no. 7, doi:10.1109/TSP.2008.919637, pp. 3108-3121 July, 2008.
4. J. R. Nagel*, K. F. Warnick, B. D. Jeffs, J. R. Fisher, and R. Bradley, "Experimental verification of radio frequency interference mitigation with a focal plane array feed," *Radio Science*, vol. 42, RS6013, doi:10.1029/2007RS003630, 2007.
5. S. van der Tol*, B.D. Jeffs and A.-J. van der Veen, "Self calibration for the LOFAR radio astronomical array," *IEEE Trans. on Signal Processing*, vol. 55, no. 9, pp. 4497-4510, Sept., 2007.
6. .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, pp. 499-502, December, 2006.
7. B.D. Jeffs, W. Lazarte*, and J.R. Fisher, "Bayesian detection of radar interference in radio astronomy," *Radio Science*, vol. 41, RS3006, doi:10.1029/2005RS003400, June, 2006.

8. 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, no. 6, pp. 2916-2927, December, 2005.
9. W. Dong*, B.D. Jeffs and J.R. Fisher, "Radar interference blanking in radio astronomy using a Kalman tracker," *Radio Science*, RS5S04, doi:10.1029/2004RS003130, vol. 40, no. 5, June, 2005.
10. C.K. Hansen*, K.F. Warnick, B.D. Jeffs, J.R. Fisher and R. Bradley, "Interference mitigation using a focal plane array," *Radio Science*, RS5S16, doi:10.1029/2004RS003138, vol. 40, no. 5, 2005, June, 2005.
11. B.D. Jeffs, L. Li* and K.F. Warnick, "Auxiliary antenna assisted interference mitigation for radio astronomy arrays," *IEEE Transactions on Signal Processing*, vol. 53, No. 2, pp. 439-451, February, 2005.
12. J.W. Wallace, M.A. Jensen, A.L. Swindlehurst, and B.D. Jeffs, "Experimental characterization of the MIMO wireless channel: data acquisition and analysis," *IEEE Transactions on Wireless Communications*, vol. 2, No. 2, pp. 335-343, March 2003.
13. Q.H. Spencer*, B.D. Jeffs, M.A. Jensen, and A.L. Swindlehurst, "Modeling the statistical time and angle of arrival characteristics of an indoor multipath channel," *IEEE Journal on Selected Areas in Communications*, vol. 18, No. 3, pp 347-360, March 2000.
14. M. Gunsay* and B.D. Jeffs, "Point source localization in blurred images by a frequency domain eigenvector based method," *IEEE Trans. on Image Processing*, vol. 4., No. 12, pp. 1602-1612, Dec., 1995.
15. W.H. Pun* and B.D. Jeffs, "Adaptive image restoration using a generalized Gaussian model for unknown noise," *IEEE Trans. on Image Processing*, vol. 4., No. 10, pp. 1451-1456, Oct., 1995.
16. B.D. Jeffs and M. Gunsay*, "Restoration of blurred star field images by maximally sparse optimization," *IEEE Transactions on Image Processing*, vol. IP-2 No. 2, pp. 202-211, Apr., 1993.
17. R.M. Leahy and B.D. Jeffs, "Maximally sparse beamforming array design," *IEEE Trans. Antennas and Prop.*, vol. AP-39, No. 8, pp. 1178-1187, Aug. 1991.
18. B.D. Jeffs, R.M. Leahy, and Manbir Singh, "An evaluation of methods for neuromagnetic image reconstruction," *IEEE Trans. Biomed. Eng.*, vol. BME-34, pp. 713-723, 1987.

Journal articles currently in review

1. B.D. Jeffs and K.F. Warnick, "Spectral bias in adaptive beamforming with narrowband interference," *IEEE Transactions on Signal Processing*, in review, 2008.

