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EDUCATION:

Ph.D. in Electrical Engineering, Dec. 1995 — University of New Mexico, Albuquerque, NM

Thesis Advisors:	Dr. Chaouki T. Abdallah and Dr. Gregory L. Heileman
Dissertation Title:	Gradient and Hamiltonian Dynamics: Some Applications to Neural Network Analysis and System Identification.

M.S. in Electrical Engineering, May 1990 — University of Central Florida, Orlando, FL

Honors & Awards:	Tau Beta Pi, Eta Kappa Nu, Litton Fellowship

B.S. in Engineering Physics, June 1986 — Lehigh University, Bethlehem, PA

CAREER-RELATED EXPERIENCE:

Technical Staff Member at Los Alamos National Laboratory (LANL) in Los Alamos, NM from 3/98 to the present. *Postdoctoral Researcher* with Dr. Kevin Buescher at LANL from 6/96 to 2/98. A selection of project work follows.

- Network Cyber Security: Developed methods for detecting chat protocols in encrypted network traffic. The method detects regions of the data space where chat data is more highly concentrated than background data. The two principle advantages of this method over traditional approaches are that it allows us to obtain near optimal detection and false alarm rates, and it allows us to design a detector specifically for the deployed environment. Trained and tested the method using real world network traffic.
- Target Recognition in SAR Images: Developed an object classifier that given a SAR image produced a list of target locations within the image. The system was trained on a set of images where sets of pixels containing targets were determined by a human analyst. The criterion function was designed to optimize the trade-off between missed detections, false alarms, and extra object false alarms (detecting the same object more than once). The criterion also compensated for the difference between the density of targets in the training data versus the deployed environment. The system was trained and tested using the the DARPA MSTAR data set.
- Anomaly Detection in Graphs: Demonstrated two novel machine learning based anomaly detection methods on a synthetic problem in which graphs represented the interactions of characters in several famous novels. Used a novel graph kernel for this study.
- Protein Function Inference: Created predictors to infer protein function from protein sequence and structure. Obtained sequence and structure data for about 24000 proteins. The specific goal was to create a 6-class classifier for the the first Enzyme Classification (EC) number for proteins. First, created a reference predictor which represented the predictions of a human expert. Second, constructed a feature space which reduced the problem dimension from about 4100 to 50. Third, designed predictors using both data dependent classifiers (DDKL) and support vector machines (SVM). Both the DDKL and SVM predictors had error rates that were roughly one half the error rate of the reference (expert).

- Communication Detection: Developed methods for detecting certain communication strategies. Used machine learning methods to design and implement detectors which maximized detection rate subject to upper bounds on the false alarm rate (Neyman-Pearson detection). Developed novel features for this problem domain which significantly enhanced detection performance. Trained and tested detectors on real world data sets from this problem domain.
- Real World Machine Learning: Used machine learning principles to develop learning strategies for solving real world problems such as classification, robust (min-max) classification, Neyman-Pearson detection and anomaly detection. Implemented algorithms based on these strategies and tested the algorithms using real world data sets. These strategies have finite sample bounds on future performance and polynomial run-time bounds on training time. In particular, wrote a software package implementing *data dependent kernel learners* (DDKL) which solve all four of the above problems plus several more, do not suffer from the curse of dimensionality, have small error deviance bounds, and have run-time and memory bounds of $O(n^3\, d)$ and $O(n\, d)$ respectively.
- Bayes Error Estimation: Developed, implemented and tested an algorithm to estimate the Bayes error from empirical data using a nearest neighbor technique. The Bayes error is the minimum classification error for a given pattern recognition problem. The Bayes error estimate can be used to analyze the problem since the magnitude of the estimate indicates the degree of class separability. The error estimate can be used to compare classifiers, since their test error estimates can be compared to the Bayes error estimate. The estimate can also be used to select features, by computing Bayes error estimates with and without each feature and keeping those features with the smallest difference.
- Blast Furnace Control: Derived a model based on heat and mass transport for the heating and cooling cycles of the thermal regenerators used to supply heat to the blast furnace. Wrote a two-dimensional simulation of the partial differential equations describing the heating and cooling processes, and a parameter estimation procedure to fit this model to measured regenerator data. Developed a model predictive controller which minimizes fuel consumption while maintaining sufficient heat in the regenerators to satisfy the process requirements, and wrote computer code to solve this optimization problem. Initial audits by the company indicate that the controller is reducing the amount of fuel used per quantity of heat produced by 6% or about $500,000 annually.
- Security and Safety Monitoring for Radioactive Experiments: Designed and conducted experiments to characterize the detection and tracking of radioactive sources using gamma radiation sensors at a LANL facility. Analyzed the experimental data to determine the radial and angular antenna pattern of the sensors. Developed a detection algorithm based on non-parametric hypothesis testing to determine the presence of radioactive sources in the facility. Developed a tracking algorithm based on nonlinear state estimation to track source locations using real-time sensor data. This algorithm is similar to a Kalman filter which uses Poisson distributed measurement noise and allows state constraints.

