
JAMES McCracken Hereford
Department of Physics and Engineering
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EDUCATION:

Georgia Institute of Technology, Atlanta, Georgia
Ph.D., Electrical Engineering, 1990
M.S., Electrical Engineering, 1985

Stanford University, Stanford, California
B.S. (with distinction), Electrical Engineering, 1982

PROFESSIONAL EXPERIENCE:

2001-present; Assistant Professor, Murray State University **Murray, Kentucky**

Tenure-track faculty member in the Department of Engineering and Physics. Joint appointment with University of Kentucky. Conduct research in the areas of evolvable hardware, evolutionary algorithms, and signal processing. Member of Faculty Senate.

Courses taught:

- *PHY 378: Logic Design (+ Lab)*
- *PHY 398: Principles of Design*
- *ETE 520: Digital Signal Processing*
- *PHY 460: Electricity and Magnetism*
- *PHY/ETE 264: Linear Circuits I (+ Lab)*
- *PHY/ETE 365: Circuits II (Systems)*
- *PHY 132: General Physics II (Elec and Mag)*
- *PHY 195: Statistics for Engineers*
- *PHY 140: C++ Programming*
- *Electrical Circuits and Electronics (UK EE 305)*

1996-2001; Assistant Professor, Christopher Newport Univ., Newport News, Virginia

Tenure-track faculty member in the Department of Physics, Computer Science and Engineering. Taught an average of 2.5 classes a semester, active on several university-wide committees, worked on externally-funded research grants, and supervised senior projects. Submitted research proposals in the areas of digital signal processing, pattern recognition with genetic algorithms, and computer vision. Active participant in two ABET accreditation visits.

Graduate courses taught:

- *Digital Signal Processing I,II*
- *Parallel Processing*

Undergraduate courses taught:

- *Digital Logic Design*
- *Computer Organization*
- *Digital Signal Processing I*
- *Engineering Ethics*
- *Programming II: C++*
- *Discrete Math and its Applications*
- *Introduction to Engineering*
- *Circuits + Circuits Lab*

1997 - 2001; Research Associate (part-time), NASA-LaRC **Hampton, VA**

Developed and implemented a technique to help NASA - Langley Research Center get more accurate and more precise data from its special-purpose wind tunnel. The technique uses a genetic algorithm to

determine the best set of temperature sensors to use to compensate for temperature gradients on the measurement balance. Initial results showed an overall improvement of almost 10-fold compared to no compensation.

1994 - present; President/Sole Employee, Wings Like Eagles

Consulted with local researchers on syntactic pattern recognition, generalized Fourier transform processing, genetic algorithms and digital signal processing. Wrote winning technical proposal applying syntactic pattern recognition concepts to strategic missile defense. Most recently, consultant with Thomas Jefferson National Accelerator Facility (Jefferson Lab) on DSP system for electron beam current monitoring.

1994 - 1996; Scientist, Camber Corporation, Huntsville, Alabama

Developed a series of pattern recognition algorithms. The algorithms utilize a variety of techniques (mathematical morphology, Fourier filtering, counter propagation neural network) and are written in C code within a visualization environment on Silicon Graphics workstations. The algorithms are tailored to specific tasks (noise removal, shape recognition, pattern completion) and specific applications (mine detection, target recognition, associative memory).

Wrote several concept papers for various government agencies. The concept papers proposed (i) enhancements to Distributed Interactive Simulation (DIS) wargame simulations (terrain visualization, environmental effects), (ii) innovative approach to cancer cell detection, and (iii) target recognition using a fuzzy expert system.

Designed and developed an algorithm testbed. The purpose of the testbed is to determine the performance of pattern recognition algorithms on different input scenes containing land mines. Developed custom modules in C code to read specialized image formats. Supported the development of a Geographical Information System (GIS) by performing quality control and map conversion.

1994 to 1994; Lecturer, The Univ. of Alabama, Huntsville, Huntsville, Alabama

Professor for entry-level (Freshman and Sophomore students) computer programming course in Electrical Engineering department.

- *Lecturer (Computer Programming)*

1990 - 1993; Senior Scientist, Sigmatech Inc., Huntsville, Alabama

Duties entailed research in target recognition and pattern recognition, analysis of millimeter wave radar systems, and examination of the next generation of air defense missile systems.

Project leader on a research grant to develop an advance signal processing system for a missile to discriminate a target from background clutter in a low signal-to-clutter ratio environment. This project led to investigations in several areas that are important for non-cooperative target recognition: most notable, radar technology, pattern recognition techniques, and stochastic modeling. One result of this research was the design and implementation of an innovative pattern classifier that adapts to changes in the background clutter. In addition, designed and coded a rule-based expert system to aid in target/clutter discrimination.