Full manuscript reviewed conference proceedings

1. B.D. Jeffs and K.F. Warnick, "Bias corrected PSD estimation with an interference canceling array," *Proc. of IEEE International Conf. Acous., Speech, and Sig. Proc., ICASSP-2007*, vol. II, pp 1145-1148, April 15-20, 2007, Honolulu.
2. B.D. Jeffs, S. van der Tol*, and A.-J. van der Veen, "Direction dependent self calibration of large distributed sensor arrays," *Proc. of IEEE International Conf. Acous., Speech, and Sig. Proc., ICASSP-2006*, vol. IV, pp 1069-1072, May 2006, Toulouse, France.
3. S. van der Tol*, B.D. Jeffs, and A.-J. van der Veen, "Direction dependent calibration for radio astronomical arrays," *Proceedings of EUSIPCO-2005*, Sept. 2005, Antalya, Turkey.
4. W. Dong*, B.D. Jeffs and J.R. Fisher, "A Kalman-tracker-based Bayesian detector for radar interference in radio astronomy," *Proc. of IEEE International Conf. Acous., Speech, and Sig. Proc., ICASSP-2005*, vol. IV, pp. 657-660, March, 2005, Philadelphia.
5. A.J. Boonstra, S.J. Wijnholds, S. v.d. Tol and B. Jeffs, "Calibration, sensitivity, and RFI mitigation requirements for LOFAR," *Proc. of IEEE International Conf. Acous., Speech, and Sig. Proc., ICASSP-2005*, vol. V, pp. 869-872, March, 2005, Philadelphia.
6. N.B. Shelton* and B.D. Jeffs, "A robust iterative algorithm for wireless MIMO array auto-calibration," *Proc. of IEEE International Conf. Acous., Speech, and Sig. Proc., ICASSP-2004*, vol. II, pp. 341-344, May, 2004, Montreal.
7. 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*, vol. 1, pp. 539-542, Monterey, CA, pp. 539-542, June 20-25, 2004.
8. J.W. Wallace, B.D. Jeffs, and M.A. Jensen, "A real-time multiple antenna element testbed for MIMO algorithm development and assessment," *Proceedings of IEEE Antennas and Propagation Society International Symposium*, vol. 2, Monterey, CA, pp. 1716-1719, June 20-25, 2004.
9. B.D. Jeffs, K.F. Warnick and L. Li*, "Improved interference cancellation in synthesis array radio imaging using auxiliary antennas," *Proc. of IEEE International Conf. Acous., Speech, and Sig. Proc., ICASSP-2003*, April, 2003, Hong Kong, vol. V, pp. V-77-V-80.
10. B.D. Jeffs and J.W. Wallace*, "MIMO wireless multipath ray parameter estimation from channel transfer matrix measurements," *Proc. of IEEE International Conf. Acous., Speech, and Sig. Proc., ICASSP-2002*, vol. III, May 13-17, 2002, Orlando, pp. 2345-2348.
11. B.D. Jeffs, E. Pyper*, and B. Hunter*, "A wireless MIMO channel probing approach for arbitrary antenna arrays," *Proc. of IEEE International Conf. Acous., Speech, and Sig. Proc., ICASSP-2001*, vol. IV, May 7-11, 2001, Salt Lake City, UT, pp. 2493-2496.

12. E. Pyper* and B.D. Jeffs, "Recovery of MIMO wireless channel ray structure using a modified CLEAN deconvolution algorithm," *Optical Society of America Technical Digest, Signal Recovery and Synthesis*, Nov. 5-7, 2001, pp. 121-123. Invited paper.
13. B.A. Chipman* and B.D. Jeffs, "Blind point-source image restoration using subspace techniques," *Proc. of IEEE International Conf. Acous., Speech, and Sig. Proc., ICASSP-2000*, vol. IV, June 5-9, 2000, Istanbul, Turkey, pp. 2207-2210.
14. M. Willis*, B.D. Jeffs and D.G. Long, "Maximum entropy image restoration revisited," *Proceedings of ICIP'2000, IEEE International Conference on Image Processing*, Sept. 10-13, 2000, Vancouver, Canada, vol. 1, pp. 89-92.
15. B.A. Chipman* and B.D. Jeffs, "Blind multiframe point source image restoration using MAP estimation," *Conference Record, Thirty-Third Asilomar Conference on Signals, Systems, & Computers*, Nov. 1999, Pacific Grove CA, vol. 2, pp 1267-1271. Invited paper.
16. M. Willis*, B.D. Jeffs and D.G. Long, "A new look at maximum entropy image reconstruction," *Conference Record, Thirty-Third Asilomar Conference on Signals, Systems, & Computers*, Nov. 1999, Pacific Grove CA, vol. 2, pp. 1272-1276.
17. M.A. Jensen, Q.H. Spencer, A.L. Swindlehurst, and B.D. Jeffs, "Measurement and modeling of temporal and spatial indoor multipath," *Proceedings of the IEEE Antennas and Propagation Society International Symposium*, July 11-16, 1999, vol. 1, pp. 388-391.
18. B.D. Jeffs, S. Hong* and J. Christou, "A generalized Gauss Markov model for space objects in blind restoration of adaptive optics telescope images," *Proceedings of ICIP'98, IEEE International Conference on Image Processing*, Oct. 4-7, 1998, Chicago, IL, pp. 737-741.
19. A.H. Gardiner* and B.D. Jeffs, "A Non-uniformly sampled Markov random field model for MAP reconstruction of magnetoencephalogram images," *Proceedings of ICIP'98, IEEE International Conference on Image Processing*, Oct. 4-7, 1998, Chicago, IL, pp. 375-379.
20. B.D. Jeffs, J. Christou and S. Hong*, "Blind MAP restoration of adaptive optics telescope images using estimated shape parameters for generalized Gaussian MRF models," *Proceedings of the 1998 IEEE DSP Workshop*, August 9-12, 1998, Bryce Canyon, Utah, Paper no. 156.
21. B.D. Jeffs and A.H. Gardiner*, "Markov random field image prior models for MAP reconstruction of magnetoencephalogram images," *Conference Record, Thirty-Sixth Asilomar Conference on Signals, Systems, and Computers*, Nov. 1-4, 1998, Pacific Grove, CA, vol. 1, pp. 314-318.
22. B.D. Jeffs, "Sparse inverse solution methods for signal and image processing applications," *Proc. of IEEE International Conf. Acous., Speech, and Sig. Proc., ICASSP-98*, May 12-15, 1998, Seattle Washington, vol. 3, pp. 1885-1888. Invited Paper.

