TW414 / PR813 Lecture 2

Some terminology and concepts applicable to the modelling of structure in complex data

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Purpose: To introduce some pattern recognition concepts and terms.

Material:

General: We have already seen that typical elements of a pattern recognition system include the DSP stage, possible further feature vector manipulation to decorrelate and compress (of which PCA is an example), and lastly the pattern modelling and classification stages. The pattern model assists coding by suggesting a relevant set of parameters which characterises the signal. It also makes classification possible by being a reference against which comparisons can be made. In today's lecture, some terminology and concepts regarding the differences between patterns and modelling approaches will be discussed.

Topics:

- Features, static patterns, temporal patterns, possible conversion of temporal to static patterns.
- Discrete/atomic versus continuous features.
- Training, verification and test data sets. Leave-one-out sets.
- Supervised versus unsupervised training (clustering).
- Parametric versus non-parametric models.
- Statistical approaches: Bayesian classifiers, discriminant functions, PDFs and mixtures thereof, Parzen and k-NN non-parametric PDF estimators. Clustering: k-means, hierarchical clustering.
- Artificial neural networks: back-propagation, time-delay networks (TDNN), radial basis function (RBF) networks etc. Clustering: Kohonen maps, ART modules etc.
- Syntactical: Stochastic grammars, regular, context-free, context-sensitive, Turing machines. Hidden Markov Models (HMM).

Project: (SELF-STUDY)

- Obtain the `simvowel` data set representing 5 simulated vowels, as well as either the `timit` set with speech from 14 female speakers, or the `faces` set with images of the faces of 20 people. Without attempting to use formal/known methods (that we will do in the rest of this course), try to set op a vowel recognition and a speaker/face recognition system based on any good/unusual idea that you can come up with. For the speech, pre-calculated feature vectors are available in the various `*.cep` files. Use the `sx*.cep` files for training the system, and then test it on the `si*.cep` and `sa*.cep` files. For the face recognition experiment, use the "straight" faces and train your algorithm on the `happy` and `sad` expressions, and then test it on the `angry` and `neutral` ones. Also use PCA and LDA in each experiment to first reduce the feature vector dimension and compare the results with those using the original feature vectors.

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[1] `http://www.dsp.sun.ac.za/pr813/lesings/2_concepts/2_concepts.pdf`