A REDUCTIONIST APPROACH TO PROCESS DISCOVERY

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Additional work includes the application of subspace noise reduction methods and their connection to blind source separation. We have established a theoretical connection between the maximum noise fraction method and independent component analysis and demonstrated the relationship with examples. This methodology has proven useful as an integral component of the Whitney Reduction Network, developed by the grantees.

Additionally, a new approach for designing support vector machines has been developed for the classification problem using a kernel based Fisher discriminant method. In addition we have developed other algorithms in terms of kernel functions using a kernel Gram-Schmidt algorithm. These techniques have been applied to the materials science bonding problem.
Final Report
A Reductionist Approach to Process Discovery
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Shawn Martin, Ph.D. 2001, (Now Sandia National Labs)

Anthony Todd, Master’s 2001 (Now Lockheed Martin)

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Submitted Papers, Dissertations and Publications

Dissertation:

Shawn Martin, Techniques in Support Vector Classification, Department of Mathematics, Colorado State University, Fort Collins, CO 80524

Master's Paper:

Anthony Todd, Data Visualization via Structured Voronoi Cell Refinement.

Submitted:

- M. Anderle and M. Kirby, Radial Basis Function Networks based on Autocorrelation Feedback Resource Allocation, submitted for publication 2001 to Neural Computation (under review)

Accepted:


Published:


2. Douglas R. Hundley, Michael J. Kirby, and Markus Anderle, Blind source separation using the maximum signal fraction approach, Douglas R. Hundley, Michael J. Kirby, and Markus Anderle, Signal Processing Volume 82, Issue 10, October 2002, Pages 1505-1508


Travel and Conferences, Seminars


- Dave Broomhead, visited Colorado State University, Fort Collins, October 2000

- Anthony Todd visited the materials science group at WPAFB, Dayton, in October 2000.


• Michael Kirby and Shawn Martin, AFRL/MLMR Researchers Meeting, The Ohio State University, Columbus, OH, 26 November 1999.

• Michael Kirby, Department of Mathematics Seminar, Multiresolution Analysis, April 1999

• Michael Kirby, Department of Mathematics Seminar, Radial Basis Functions, September 1999

• Shawn Martin, Seminar in Applied Mathematics, Veronese mappings, October 1999.

• Michael Kirby, Whitney Reduction Networks, AFIT Colloquium, Wright-Patterson AFB, OH, 29 September 1998.

• Mark Oxley, Artificial Intelligence in Real-Time Control, Grand Canyon National Park, AZ, 5-8 October 1998.

• Mark Oxley, The Functional and Harmonic Analysis of Wavelets, AMS Special Session at the AMS Joint Mathematics Meetings, San Antonio, TX, 13 January 1999.

• Mark Oxley, AFRL/MLMR Researchers Meeting, The Ohio State University, Columbus, OH, 2 April 1999.


• Mark Oxley, AFOSR review, Minnowbrook Conference Center, NY, 16-18 April 1999.

• Mark Oxley, Evaluating the VC dimension using the Poincare Polynomial, Mathematics Seminar, Colorado State University, Fort Collins, CO, 18 May 1999.

• Mark Oxley, Symmetric Veronese Classifiers, AFOSR Electronic Prototyping Review, AFIT, Wright-Patterson AFB, OH, 8 July 1999.

Transitions

Additional Grants Transitioned From This Award:

- PI Michael Kirby, Title: Wavelet Analysis for Detecting and Characterizing Landscape Scale Patterns of Forest Disturbance, Funding Source: United States Forest Service, 7/30/01-6/1/02, $11,000.

- PI Michael Kirby, Image Mining of Sensed Data, Funding Source, Technical Management Concepts, Inc., Funding 10/15/00–9/30/01, $16,977.

- CO-PI Michael Kirby, Geometric Pattern Analysis & Mental Task Design for a Brain-Computer Interface, Funding approximately $800,000 over 4 years. (Charles Anderson, CSU, PI).

- PI Michael Kirby, Development of a MATLAB Novelty Detection Algorithm, summer 2000, $50,000, Honeywell Corporation.

Student Transitions:

- Shawn Martin Ph.D. 2001 was supported by this grant and was awarded a postdoctoral fellowship at Sandia National Labs.

- Anthony Todd, Master’s 2001 was supported by the related spin-off grant by Technical Management Concepts to address Air Force materials science problems sponsored by Steve LeClair (Wright Patterson). He has now graduated and is employed in the data fusion group at Lockheed Martin.

Consultative and advisory functions to other laboratories and agencies, especially Air Force and other DoD laboratories.

The personnel supported by this grant have been working with Dr. Steve LeClair, AFRL/MLMR, (937) 255-8787 and his Branch to determine bonding properties of materials. Dr. Pierre Villars, Material Phases Data System (MPDS), Switzerland, has data on binary and ternary compounds (Villars is funded by AFRL). We have been working with this data to discover features that determine when a compound will form. In addition, Anthony Todd and Michael Kirby have worked with Dr. LeClair for image mining of sensed data.
The data reduction techniques initiated here have been extended to the application of failure prediction and asset analysis. Using this technology, we developed the "Asset Analyzer" toolbox that for Honeywell Corporation.

Awards During Period of Grant

1. IBM Faculty Award (Michael Kirby)
2. Colorado State University College of Natural Sciences Graduate Education Award (Michael Kirby)