Extended summary reviewed conference proceedings

1. Q.H Spencer*, B.D. Jeffs, M.A. Jensen, and A.L. Swindlehurst, "Experiments in modeling the space-time indoor wireless communication channel," IEEE Workshop on Signal Processing Advances in Wireless Communications, 1997. PDF file
2. B.D. Jeffs and W.H. Pun*, "Simple shape parameter estimation from blurred observations for a generalized Gaussian MRF image prior used in map image restoration," Proceedings of the IEEE International Conference on Image Processing, ICIP-96, 16-19 Sept., 1996, vol. II, pp. 465-468. PDF file
3. B.D. Jeffs, "Rank enhancement for eigenstructure-based direction finding using arrays with non-uniform element responses," Proc. of IEEE International Conf. Acous., Speech, and Sig. Proc., ICASSP'96, May 7-10, 1996, Atlanta GA, vol. VI, pp. 2181-3184. PDF file
4. W.H. Pun* and B.D. Jeffs, "A comparison of methods for estimating shape parameters in generalized Gauss Markov random fields," Proceedings of the Ninth Workshop on Image and Multidimensional Signal Processing, March 3-6, 1996, IEEE Signal Processing Society, pp. 92-93.
5. W.H. Pun* and B.D. Jeffs, "Shape parameter estimation for generalized Gaussian Markov random field models used in MAP image restoration," Conference Record, 29th Asilomar Conf. on Signals, Systems, and Computers, Oct. 29-Nov. 2, 1995, IEEE Computer Society Press, pp. 1472-1476. PDF file
6. W.H. Pun* and B.D. Jeffs, "MAP image restoration using an adaptive generalized Gaussian Markov random field model," Record, IASTED International Conference on Signal and Image Processing (SIP-95), Nov. 20-23, 1995.
7. B.D. Jeffs and M. Gunsay*, "Performance analysis for a subspace decomposition point-source image restoration algorithm," Proc. of the IEEE International Conf. on Image Processing, ICIP-94, vol. 2, 13-16 Nov., 1994, pp. 675-679. PDF file
8. W.H. Pun* and B.D. Jeffs, "Iterative adaptive lp restoration of blurred images," Proc. of IEEE International Conf. Acous., Speech, and Sig. Proc., ICASSP'94, vol. 5, 19-22 April 1994, pp. 449-452. PDF file
9. M. Gunsay* and B.D. Jeffs, "A subspace decomposition method for point source localization in blurred images," Proc. of IEEE Intern. Conf. Acous., Speech, and Sig. Proc., ICASSP'94, vol. 5, 19-22 April 1994, pp. 469-472. PDF file
10. M. Gunsay* and B.D. Jeffs, "An eigenvector based method for point source localization in blurred images," Conference Record, 27th Asilomar Conf. Signals, Syst., Comp., pp. 159-168, Nov. 1-3. 1993. PDF file
11. W.H. Pun* and B.D. Jeffs, "Model adaptive restoration," Conference Record, 27th Asilomar Conf. Signals, Syst., Comp., pp. 573-577, Nov. 1-3. 1993. PDF file

12. B.D. Jeffs and D. Elsmore*, "Maximally sparse reconstruction of blurred star field images," Proc. of IEEE International Conf. Acous., Speech, and Sig. Proc., ICASSP '91, vol. 4, pp. 2937-2940 May 1991. PDF file
13. R.M. Leahy and B.D. Jeffs, "Optimal element placement in conformal beamforming," Proc. 22nd Asilomar Conf. Signals, Syst. Comp., Nov. 1988. PDF file
14. R. Leahy, B. Jeffs and Z. Wu, "A DSP algorithm for minimum order solutions," Proc. 21st Asilomar Conf. Signals, Syst., Comp., Asilomar, CA, Nov. 1987.