Project leader on a NASA funded grant to determine the orientation and position, six degrees of freedom, of an object using a laser radar. Developed a new technique that does not require a cooperative target. Two possible laser radar system architectures were analyzed to determine the signal-to-noise ratio, range limits, and resolution parameters for the new concepts. System performance was simulated on a PC using C.

1984 - 1990; Research Ass't, Georgia Institute of Technology, Atlanta, Georgia

Researched two-dimensional signal processing techniques using an optical system. Performed one of the first optical implementations of a particular class of nonlinear operations called morphological transformations. The transformations were also simulated on a UNIX-based SUN workstation. The computer simulations were coded in C and determined the impact of detector imperfections on the overall system operation. This research led to several publications and has potential use in the areas of optical computing, pattern recognition, defect detection, and machine vision.

Part-time lecturer in graduate Fourier analysis course. Supervised a graduate research project in optical system design and an undergraduate research project in fractal simulation. Also performed experimental research on space-variant imaging systems and holography.

1982 - 1984; Design Engineer, Delco Electronics**Santa Barbara, California**

Lead engineer for the completion and documentation of a computerized prediction tool to model the performance of an automobile sound system. This model incorporated speaker performance, interior acoustics and ray tracing to aid designers in the size and location of automobile speakers. Other activities included designing and testing electronic prototypes for switching power supplies, AM demodulators, and automobile navigation systems.

MEMBERSHIPS/HONORS:

- *Phi Beta Kappa (Top 2% of all junior-level students at Stanford)*
- *Tau Beta Pi (Top 12% of junior-level engineering students)*
- *Frederick Terman Award (Top 5% of senior-level engineering students at Stanford)*
- *ASEE Summer Faculty Fellowship (3x)*
- *IEEE*

PUBLICATIONS

Journal articles/Book Chapters/Invited articles:

- James M. Hereford, Michael Siebold, "Multi-robot search using a physically-embedded Particle Swarm Optimization", International Journal of Computational Intelligence Research, accepted for publication, 2007.
- James M. Hereford, "Fault-tolerant systems using evolvable hardware", IEEE Transactions on Instrumentation and Measurement, vol. 55, pp. 846-853, June 2006.
- James M. Hereford, Tuze Kuyucu, "Neural Network with distributed nodes provides fault tolerance", SPIE Newsroom, March 2006. < <http://newsroom.spie.org/x2324.xml?highlight=x537>>
- James M. Hereford and William T. Rhodes, "Nonlinear Optical Median Filtering by Time-Sequential Threshold Decomposition" SPIE Milestone Series of Selected Reprints on Morphological Image Processing: Principles and Optoelectronic Implementations, Tomasz Szolpik, ed., pp. 364 – 369, 1996.
- William T. Rhodes and James M. Hereford, "Optical Asymmetrical Median Filtering Using Gray-Scale Convolution Kernels," Optics Letter, pp. 696 – 699, 15 June 1990.
- James M. Hereford and William T. Rhodes, "Nonlinear Optical Median Filtering by Time-Sequential Threshold Decomposition" Optical Engineering, Vol. 27, pp.274-279, May 1988 (Cover article)

Referred conferences: (50% or less acceptance rate)

- James M. Hereford, Michael Siebold, Shannon Nichols, "Using the Particle Swarm Optimization algorithm for robotic search applications", 2007 Swarm Intelligence Symposium, Honolulu, HI, pp. 53 – 59, April 2007.
- James M. Hereford, "A distributed Particle Swarm Optimization algorithm for swarm robotic applications", 2006 Congress on Evolutionary Computation, Vancouver, BC, pp. 6143 – 6149, July 2006.
- James M. Hereford, Tuze Kuyucu, "Robust neural networks using motes", 2005 NASA/DoD Conference on Evolvable Hardware, Washington, DC, pp.117-124, June 2005.
- James M. Hereford and Charles Pruitt, "Robust sensor systems using evolvable hardware", 2004 NASA/DoD Conference on Evolvable Hardware, Seattle, WA, pp. 161-168, June 2004.
- James M. Hereford and Duane Moffitt, "High-Resolution Terrain Database Issues in Distributed Interactive Simulations", 18th IITSEC Proceedings, 8 pages, December 1996.

