

FIELD OF STUDY

Signal Analysis

DISSERTATION TOPIC

**“DIMENSIONALLY ALIGNED SIGNAL PROJECTIONS FOR
SIGNAL CHARACTERIZATION”**

EXAMINING COMMITTEE

Dr. Adam Anderson, Committee Chair
Former Assistant Professor, Electrical & Computer Engineering

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ABSTRACT

Unintended radiated emissions (URE) can provide valuable electrical device classification and characterization insights for many applications from non-intrusive load monitoring (NILM) to condition-based maintenance. URE processing algorithms often require subject matter expertise to tailor transforms and feature extractors for the specific electrical device of interest. Dimensionally aligned signal projections (DASP) are presented as a method for projecting aligned signal dimensions, such as frequency harmonics, frequency spacings, and signal modulations that are inherent to the physical implementation of the vast majority of commercial electronic devices, thus removing the need for an intimate understanding of the underlying physical circuitry and the URE generation mechanism. In addition, methods for the processing of DASP images, extracting statistical features from DASP images, and direct learning from DASP images using convolutional neural networks (CNNs) were detailed and evaluated using a data set of URE captures from commercial electronic devices.

Classification of devices using DASP based features was demonstrated with one-versus-all accuracies reaching 100% for Linear Discriminant Analysis (LDA) and K-Nearest Neighbor (KNN) classifiers applied to statistical-based features, as well as a CNN learner applied directly to DASP images. The LDA and CNN learning methods were adapted to multi-class all-versus-all classification and were able to obtain an accuracy of 66.7%, with precisions reaching 97%. The multi-class CNN learner was also tested against DASP images derived from URE clutter devices and was able to correctly identify clutter at an accuracy of 80%.

BIOGRAPHICAL SKETCH

J. Michael Vann received his B.S and M.S. degrees in Electrical and Computer Engineering from the University of Tennessee-Knoxville in 1997 and 1998 respectively. His is currently a researcher at Oak Ridge National Laboratory in Oak Ridge, TN. His research interest focuses on communications in disadvantaged environments and URE signal processing.

EDUCATION

University of Tennessee
Knoxville, Tennessee
B.S. Electrical & Computer Engineering, 1997

University of Tennessee
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College of Engineering

TENNESSEE TECH

The Department of

Electrical & Computer Engineering

Announces the Dissertation Defense

Of

Jason Michael Vann

In Partial Fulfillment of the Requirements

For the degree of

Doctor of Philosophy

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