Abstract reviewed and other conference articles, presentations and reports

1. B.D. Jeffs, K.F. Warnick, M. Elmer*, J. Landon*, J. Waldron*, D. Jones*, R. Fisher, and R. Norrod, "Calibration and optimal beamforming for a 19 element phased array feed," Calibration and Imaging Workshop, CALIM2008, Perth Australia, 7-9 Apr. 2008.
<http://calim2008.atnf.csiro.au/twiki/pub/Main/WorkshopProgram/JeffsCalim.pdf>. PDF file
2. K. F. Warnick, D. Jones, B. D. Jeffs, and M. A. Jensen, "Noise penalty due to mutual coupling for receive arrays," URSI National Radio Science Meeting, Boulder, CO, Jan. 3-6, 2008.
3. J. Landon*, D. Jones*, B. D. Jeffs, K. F. Warnick, R. Fisher, and R. Norrod, "Interference cancellation and sensitivity optimization using an L-band focal plane array on the Green Bank 20m Telescope," URSI National Radio Science Meeting, Boulder, CO, Jan. 3-6, 2008.
4. K. F. Warnick, J. Waldron*, J. Landon*, M. Lilrose*, and B. D. Jeffs, "Experimental results on interference mitigation with a 19 element array feed," Proceedings of 2nd European Conference on Antennas and Propagation, Edinburgh, UK, Nov. 11-16, 2007.
5. K. F. Warnick, B. D. Jeffs, J. Landon*, J. Waldron, D. Jones*, A. Stemmons*, "BYU/NRAO 2007 Green Bank 20 Meter Telescope focal plane array – modeling and experimental results," invited presentation, SKADS MCCT Technical Workshop on 'Design of Wideband Receiving Array Systems,' Dwingeloo, The Netherlands, Nov. 26-30, 2007.
6. B.D. Jeffs, K.F. Warnick and J. Nagel*, "On interference cancellation with a focal plane array," Square Kilometer Array Calibration and Imaging Workshop, CALIM2006, Cape Town, South Africa, Dec. 4-6, 2006,
<http://www.kat.ac.za/calim2006/wiki/Program>.
7. S. van der Tol* and B.D. Jeffs, "Theoretical performance bounds for LOFAR calibration," Square Kilometer Array Widefield Imaging Workshop, June 22-24, 2005, Dwingeloo, The Netherlands,
<http://www.skatelescope.org/pages/news/Wrksp20220605.htm>.
8. B.D. Jeffs and S. van der Tol*, "Analysis of the peeling algorithm," Square Kilometer Array Widefield Imaging Workshop, June 22-24, 2005, Dwingeloo, The Netherlands, <http://www.skatelescope.org/pages/news/Wrksp20220605.htm>.

9. W. Dong* and B.D. Jeffs, "Kalman tracking and Bayesian detection for radar RFI blanking," *Proceedings of RFI2004, IUCAD DRAO Workshop in Mitigation of Radio Frequency Interference in Radio Astronomy*, Penticton, British Columbia, July 16 - 18, 2004, <http://www.drao-ofr.hia-iha.nrc-cnrc.gc.ca/rfi2004/>.
10. C. Hansen*, K. Warnick, B. Jeffs, R. Fisher and R. Bradley, "Interference mitigation using an array feed," *Proceedings of RFI2004, IUCAD DRAO Workshop in Mitigation of Radio Frequency Interference in Radio Astronomy*, Penticton, British Columbia, July 16 - 18, 2004, <http://www.drao-ofr.hia-iha.nrc-cnrc.gc.ca/rfi2004/>.
11. A. Poulsen*, B.D. Jeffs, C. Hansen, K. 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.
12. 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.
13. L. Li*, B.D. Jeffs, A. Poulsen*, and K. Warnick, "Analysis of adaptive array algorithms performance for satellite interference cancellation in radio astronomy," *Nat. Academies of Sciences and Engineering, URSI General Assembly XXVII*, Aug. 2002, Maastricht the Netherlands. Invited paper.
14. B.D. Jeffs, J.R. Fisher, and R.F. Bradley, "Development of a programmable real-time interference canceller for a small radio telescope array," *Nat. Academies of Sciences and Engineering, URSI National Radio Science Meeting*, p. 322, Jan. 8-11, 2001, Boulder CO.
15. B.D. Jeffs and J. Christou, "Blind Bayesian restoration of adaptive optics images using generalized Gaussian Markov random field models," *Proceedings of the SPIE, Conference 3353, Adaptive Optical System Technologies*, Mar. 23-26, 1998, Kona Hawaii, pp. 1006-1013.
16. Q. Spencer*, B. Jeffs, M. Jensen, M. Rice, "Indoor wideband time/angle of arrival multipath propagation results," *Proceedings of the IEEE Vehicular Technology Conference*, Phoenix, vol. 3, May, 1997, pp. 1410-1414. PDF file
17. Q. Spencer*, B. Jeffs, M. Jensen, M. Rice, "A statistical model for angle of arrival in indoor multipath propagation," *Proceedings of the IEEE Vehicular Technology Conference*, Phoenix, vol. 3, May, 1997, pp. 1415-1419. PDF file
18. B.D. Jeffs and W.H. Pun*, "Model adaptive optimal image restoration," *Proc. of the SPIE Conf. on Applications of Digital Image Processing XV*, SPIE vol. 1771, pp. 307-321, July 19-24, 1992.
19. B.D. Jeffs, M. Gunsay*, and J Dougal*, "Resolution enhancement of blurred star field images by maximally sparse restoration," *Proc. of the SPIE Conf. on Applications of Digital Image Processing XIV*, SPIE vol. 1567, pp. 511-521, July 22-26, 1991.