Research Assistant for Drs. Abdallah and Heileman at the University of New Mexico in Albuquerque, NM from 8/91 to 5/96. Conducted basic research into the analysis of the dynamics in recurrent neural networks. Used control theory and dynamical systems theory concepts to develop a mathematical formalism which unifies the analysis of Lyapunov stability, phase space behavior, and structural stability for many existing neural network paradigms. Extended this by developing a formalism which decomposes system dynamics into the sum of dissipative (e.g., convergent) and conservative (e.g., periodic) components. Used this formalism to develop a class of nonlinear models and an associated learning algorithm which are guaranteed to solve certain types of nonlinear identification problems. Wrote software to simulate the various models and verify results. This work was funded by a contract from Boeing Computer Services.

Research Assistant for Dr. Robert F. Cromp at NASA / Goddard Space Flight Center in Greenbelt, MD from 5/92 to 8/92. Performed basic research into the development and analysis of unsupervised learning algorithms for the automatic characterization of remotely sensed satellite images. The work was used to examine Landsat TM and MSS data, AVHRR data, and SAR data. Developed software for these algorithms.

Research Assistant for Dr. Gamal (Jim) M. Moharam at the Center for Research in Electro-Optics and Lasers (CREOL) in Orlando, FL from 3/89 to 5/90. Wrote software to simulation diffraction effects in acousto-optic and photorefractive media. Assisted with the construction of a unique optical correlator that determined whether two input frequencies were identical through acousto-optic and photorefractive optical device technology. This work was funded by a contract from Harris Government Systems.

Senior Staff Technologist for Dr. Davis H. Hartman at Bellcore in Morristown, NJ from 5/87 to 5/88. Responsible for the research and development of a new process to produce channel waveguides from radiant curing polymers for use in optical interconnects. Researched and tested various materials. Investigated both photolithographic and laser writing techniques to produce the waveguides. Measured the loss characteristics of optical waveguides. To accommodate different waveguide types, designed experiments using three coupling schemes; end-fire, prism and a unique wedge. Assembled and in some cases machined the necessary components for each experiment. Collected and analyzed the data for each waveguide.

SKILLS:

- Extensive experience programming in C and FORTRAN
- Extensive experience with a variety of Unix operating systems
- Experience using SPlus, Matlab, Mathematica, and Maple
- Active DOE Q and SCI clearances

AFFILIATIONS:

Institute of Electrical and Electronic Engineers

Society of Industrial and Applied Mathematics

PUBLICATIONS:

"Radiometric Calibration of Gray Scale Images", J.W. Howse and J. Hogden, Technical Report, Los Alamos National Lab, LA-UR-06-7109, 2006.

