



Signal Processing Techniques for Wireless Communication Systems

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Abstract

The demands for wireless communication services are growing at a rapid rate. Meeting these demands is challenging since the availability of the radio spectrum at the frequencies of interest is limited. Furthermore, wireless communications also must cope with several other difficulties such as multiple access interference (MAI), channel fading, and limitations on the power and size of the mobile terminals. This thesis investigates the problems of MAI and channel fading in wireless communications, and focuses on developing spectrally efficient coding and signal processing techniques to mitigate the effects of these problems.

The first part of the thesis discusses the use of multiuser detection techniques to overcome the problems of MAI in code-division multiple access (CDMA) systems. The thesis develops two new interference cancellation detection techniques and an adaptive multiuser detector for joint parameter estimation and symbol detection. In addition, the thesis derives a novel framework for analysing the convergence behaviour of an interference cancellation technique which is commonly known as parallel interference cancellation.

In the second part of the thesis, the effects of channel fading on the performance of wireless communication systems are considered. The thesis examines the use of multiple transmit and multiple receive antennas in conjunction with coding for providing diversity to combat channel fading. Particular focus is given to the case when the propagation paths are spatially correlated. The performance of such communication systems is analysed and design criteria for constructing good codes are derived subsequently. The thesis then develops a receiver for joint decoding and channel estimation in time-varying fading channels.

Finally, since there are many different types of diversity which can be exploited in wireless communication systems, the thesis develops a generalised and unified taxonomy for system modelling and signal processing for such systems.

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