

Applied Signal Recognition

MECE E6620y

Th. 6:50PM-9:20PM

Prof. Homayoon Beigi¹

(A Columbia Engineering PhD, who has extensive experience in signal recognition at IBM Watson Research Labs. and Recognition Technologies, Inc.)

Bulletin Description

Lect: 3. 3pts. **Prerequisite:** MATH E1210, APMA E3101, programming, or instructor's permission.

Applied recognition and classification of signals using a selection of tools borrowed from different disciplines. Applications include human biometrics, imaging, geophysics, machinery, electronics, networking, languages, communications, and finance. Practical algorithms are covered in signal generation, modeling, feature extraction, metrics for comparison and classification, parameter estimation, supervised, unsupervised and hierarchical clustering and learning, optimization, scaling and alignment, signals as codes emitted from natural sources, information, markov modeling, and extremely large-scale search techniques.

For more information (see <http://www.RecognitionTechnologies.com/beigi> – Click on “Courses”)

Comments

Signal Recognition is a highly multi-disciplinary topic which has not been covered in whole by any one course. This course describes commonalities among many real-world signal recognition and classification problems stemming from sources such as human biometrics, imaging, geophysics, machinery, electronics, genetics, networking, chemical plants, languages, communications, finance, etc. It introduces tools and algorithms derived from many different engineering disciplines to be able to fully address practical recognition and classification problems. The course is appropriate for graduate students in all engineering disciplines.

Signal recognition is important in robotics, in trying to make the robot react and modify its commands based on the observed situation in the world. One very important application is the use of signal analysis to predict failure in mechanical systems before they happen, for example failure of the gear box in helicopters, or failure of cutting tools in machining.

The list above gives some understanding of the broad applications of these techniques. Some applications that get a lot of publicity are Identification and Verification using signature, speech, finger-print, retina, iris, and other biometrics as well as speech and handwriting recognition as a human-machine interface.

Lecture 1: Introduction (Generation of Signals and Modeling)

Lecture 2: Feature Extraction Techniques

Lecture 3: Metrics and Distortion Measures for Signal Comparison

Lecture 4: Signal Classification

Lecture 5: Parameter Estimation, Supervised Clustering and Learning Techniques

Lecture 6: Probability Densities and Unsupervised Clustering

Lecture 7: Hierarchical Clustering Techniques

Midterm

Lecture 8: Nonlinear Optimization Algorithms and Handling Constraints

Lecture 9: Scaling and Time-Alignment Techniques

Lecture 10: Signals Viewed as Codes Emitted from Natural Sources and Metrics of Information

Lecture 11: Markov Modeling – Practical Training and Decoding Algorithms

Lecture 12: Search Techniques for Extremely Large-Scale Systems

Project

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