20. R. Leahy, B. Jeffs, M. Singh, and R. Brechner, "Evaluation of algorithms for a SQUID detector neuromagnetic imaging system," *Proc. of the SPIE Conf. on Medical Imaging*, Newport Beach, CA, Feb. 1987.
21. B.D. Jeffs, R.M. Leahy and M. Singh, "Analysis of reconstruction algorithms for neuromagnetic imaging using SQUID-detectors," *Proc. of IEEE ASSP 1986 Digital Signal Processing Workshop*, Chatham, MA, Oct. 20-22, 1986.

4.0 Externally Funded Research Grants and Contracts

1. *National Science Foundation*. (co-PI)
K.F. Warnick, J.R. Fisher, B.D. Jeffs, R.D. Norrod, "MRI: Development of a Flexible Multichannel Digital Receiver for Radio Astronomy," Aug. 2008, \$641,275
2. *National Science Foundation*. (PI)
B.D. Jeffs, K.F. Warnick, J.R. Fisher and R.F. Bradley, "Research experience for undergraduates: RFI mitigation for radio astronomy with emphasis on array feeds," Aug. 2007, 12 months, supplemental award, \$22,500.
3. *National Science Foundation*. (co-PI)
J.R. Fisher, R.F. Bradley, B.D. Jeffs and K.F. Warnick, "Development of real-time interference mitigation instrumentation for radio astronomy," Feb. 2005, \$321,919, BYU subcontract: \$117,900.
4. *National Science Foundation*. (PI)
B.D. Jeffs, K.F. Warnick, J.R. Fisher and R.F. Bradley, "RFI mitigation for radio astronomy with emphasis on array feeds," Sep. 2004, 36 months, \$573,665.
5. *Stichting voor de Technische Wetenschappen, STW (Foundation for Technical Sciences, Netherlands equivalent of NSF)*. (co-PI)
B.D. Jeffs and A.-J. van der Veen, "Grant for living expenses and travel for research sabbatical visit to Technical University of Delft," competitive, Aug. 2004, 11 months, \$30,000.
6. *Technical University of Delft*. (co-PI)
B.D. Jeffs and A.-J. van der Veen, "Grant for half salary for research sabbatical visit to Technical University of Delft," Aug. 2004, 11 months, \$30,000.
7. *U.S. Army Communications-Electronics Command*. (PI)
B.D. Jeffs, principal investigator "Experimental analysis of impairments to RFI mitigation," Mar. 2003, 12 months, \$97,530.
8. *National Science Foundation*. (co-PI)
A.L. Swindlehurst, B.D. Jeffs, M.A. Jensen, and M. Rice, "Development of a comprehensive real-time instrument for MIMO wireless channel measurement," Aug. 2000, 36 months, \$370,567.
9. *National Science Foundation*. (co-PI)
A.L. Swindlehurst, B.D. Jeffs, M.A. Jensen, and M.D. Rice, "Analysis of the capacity improvement for wireless networks with multiple transmit and receive antennas," Sep. 2000, 36 months, \$499,761.

