UTD *Electrical Engineering Seminar Series &*
Dallas Chapter of IEEE Signal Processing Society Present

On Signal Representation for Statistical Learning and Pattern Recognition

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2pm, Monday, June 21, 2010
UTD Conference Center - CN 1.120

This talk covers two topics on the role of signal representation in statistical learning problems, in the context of deriving new filter bank solutions for speech recognition and new histogram-based constructions for estimating information measures. The first topic focus on filter bank selection and the use of Wavelet Packets (WPs) for phone recognition. The minimum probability of error signal representation (MPE-SR) criterion is adopted for selecting the filter structure that achieves an optimal tradeoff between feature complexity and discrimination. The problem is formulated as a complexity regularized optimization criterion, where the tree-indexed structure of the WPs is explored to find conditions for reducing this criterion to a type of minimum cost tree pruning, a method well understood in regression and classification trees (CART). For the experimental validation, a simplified phone classification task is presented. Experiments ratify the goodness of WPs as an analysis scheme, and show the potentiality of the MPE-SR as a criterion for categorizing complex time series observations. The second topic addresses the problem of universal estimating of mutual information on continuous spaces. A general histogram-based construction is proposed considering non-product data-driven partition schemes. We present a result stipulating sufficient conditions to make the histogram-based construction strongly consistent. From this, two density free estimators are derived, one based on statistically equivalent blocks and the other, on a tree-structured vector quantization (TSVQ) scheme. Simulated experiments demonstrate the superiority of these adaptive techniques in terms of a bias-variance analysis when compared to conventional product histogram-based and kernel plug-in estimates.

Jorge Silva received the PhD degree in electrical engineering from the University of Southern California (USC) in 2008. He was formerly a Research Assistant at the Signal Analysis and Interpretation Laboratory (SAIL) at USC from 2003 to 2008 and was also a research intern at the Speech Research Group, Microsoft Corporation in summer 2005. He is currently an Assistant Professor in the Electrical Engineering Department, University of Chile, Santiago. Dr. Silva is a member of the IEEE Signal Processing and Information Theory Societies. He is recipient of the Outstanding Thesis Award 2009 for Theoretical Research of the Viterbi School of Engineering, the Viterbi Doctoral Fellowship 2007-2008, and the Simon Ramo Scholarship 2007-2008 at USC. His research interests include nonparametric learning; optimal signal representation for pattern recognition; speech processing; vector quantization for lossy compression; sequential detection; and distributive learning in sensor networks.
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