# A Distributed Neurocomputing Approach for Event Classification

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**ABSTRACT:**

Classifier performance results are compared for a distributed bank of Partial Least-Squares Regression (PLSR) calibration models and the same classifier architecture but using Radial Basis Function (RBF) neural networks. PLSR is a statistical modeling method from the class of techniques know as chemometrics used in analytical chemistry to quantitatively analyze spectrophotometric data.

Both the PLSR and RBF distributed classifier architectures are used to discriminate between different infrasound events. Infrasound is a longitudinal pressure wave with characteristics similar to audible acoustic waves but in a frequency range far below what the human ear can detect. The typical frequency range for infrasound is between 0.01 Hz and 10 Hz. An integral part of the comprehensive nuclear test ban treaty (CTBT) international monitoring system (IMS) is an infrasound network system capable of detecting nuclear events. Other man-made events that can produce infrasound are the space shuttle, vehicles, rockets, artillery fire, and high-speed aircraft, to name a few. Moreover, nature is an incredible source of infrasound, such as volcano eruptions, earthquakes, tsunamis, bolides (meteors), microbaroms (infrasound radiated from ocean waves), surf, mountain ranges (mountain associated waves), avalanches, and auroral waves, to name a few. Because of the relatively low atmospheric absorption at low frequencies, infrasound waves can travel long distances in the earth's atmosphere and can be detected with sensitive ground-based sensors.

Each module (from the bank of modules within the distributed classifier architecture) is responsible for classifying one of several infrasound events, and thus is trained to identify only that particular event. The output threshold of each module is set according to a specific 3-D Receiver Operating Characteristic (ROC) curve as opposed to using classic 2-D ROC curves.

Preprocessing of the infrasound signals is carried out by extracting an optimal set of cepstral coefficients and their associated derivatives that form the feature vectors used to train and test the distributed classifier modules. This pre-processing method is similar to that used for speaker recognition. When a set of optimal feature vectors is used for training and testing, there is a significant increase in the Correct Classification Rate (CCR). For both classifier types, that is, using either the PLSR model or the RBF neural network within each module, greater than 95% CCR can be achieved.

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Dr. Ham is Harris Professor of Electrical Engineering at Florida Institute of Technology in Melbourne. He is also the Director of the Information Processing Laboratory. During the 2004-2005 academic year he was the Interim Dean of the College of Engineering and from 2000-2005 he was the Associate Dean for Research in the College of Engineering. He worked 10 years in industry before coming to Florida Tech in 1988. He was with the Harris Corporation from 1980 to 1988 and the Shell Oil Company from 1976 to 1977. He is currently the President of the International Neural Network Society (2007-2008), President Elect of INNS (2006), and Secretary of INNS (2004-2005). He is a Senior Member of IEEE and was an Associate Editor for the IEEE Transactions on Neural Networks from 2001 to 2007. He has published over 100 technical papers and reports, mostly in the areas of neural networks, digital signal processing and biomedical engineering (specifically, biosensors). He holds 3 U.S. patents and is author of the textbook: *Principles of Neurocomputing for Science and Engineering*, McGraw-Hill, 2001. Dr. Ham's current research interests include: applications of neural networks, adaptive signal processing, biosensor development for non-invasive blood glucose monitoring, and development of neural-based classification methods using infrasound for monitoring nuclear explosions to support the Comprehensive Nuclear Test Ban Treaty.