10. *National Science Foundation.* (PI)
B.D. Jeffs, D.V. Arnold, R.F. Bradley, and J.R. Fisher, "Real-time adaptive cancellation of non-stationary interference in radio astronomy," Jul. 2000, 36 months, \$600,280.
11. *National Science Foundation.* (co-PI)
A.L. Swindlehurst, B.D. Jeffs, M.A. Jensen, and M. Rice, "Modeling and design for the lower layers of 4th generation indoor/outdoor wireless networks," Sep. 1999, 36 months, \$697,636.
12. *Air Force Office of Scientific Research.* (PI)
B.D. Jeffs, "Algebraic methods for improved blind restoration of adaptive optics images of space objects," Air Force Office of Scientific Research, Summer Research Extension Program, 1999, \$25,000.
13. *Air Force Office of Scientific Research.* (PI)
Brian D. Jeffs, "Bayesian restoration of space object images from adaptive optics data with unknown residual blur," Air Force Office of Scientific Research, Summer Research Extension Program, 1998, \$25,000.
14. *Department of Energy / Los Alamos National Laboratory.* (PI)
B.D. Jeffs, "Airborne plume identification using generalized Gauss-Markov model parameter estimation," Jul. 1997, 12 months, \$20,000.
15. *Engineering Foundation, Air Force Engineering Research Initiation Grant.* (PI)
B.D. Jeffs, "Design of sparse beamforming arrays using an optimization theoretic approach," Sep. 1991, 11 months, \$23,000.
(Note, this award was subsequently returned to the Engineering Foundation as per their policy after receiving the NSF Research Initiation Award on a different proposed project.)
16. *National Science Foundation, Research Initiation Award.* (PI)
B.D. Jeffs, "Optimally sparse restoration of blurred star field images," Aug. 1991, 36 months, \$59,980.
17. *Space Dynamics Laboratory / Utah State University.* (PI)
B.D. Jeffs, "Algorithm development for Spirit III," including research to evaluate candidate algorithms for space-born infrared imaging array data preprocessing and resolution enhancement, Nov. 1991, four months, \$1,500.
18. *Space Dynamics Laboratory / Utah State University.* (PI)
B.D. Jeffs, BYU IR Initiative, subcontract number C868770. "Adaptive optimal image restoration," Sep. 1991, 27 months, \$46,716.
19. *Naval Research Laboratory, subcontract through JIL Systems Incorporated.* (co-PI)
D.M. Chabries, R.H. Selfridge, and B.D. Jeffs, "Advanced submarine technologies," including research in the areas of underwater acoustic imaging and modeling of acoustic scattering from submerged bodies, Jul. 1990, 13 months, \$116,800.

Total awards and contracts as PI:	\$1,472,171.
Total awards and contracts as PI or co-PI:	\$3,976,110.

6.0 *Research Emphasis*

The major area of focus for Dr. Jeffs' research includes the related disciplines of digital signal processing, sensor array processing, and digital image restoration. The following list describes research topics Dr. Jeffs has been involved with, with the most recent activities listed first.

1. Phased array feeds for radio telescopes dishes: A new trend in developing the next generation of radio telescopes is to use a compact array of antennas at the focal plane of a large dish reflector. Compared to traditional single waveguide feeds, these phased array feeds (PAFs) can increase the instrument field of view and sky survey speed. Unique challenges associated with PAF observations, including extremely low signal levels, long-term system gain stability requirements, spatially correlated noise due to mutual coupling, and tight beamshape tolerances, require the development of new array signal processing techniques for this application. We are studying calibration and beamforming strategies for PAFs including interference mitigation with power spectral density (PSD) estimation bias correction. We have extended key efficiency metrics for single-feed instruments to the array case and are using these to verify performance of the algorithms. We are collaborating with the National Radio Astronomy Observatory (NRAO) validate these techniques using an experimental PAF prototype on the Green Bank 20-Meter Telescope.
2. Self calibration for low frequency radio astronomical arrays: There is growing interest in radio astronomical observations in the low frequency range where it may be possible to detect the most distant, and highly red shifted celestial objects yet observed. Instruments must detect signals at unusually low frequencies (10-350 MHz) and over large apertures (100 km). Major projects include the Dutch Low Frequency Array (LOFAR), the Giant Metre-wave Radio Telescope (GMRT), the Long Wavelength Array (LWA), and low-frequency retrofits to the Very Large Array (VLA) in New Mexico, and the Murchison Wide Field Array in Australia. Our research addresses the most significant outstanding calibration challenge for large low-frequency arrays, i.e. correction for ionospheric phase distortion. At these frequencies the Earth's ionosphere acts as a random refractive sheet which over the large aperture induces source-direction-dependent gain and phase errors that must be estimated and calibrated out. Due to direction dependence, existing self calibration techniques cannot be applied. We have studied the direction dependent calibration problem in detail for the LOFAR and VLA arrays from a parameter estimation theoretic perspective. Self calibration algorithms have been proposed, and Cramer-Rao lower bounds (CRB) have been developed to guide further algorithm development and array geometry design.
3. Adaptive interference mitigation for radio astronomy: Radio astronomical observation is increasingly plagued by man-made interference from ground based broadcast, mobile wireless communications, and satellite downlink sources. We have studied several mitigation approaches. Real-time signal processing tools

have been developed to cancel space-based interference using adaptive filtering techniques. This has been successfully demonstrated at the National Radio Astronomy Observatory (NRAO) 100m Green Bank Telescope (GBT). New algorithms have been developed and analyzed for algebraically projecting out interference seen in imaging arrays like the Very Large Array in New Mexico. Kalman tracking techniques have been adapted to improve data time blanking for removing aviation radar interference seen at the GBT. Adaptive beamforming cancellation has been employed with a phased array feed on the Green Bank 20 meter Telescope dish to remove mobile interference. Estimation bias caused by array interference cancellation has been studied and correction algorithms proposed.