Conferences:

- James M. Hereford, "Swarm applications: a potential future application for evolvable hardware", 2007 Workshop on Evolvable and Adaptive Hardware, Honolulu, HI, pp. 72 – 78, April 2007.
- James M. Hereford, Tuze Kuyucu, Shannon Nichols, Michael Siebold, "Development and control of small robots", 2006 Kentucky EPSCOR conference, Louisville, KY, May 2006. (Poster + presentation)
- Silas Menser, James M. Hereford, "A new optimization technique", 2006 IEEE SoutheastCon, Memphis, TN, pp. 250-255, March 2006.
- James M. Hereford, Tuze Kuyucu, "Robust neural networks, 2005 Kentucky EPSCOR conference, Louisville, KY, May 2005. (Poster)
- James M. Hereford and David Gwaltney, "Design space issues for intrinsic evolvable hardware", 2004 NASA/DoD Conference on Evolvable Hardware, Seattle, WA, pp 231-235, June 2004.
- Tuze Kuyucu, James M. Hereford, "Robust systems using evolvable hardware", 2004 Kentucky Academy of Sciences Annual Meeting, Murray, KY, November 2004. (presentation)
- James Humes, James M. Hereford, "Control of an inverted pendulum", 2004 Kentucky Academy of Sciences Annual Meeting, Murray, KY, November 2004. (Best presentation award)
- James M. Hereford, "Robust systems using evolvable hardware", 2004 Kentucky EPSCOR conference, Lexington, KY, May 2004. (Poster)
- James M. Hereford and Nick Galyen, "Failure detection for multiple input systems", 2004 IEEE SoutheastCon, Greensboro, NC, pp. 186 – 193, March 2004.
- Theodore D. Thiede and James M. Hereford, "Conversion of Physics-Based Labs to an Engineering Physics Curriculum", 2003 ASEE Annual Conference, Nashville, TN, pp. 1679 – 1693, June 2003.

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- James M. Hereford, David Roach, Ryan Pigford, "Image compression using parameterized wavelets with feedback," SPIE Aerosense conference, Independent Component Analyses, Wavelets, and Neural Networks, Orlando, FL, pp. 267 – 277, April 2003.
 - James M. Hereford, "Resource for Effective Engineering Physics Laboratory and Project Assignments", 2002 ASEE Annual Conference, Montreal, Canada, pp. 1189 – 1195, June 2002.
 - John Musson, James M. Hereford, H. Dong, R. Flood, C. Hovater, "A DSP-Based Beam Current Monitoring System for Machine Protection Using Adaptive Filtering", 2001 Particle Accelerator Conference, Chicago, Illinois, pp. 2329 – 2331, June 2001.
 - James M. Hereford, "Comparison of four parameter selection techniques", 2001 IEEE SoutheastCon, Clemson, SC, pp. 11 – 16, March 2001.
 - James M. Hereford, Peter A. Parker, Ray D. Rhew, "TIGER: Development of Thermal Gradient Compensation Algorithms and Techniques", 2nd International Balance Symposium, England, May 1999.
 - James M. Hereford, Peter A. Parker, Ray D. Rhew, "Impact of thermal gradients on wind tunnel force measurements", 37th AIAA Aerospace Sciences Meeting, January 1999.
 - Robert Hodson and James M. Hereford, "Infrastructure for Laboratory Distribution", IEEE Microelectronics Systems Education Conference, pp. 95 – 96, July 1997.
 - Robert Hodson and James M. Hereford, "Interactive CPU Simulator for Computer Organization Instruction", Workshop on Computer Architecture Education, February 1997.
 - James M. Hereford and George M. Parsons, "Terrain Standards Considerations for Advanced Simulation Exercises", Proceeding 14th DIS Workshop, Orlando, FL, March 1996.
 - Hanjun Peng, H.J. Caulfield, J. M. Kinser, James M. Hereford, "Optimization filters design for GFT by genetic algorithm", Proceeding SPIE, vol. 2565, Optical Implementation of Info Processing, pp. 74 – 84, August 1995.
 - H.J. Caulfield, Hanjun Peng, James M. Hereford, D. Mitchell Wilkes, "Generalized Fourier Transform Processor", Proceeding SPIE, Optical Pattern Recognition V, pp. 320 – 328, April 1994.
 - James M. Hereford, "Optical Expert System with Fuzzy Response Capability," OSA Annual Meeting, ThW, September 1992.
 - James M. Hereford and William T. Rhodes, "Nonideal Thresholding effects in the Optical Implementation of Median Filtering," OSA Annual Meeting, MX5, November 1990.
 - William T. Rhodes and James M. Hereford, "Nonlinear Optical Image Processing", Proceedings SPIE, Vol. 960, 1989.
 - James M. Hereford and William T. Rhodes, "Nonlinear Optical Median Filtering by Time-Sequential Threshold Decomposition" Proceedings SPIE, Vol. 939, pp-40-45, 1988.
 - William T. Rhodes and James M. Hereford, "Quasi Space-Invariance for Coherent Imaging of Diffuse Object," OSA Annual Meeting, K2, October 1987.

