I-Q TCM: Reliable Communication Over The Rayleigh Fading Channelclose To The Cutoff Rate

Al-Semari, S.A. Fuja, T.E.;Dept. of Electr. Eng., King Fahd Univ. of Pet.Miner., Dhahran;

Information Theory, IEEE Transactions on;Publication Date: Jan 1997;Vol: 43,Issue: 1

Summary

This paper presents some trellis codes that provide high coding gain to channels with slow, non frequency-selective Rayleigh fading. It is shown that the use of two encoders in parallel-used to specify the in-phase and quadrature components of the transmitted signal-results in greater minimum time diversity than the conventional design in which a single encoder is used. Using this approach-which we label I-Q TCM-codes with bandwidth efficiencies of 1, 2, and 3 bits/s/Hz are described for various constraint lengths. The performance of these codes is bounded analytically and approximated via simulation; the results show a large improvement in the bit error rate (BER) when compared with conventional trellis-coded modulation (TCM) schemes when perfect channel state information (CSI) is available to the receiver. Indeed, when this approach is applied to channels with independent Rayleigh fading, the resulting coding gain is close to that implied by the cutoff rate limit, even for only moderately complex systems. The proposed codes are also simulated under less ideal assumptions. For instance, results for a 1-bit/s/Hz IQ-TCM code without CSI show a significant gain over conventional coding. Finally, simulations over channels with correlated fading were undertaken; it is concluded that an interleaver span of 4 yields performance close to what is achieved with ideal interleaving