

Time-Selective Signaling and Reception for Communication over Multipath Fading Channels

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Abstract

The mobile wireless channel offers inherent diversity by virtue of multipath and Doppler shifts. Multipath diversity is exploited via spread-spectrum signaling employed in code division multiple access (CDMA) systems. However, the RAKE receiver commonly used in CDMA systems exploits only multipath diversity, and consequently suffers from significant performance degradation under fast fading. We develop new signaling and reception schemes in the context of CDMA systems that fully exploit the channel via joint multipath-Doppler diversity. The signaling waveforms are spread in time and frequency. Receiver structures are developed to deal with the inter-symbol interference (ISI) introduced by overlapping successive symbols. Analytical and simulated performance results indicate that the effects of ISI are negligible due to the excellent correlation properties of the spreading codes. Moreover, even the small Doppler spreads encountered in practice can yield significant performance gains. Additionally, the time-selective signaling scheme allows for substantially higher level of diversity and thereby brings the fading channel closer to an additive white Gaussian noise channel. This facilitates the use of error control codes developed for the Gaussian channel.