演講題目: Multiclass Remote Sensing Image Classification by Multivariate Time Series Model Based
Support Vector Machine

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Abstract: (This similar topic was presented by Pei-Gee Peter Ho at MIT Lincoln lab. in 2008.)

Satellite and airborne Remote Sensing for observing the earth surface, land monitoring and geographical information systems control are now big issues in our daily life as well as country's defense projects. The source of information was primarily acquired by imaging sensors and spectroradiometer in remote sensing multi-spectral image stack format. The traditional image processing techniques either by single picture image processing or compressing pictures stack via PCA or ICA into a single image component for further pixel classification or region segmentation is not adequate to describe the true information extracted from multi-spectral satellite sensors. In an effort to significantly improve the existing classification and segmentation performance in this dissertation research, the contextual information between pixels or pixel vectors is characterized by a time series model for image processing in remote sensing. Time Series statistical models such as Autoregressive Moving Average (ARMA) were considered useful in describing the texture and contextual information of a remote sensing image. To simplify the computation, we use a two-dimensional (2-D) Autoregressive (AR) model instead. In the first phase, the 2-D univariate time series based imaging model was derived mathematically to extract the features for further terrain segmentation. The effectiveness of the model was demonstrated in region segmentation of a multispectral image of the Lake Mulargias region in Italy. Due to the nature of remote sensing images such as SAR (Synthetic Aperture Radar) and TM (Thermal Mapper) which are mostly in multi-spectral image stack format, a 2-D Multivariate Vector AR (ARV) time series model with pixel vectors of multiple elements (e.g. 15 elements in the case of TM+SAR remote sensing) are examined. The 2-D system parameter matrix and white noise error covariance matrix are estimated for further classifications in the second phase of algorithm development . To compute the time series ARV system parameter matrix and estimate the error covariance matrix efficiently, a new method based on modern numerical methods is developed by introducing the Schur complement matrix, the QR (orthogonal, upper triangular) matrix and the Cholesky factorizations in the ARV model formulation. As for pixel classification, the powerful Support Vector Machine (SVM) kernel based learning machine is applied in conjunction with the 2-D time series ARV model. The SVM is particularly suitable for the high dimensional vector measurement as the curse of dimensionality problem is avoided. The performance improvement over the popular Markov random field is demonstrated. The 2-D multivariate time series model is particularly suitable to capture the rich contextual information in single and multiple images at the same time. A single composite image is constructed from the vector pixels through ARV based Support Vector Machine classifications. As an additional study the issue of objective image quality assessment is considered experimentally with the use of entropy, histogram, edge and variance.

Speaker Biography:

Dr. Pei-Gee Peter Ho received his MS degree in Electrical Engineering and Ph.D. degree in Electrical and Computer Engineering, both from UMass Dartmouth. During the past about 30 years he has worked in various electrical and computer engineering companies such as Wang Lab., Brooktrout Technology, Compugraphics, SystemSoft, Ennovate Networks, Quarry Technology, Lockheed Martin Inc. and was primarily associated with embedded computing systems, networking, and device driver developments. He is now working in the Digital Signal Processing algorithm and Software Design group in Range and Engineering department of Naval Undersea Warfare Center at Newport, Rhode Island USA.