4. Multiple antenna arrays for wireless communication: Recently developed algorithms for space-time coded Multiple Input, Multiple Output (MIMO) wireless systems have been shown to be theoretically capable of increasing channel capacity by an order of magnitude or more. This gain is achieved using multiple antennas at both the transmit and receive ends of a wireless link to exploit the presence of multipath scattering, without increasing radio frequency bandwidth requirements. We have studied both the indoor and outdoor MIMO channel environments with an experimental channel sounding platform. Based on these observations, statistical models to enable realistic channel capacity calculations were proposed.
5. Multiframe blind restoration of adaptive optics telescope images: This research is directed at high resolution restoration of multiframe adaptive optics (AO) telescopic images. AO systems remove in real time much of the atmospheric-turbulence-induced blur, but a residual time-varying component remains. While observing a single object, the sequence of AO image frames has a different unknown residual blur point-spread function per frame. This constitutes a multiframe, blind image restoration problem. Algorithms based on Bayesian restoration using Markov random field models for the unknown object and psf's have been developed and shown to provide high quality restorations.
6. Deblurring of point source images: We have shown that for point-like images (star fields, bio-magnetic imaging, optical target tracking, etc.), restoration and reconstruction methods which exploit the known point-like structure far outperform conventional methods. Two techniques to identify and localize the image point sources corresponding to individual stars have been studied: an optimization theoretic approach based on a sparseness metric, and an image subspace decomposition method.

6.0 Professional Activities

Dr. Jeffs is active in IEEE professional programs related to digital signal processing and digital image processing. He is a founding member of the Utah Chapter of the IEEE Signal Processing and Communications Societies. He regularly participates and contributes at the related international conferences and workshops, including the IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP), URSI Conferences in the area of radio Astronomy, Square Kilometer

Array (SKA) workshops, and the Asilomar Conference on Signals, Systems & Computers. Specific professional activities include:

1. July 2007 - present, Guest Editor for IEEE Transactions on Selected Topics in Signal Processing. With four other guest editors, responsibilities include: a) proposing the "Special issue on Signal Processing for Astronomical and Space Research Applications," to the JSTSP board, b) creating and distributing the call for papers, c) promoting the special issue by individual contact with members of the target community, d) soliciting and assigning reviewers for papers, e) assessing reviews to make final editorial acceptance decisions for papers, and f) coordinating with JSTSP staff for final production.
2. 1996 - 2001, Vice General Chair for IEEE ICASSP 2001. Local arrangements chair. This premier signal processing conference will be held in Salt Lake City, May 2001 and will have over 2,000 participants. The executive committee, including me and three other faculty from BYU and Utah, will be responsible for all technical, financial, publications, and facilities arrangements.
3. 1996 - 1998, Executive Committee member for IEEE DSP Workshop 98. Local arrangements chair and technical committee member. This workshop was held at Bryce Canyon National Park, Aug. 9-12, 1998 and had approximately 250 attendees. A significant amount of time was spent in 1998 in detailed planning, making contractual arrangements with the hotel and caterers, and in hosting the event.
4. 1998 - 2001, Chair of the Utah Chapter for the IEEE Signal Processing and Communications Societies. Previous assignments include Vice Chair, and Secretary/Treasurer.
5. 1998, Member of the Technical Committee for IEEE ICIP-98 and ICIP-99. Duties included reviewing 12 papers for the conference to determine acceptance or rejection.
6. Chaired technical conference sessions for the 1998 Asilomar Conference on Signals and Systems, 1998 IEEE DSP Workshop, and ICASSP - 96. At Asilomar '98 organized a special session on "Blind Image Restoration and Image Processing Applications."
7. Critically reviewed over 130 technical papers for publication acceptance or rejection. A frequent technical reviewer for *IEEE Transactions on Signal Processing*, *IEEE Transactions on Image Processing*, *Radio Science*, *Journal of Electronic Imaging*, *IEEE Transactions on Aerospace and Electronic Systems*, *SPIE Optical Engineering*. Have also performed reviews for *IEEE Signal Processing Letters*, *Proceedings of the IEEE*, several publishers of technical text books, ICIP-98, ICIP-99, and 1998 IEEE DSP Workshop.
8. 1999 and 2005, National Science Foundation review panelist on multiple occasions. Critically reviewed more than 70 NSF proposals for grant funding.

9. 2003, elevated to Senior Member, IEEE.

