

ECE Seminar 794
(Required for Communication and Control Group Graduate Students)
Date : Wednesday, April 5
Time: 11:15-12:15
Place: Guinness Student Center

Methods and Applications of Time-Varying Spectral Analysis

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Abstract: Many natural and man-made signals, such as speech, sonar, radar, machine vibrations, and biomedical signals, exhibit spectral characteristics that change over time. In 1946, Gabor laid the theoretical foundations for time-varying spectral analysis, and noted the inadequacy of standard Fourier analysis to describe the physical reality of time-varying frequencies, stating “Our everyday experiences -- especially our auditory sensations -- insist on a description [of signals] in terms of both time *and* frequency.” At about the same time, instruments to perform time-varying spectral analysis were being developed at Bell Laboratories; the resulting “sound spectrograph” was paramount in discovering how the frequencies in speech change over time, the understanding of which has been fundamental to the development of devices to synthesize speech and to perform automatic speech recognition. Since these pioneering efforts, many advances have been made, in theory, implementation and application of time-varying spectral analysis. These analysis techniques have been found to be useful in a variety of areas, including acoustic scattering, pulse propagation, biological signal analysis, and machine vibration analysis, among many others. This analysis provides a more complete characterization of signals by showing how the frequencies change over time, which in turn can provide insight about the underlying system or structure from which the signals originated. In this talk, a review of the methods and applications of time-frequency analysis is presented, with an emphasis on application areas of particular interest to the speaker, including biomedical signal analysis (human balance) and sound propagation and classification in shallow water.

Bio: Patrick Loughlin is the William Kepler Whiteford Professor of Electrical & Computer Engineering, and Bioengineering, at the University of Pittsburgh, which he joined in 1993. He obtained a Ph.D. in electrical engineering from the University of Washington (Seattle), an M.S. in bioengineering from the University of Utah, and a B.S. in biomedical engineering from Boston University. He has made contributions to signal processing and bioengineering, including the development and application of nonstationary signal processing methods; analysis and modeling of human postural control; control of inhalation anesthetic delivery; and development of a physical model of anesthetic uptake. Prof. Loughlin is Associate Editor and member of the editorial board for the IEEE Transactions on Biomedical Engineering; past chair of the signal processing chapter of the IEEE (Pittsburgh Section); and member of the technical committee on acoustic signal processing of the Acoustical Society of America. His research has been supported by the NSF, NIH, DOD, Boeing company, and the Whitaker Foundation. He has held visiting positions at the Naval Surface Warfare Center (Bremerton) as a US Navy/ASEE Faculty Fellow, and the Applied Physics Laboratory (UW, Seattle). Prof. Loughlin is the recipient of young investigator awards from the National Science Foundation (CAREER, 1996) and the Office of Naval Research (YIP, 1998). He was awarded the Chancellor’s Distinguished Research Award at the University of Pittsburgh in 1999.

