Notice and Invitation

Oral Defense of Doctoral Dissertation
The Volgenau School of Engineering, George Mason University

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Computationally Efficient Equalizer Design

July 10th, 2014, 12:30pm-2:30pm
Engineering Building 3507
All are invited to attend.

Committee

Dr. Jill K. Nelson, Chair
Dr. Bernd-Peter Paris, Committee Member
Dr. Shih-Chun Chang, Committee Member
Dr. Jie Xu, Committee Member

Abstract

Intersymbol interference (ISI) caused by frequency selective multipath propagation is a primary source of distortion in wireless communication systems. ISI significantly degrades system performance, and hence channel equalization is typically employed at the receiver to mitigate the harmful effects of ISI. An equalizer can be designed to operate on either a symbol-by-symbol or sequential basis. Symbol-by-symbol based equalizers estimate the transmitted symbols one at a time, while sequential-detection based equalizers make an estimate of the full transmitted sequence based on the received signal over a full block of data. In this work, we propose computationally efficient methods to design both symbol-by-symbol and sequential equalizers for various communications scenarios.

In symbol-by-symbol schemes, we focus on the computationally efficient design of a maximum asymptotic efficiency (MAE) equalizer. The MAE equalizer achieves an attractive balance between performance and complexity. It minimizes bit error rate as the signal-to-noise ratio approaches infinity while retaining simple implementation by using a linear structure. However, its design requires solving
quadratic programming problems and hence has high computational complexity. We propose a geometrically-inspired approach to the MAE equalizer design that dramatically reduces complexity. Additionally, we extend the MAE equalizer to applications in which the channel varies significantly with time by proposing a pre-equalization technique which enables the MAE equalizer to be designed only once despite channel variations. The combination of the two proposed methods simplifies the design of the MAE equalizer, facilitating its use for time-varying channels with longer delay spreads.

In sequential detection schemes, we focus on communication problems which involve detecting data transmitted over channels with a small number of sparsely spaced channel taps. Such sparse channels are present in applications such as underwater acoustic (UWA) communications, ultra-wide band (UWB) communications, and high-definition television (HDTV) systems. We propose a tree-search based sequential equalizer that considers only the significant channel coefficients. In addition, we consider situations in which the sparse channel is unknown and no training data is available. We develop a blind sequential detection method by incorporating a novel greedy algorithm into a tree-search based sequential detector. The proposed technique reduces complexity and yields improved performance relative to existing matching pursuit (MP) based methods.

A copy of this doctoral dissertation is on reserve at the Johnson Center Library.