"A Machine Learning Approach for Predicting EC Numbers of Proteins", J.W. Howse, Technical Report, Los Alamos National Lab, LA-UR-06-5056, 2006.

"Anomaly Detection in Graphs", J.W. Howse and D.R. Hush, Technical Report, Los Alamos National Lab, LA-UR-05-8440, 2005.

"Model-based fault detection for three-way automotive catalyst systems", K.R. Muske, J.C. Peyton Jones, and J.W. Howse, *Proceedings of the First IFAC Symposium on Advances in Automotive Control*, Salerno, Italy, April 2004, pp. 374–379, 2004.

"Simple Classifiers", A. Cannon, J.W. Howse D.R. Hush and C. Scovel, Technical Report, Los Alamos National Lab, LA-UR-03-0193, 2003.

"A sequential quadratic programming method for nonlinear model predictive control", K.R. Muske and J.W. Howse, in *Large-scale PDE-Constrained Optimization*, L.T. Biegler, O. Ghattas, M. Heinkenschloss, and B. van Bloemen Waanders, editors, Lecture Notes in Computational Science and Engineering, Vol. 30, Springer-Verlag, pp. 253–267, 2003.

"Nonparametric statistical tests for radioactive source detection", J.W. Howse, and K.R. Muske, *Proceedings of the Fifth IFAC Symposium on Fault Detection, Supervision and Safety of Technical Processes*, Washington, DC, June 2003, pp. 1233–1238, 2003.

"Learning with the Neyman-Pearson and Min-Max Criteria", A. Cannon, J.W. Howse D.R. Hush and C. Scovel, Technical Report, Los Alamos National Lab, LA-UR-02-2951, 2002.

"Linking Learning Strategies and Performance for Support Vector Machines", A. Cannon, J.W. Howse D.R. Hush and C. Scovel, Technical Report, Los Alamos National Lab, LA-UR-02-1933, 2002.

"Least squares estimation techniques for position tracking of radioactive sources", J.W. Howse, L.O. Ticknor, and K.R. Muske, *Automatica*, Vol. 37, No. 11, pp. 1727–1737, 2001.

"Comparison of recursive estimation techniques for position tracking radioactive sources", K.R. Muske and J.W. Howse, *Proceedings of the 2001 American Control Conference*, Arlington, VA, June 2001, pp. 1656–1660, 2001.

"Product property monitoring for a batch polymerization reaction system", K.R. Muske, J.W. Howse, and D.R. Hush, *Proceedings of the 2001 American Control Conference*, Arlington, VA, June 2001, pp. 987–992, 2001.

"Product property monitoring for a batch polymerization reaction system", K.R. Muske, J.W. Howse, and D.R. Hush, *Proceedings of the 2001 American Control Conference*, Arlington, VA, June 2001, pp. 987–992, 2001.

"A Lagrangian method for simultaneous nonlinear model predictive control", K.R. Muske, and J.W. Howse, Presented at the *First Sandia Workshop on Large Scale PDE-Constrained Optimization*, Santa Fe, NM, April 2001.

"Solving a thermal regenerator model using implicit Newton-Krylov methods", J.W. Howse, G.A. Hansen, D.J. Cagliostro, and K.R. Muske, *Numerical Heat Transfer: Part A - Applications*, Vol. 38, No. 1, pp. 23–44, 2000.

"Model-based control of a thermal regenerator. Part 1: Dynamic model", K.R. Muske, J.W. Howse, G.A. Hansen, D.J. Cagliostro, *Computers and Chemical Engineering*, Vol. 24, No. 11, pp. 2521–2533, 2000.

"Model-based control of a thermal regenerator. Part 2: Control and estimation", K.R. Muske, J.W. Howse, G.A. Hansen, D.J. Cagliostro, *Computers and Chemical Engineering*, Vol. 24, No. 11, pp. 2509–2519, 2000.