TECHNICAL REPORTS:

- T. Liu, J. Hereford, S. Graves, R. Ross, A. Burner, K. Eom, "Computer Vision as a Universal Framework for Image-Based Measurements in Aerospace Engineering and Sciences", submitted to NASA, 150 pages, September 2000.
- James M. Hereford, "Analysis of National Transonic Facility (NTF) Balance Temperature Data", submitted to NASA-LaRC, 69 pages, August 2000.
- James M. Hereford, "TIGER MANE: Thermally-Induced Gradient Effects Research - Model Analysis and Nontransferability Evaluation", ASEE Summer Faculty Fellowship Program Best Research Competition, 1998.
- James M. Hereford, "TIGER PAU: Applying Genetic Algorithms to the Thermally-Induced Strain Problem", ASEE Summer Faculty Fellowship Program Best Research Competition, August 1997.
- James M. Hereford, "Innovative Pattern Recognition Paradigm", Bytes of Science: An Internet Magazine, D. Mazel, ed., January 1997.
- James M. Hereford, "Evaluation of Westinghouse Mine Detection and Processor (MIDAP) Algorithms", submitted to ASTAMIDS Project Office, Camber Corporation, March 1995.
- James M. Hereford, H.J. Caulfield, S. James Siverd, "Pseudo-Fringe Sensing Technique for Autonomous Spacecraft Rendezvous and Capture," Sigmatech, Inc., ST-NASA-920001-JH, SBIR Phase I, June 1992.
- James M. Hereford, Ed D. Watts, N. Blanche Clanton, Gurmej S. Sandhu, "Pseudo-Geometric Image Processor for Target Detection and Classification," Sigmatech, Inc., SIG-TR-92-001, SBIR Phase II, February 1992.

SUCCESSFUL GRANTS and PROPOSALS

Title	Dates	Amount	Grantor
KySat 2	2007-2008	\$28,000	Kentucky Satellite (KySat)
Dispersion algorithms for swarm robotics	2007-2008	\$2300	Murray State University – CISR
Algorithms for swarms for planetary exploration	2007-2008	\$5000	Kentucky Space Grant Consortium
Kentucky Satellite Project: Central Team Member	2006-2007	\$12,800	Kentucky Space Grant Consortium
Algorithms for robot swarms	2006-2007	\$2355	Murray State University – CISR
Development and control of MitEBots	2005-2006	\$9995	Kentucky Space Grant Consortium
Development and control of MitEBots	2005-2006	\$2200	Murray State University – CISR
Robust systems using evolvable neural nets	2004-2005	\$25,000	Kentucky NASA EPSCOR
Programming neural networks using evolvable hardware techniques	2004-2005	\$1775	Murray State University – CISR
Robust systems using evolvable hardware	2003-2004	\$25,000	NSF EPSCOR Research Enhancement Grant
Robust systems using evolvable hardware techniques	2003-2004	\$2200	Murray State University – CISR
Matlab and Toolboxes for Physics and Engineering coursework	Spring 2002	\$1580	Murray State University - Instructional Development Grant
Improved noise reduction technique	2002-2003	\$2630	Murray State University – CISR
ISE Foundation software + FPGA development boards	Fall 2001	\$10,980	Xilinx corporation
Development and Modeling of Digital Filters to be used in the Beam Current Monitor System	Spring 2001	\$6400	Department of Energy – Jefferson Lab
TIGER PAU: Thermally-Induced Gradient Effects Research Parameter Assessment Undertaking	1997-2001 (Includes 3 renewals)	\$102,000	NASA - Langley Research Center
Next Generation Remote Acquisition and Storage System	1999-2000	\$30,800	NASA - Langley Research Center
ASEE - Summer Faculty Fellowship Program	1997, 1998, 1999 (3 awards)	\$30,000	American Society for Engineering Education (ASEE)
Optical syntactic pattern recognition	1993	Approx \$40,000	US Army Space and Strategic Defense Command
Advanced Hybrid Multiple Target Recognition System	1991	\$50,000	NASA – Marshall Space Flight Center (SBIR)