7.0 Teaching

Dr. Jeffs teaches a wide variety of graduate and undergraduate courses in the areas of signals and systems, and electronic circuits. At the graduate level his regular lectures include Digital Image Processing (ECEn 678), Advanced Digital Signal Processing (ECEn 777), and Stochastic Processes (ECEn 670). Undergraduate offerings include Introduction to Digital Signal Processing (ECEn 487), Real-time DSP laboratory (ECEn 487 Lab), Probability theory (ECEn 370), Software Radio Senior Project (ECEn 490), Signals and Systems (ECEn 380), Introduction to Circuits (ECEn 212), and Electronic Circuits and Devices (ECEn 313).

The following list itemizes some of the curriculum innovations and new courses developed and introduced by Dr. Jeffs.

1. ECEn 487, Discrete-Time Signal Processing lecture and Real-Time Digital Signal Processing Laboratory. The lecture course was revised and moved to the undergraduate level by Dr. Jeffs. This permitted much more advanced offerings at the graduate level. The associated real-time DSP lab, developed by Dr. Jeffs, uses the TMS320C6701 floating point signal processor evaluation module. Students develop code for filters, a spectrum analyzer, acoustic direction finder, and adaptive noise canceller.
2. ECEn 490, Software Radio Senior Project. In this lab course, teams of upper division students (four per team) design a complete operational DSP-based digital communications receiver in a competitive environment. The 924 MHz QPSK receiver is implemented in real-time DSP code on a Texas Instruments TMS320C6701 floating point evaluation board. Students must design and build the antenna, radio frequency front-end circuits, and develop code for the digital demodulation. Teams compete based on lowest transmit power required for a specified bit error rate at a fixed distance. Winning teams receive a significant cash award from corporate sponsors.
3. ECEn 212 lab, Circuits Laboratory. This course is based on a semester-long major project where the students design and build a complete stereo audio amplifier and speaker system, and in the process apply all of the major circuits principles taught in class.
4. ECEn 380 Signals and systems. Dr. Jeffs led the effort in 1991 to have this course on linear systems and transforms expanded and moved from the graduate level to be taught at the Junior level. The current course syllabus was developed and first taught by Dr. Jeffs.
5. ECEn 316, Signals and Systems Laboratory. This companion to ECEn 380 included op-amp and DSP-based experiments to study principles of both analog and digital linear systems.

6. ECEn 687, Advanced Digital Signal Processing. Includes topics of statistically optimal signal processing, array processing, adaptive filtering, parametric spectral analysis, etc.
7. ECEn 619, Advanced Digital Image Processing. Includes in depth study of iterative and regularized methods for image restoration and medical image reconstruction. The ill-posed inverse problem is analyzed.

8.0 University Administrative Activities

1. 2006 - present, member of the Department of Electrical and Computer Engineering graduate committee. Responsibilities include admissions decisions, graduate exam development and administration, policy advisement, and graduate student advisement prior to being assigned a thesis advisor.
2. 2001 - present, member of the Department of Electrical and Computer Engineering Rank and Status Committee. This committee is responsible to review and make recommendations on faculty applications for tenure status and promotions.
3. 1999 - 2002 (3 year appointment), member of the University Internal Review Committee. This committee is charged with performing detailed graduate and undergraduate academic reviews of each department in the University on a seven year cycle. These internal reviews are used to guide University assessment and planning, and to encourage continuous improvement of departments and institutional excellence.
4. 1999-2000, ABET accreditation coordinator for the department. duties include planning and implementing policies to comply with ABET requirements for outcomes and objectives assessment.
5. 1993 -1997, Chair of the University Forum Committee. Responsible to solicit and review nominations for University Forum speakers. Speakers of international renown are invited to address the entire University community in the Marriott Center four times a semester. Speakers are selected based on scholarly record, academic contributions, and respect and standing in national and international communities.
6. 1995 - 1999, member of the Department Undergraduate Committee. Responsible for curriculum improvement and oversight, accreditation, and student academic standards implementation, and student academic advising.
7. 1994 - 1999, member of the Analog Laboratory Committee. Responsible for instrument acquisition, laboratory policy, laboratory curriculum improvement.
8. 1994 - 1995, Chair, Undergraduate Curriculum Committee. Supervised a major renovation of the undergraduate curriculum which included changing over 50% of the course offerings.

9. 1990 - 1994, IEEE Student Chapter Faculty Advisor.

9.0 Awards and Society Memberships

Awards: Hughes Aircraft Ph.D. Fellow; recipient of Brigham Young University's President's and Alvina S. Barrett scholarships; Magna Cum Laude citation, Brigham Young University; Utah Section of the IEEE Award of Merit for outstanding service, Signal Processing and Communications Societies, 1998-2000.

Society Memberships: IEEE member 1990-2001, IEEE senior member 2002-present, IEEE Signal Processing Society, Tau Beta Pi and Phi Kappa Phi honor societies.