"Lagrangian solution methods for nonlinear model predictive control", K.R. Muske, J.W. Howse, and G.A. Hansen, *Proceedings of the 2000 American Control Conference*, Chicago, IL, June 2000, pp. 4239-4243, 2000.

"Hot blast stove process model and model-based controller", K.R. Muske, J.W. Howse, G.A. Hansen, D.J. Cagliostro, P.C. Chaubal, P.E. Quisenberry, and M.J. Washo, *Iron and Steel Eng.*, Vol. 76, No. 6, pp. 56-62, 1999.

"Temperature profile estimation for a thermal regenerator", K.R. Muske, J.W. Howse, G.A. Hansen, and D.J. Cagliostro, *Proceedings of the 1999 Conference on Decision and Control*, Phoenix, AZ, December 1999, pp. 3944-3949, 1999.

"On-line process model of a hot blast stove", K.R. Muske, J.W. Howse, G.A. Hansen, and D.J. Cagliostro, *1999 AIChE National Meeting*, Dallas, TX, November 1999, paper 213a, 1999.

"Recursive estimation for the tracking of radioactive sources", J.W. Howse, L.O. Ticknor, K.R. Muske, *Proceedings of the 1999 American Control Conference*, San Diego, CA, June 1999, pp. 1905–1909, 1999.

"Hot blast stove process model and model-based controller", K.R. Muske, J.W. Howse, G.A. Hansen, D.J. Cagliostro, and P.C. Chaubal, *Proceedings of the 1998 AISE Annual Conference*, Pittsburgh, PA, September 1998, paper 48, 1998.

"Blast furnace stove control", K.R. Muske, G.A. Hansen, J.W. Howse, D.J. Cagliostro, and P.C. Chaubal, *Proceedings of the 1998 American Control Conference*, Philadelphia, PA, June 1998, pp. 3809–3810, 1998.

"Implicit Newton–Krylov methods for modeling blast furnace stoves", J.W. Howse, G.A. Hansen, D.J. Cagliostro, and K.R. Muske, *Proceedings of the 1998 AIAA/ASME Joint Thermophysics and Heat Transfer Conference*, Albuquerque, NM, June 1998, pp. 283–290, 1998.

"Model-based hot blast stove control and optimization", K.R. Muske, G.A. Hansen, J.W. Howse, D.J. Cagliostro, and P.C. Chaubal, Presented at the *1997 AIChE National Meeting*, Los Angeles, CA, paper 197c.

"A learning algorithm for applying synthesized stable dynamics to system identification", J.W. Howse, C.T. Abdallah, and G.L. Heileman, *Neural Networks*, Vol. 11, No. 1, pp. 81–87, 1998.

"Some control theoretic issues in neural networks", J.W. Howse, C.T. Abdallah, and G.L. Heileman, *International Conference on Neural Networks*, Washington, DC, June, 1996, IEEE Press, Vol. Special Sessions, pp. 205–210, 1996.

"Gradient and Hamiltonian dynamics applied to learning in neural networks", J.W. Howse, C.T. Abdallah, and G.L. Heileman, *Advances in Neural Information Processing Systems*, Denver, CO, November 1995, MIT Press, Vol. 8, pp. 274–280, 1996.

"An application of gradient-like dynamics to neural networks", J.W. Howse, C.T. Abdallah, G.L. Heileman and M. Georgiopoulos, *SouthCon*, Orlando, FL, March 1994, IEEE Press, pp. 92–96, 1994.

"Total stability of dynamical neural networks", J.W. Howse, C.T. Abdallah, G.L. Heileman and M. Georgiopoulos, *World Congress on Neural Networks*, Portland, OR, July, 1993, INNS Press, Vol. 4, pp. 280–284.

"Radiant cured polymer optical waveguides on printed circuit boards for optical interconnection use", D. Hartman, G. Lalk, and J.W. Howse, *Applied Optics*, Vol. 28, No. 1, pp. 40–47, 1989.