Space-time code designs for MIMO wireless systems

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出版者:ProQuest / UMI

出版时间:2006-03-18

装帧:Paperback

isbn:9780542292644

It has been shown in the literature that multiple antenna systems have huge capacity gain over single antenna systems. To achieve the capacity gain, good modulation schemes/codes, called 'space-time codes,' are of key importance. Recently a variety of codes have been proposed for coherent or non-coherent channel, which can be divided into three categories: (1) Space-time block codes for coherent channel; (2) Differential space-time codes for non-coherent channel; (3) Unitary space-time codes for non-coherent channel. In the first part of this dissertation, space-time block codes are concerned. In Chapter 2, we systematically study general linear transformations of information symbols for QOSTBC to have both full diversity and real symbol pair-wise ML decoding. We present the optimal transformation matrices of information symbols for QOSTBC with real symbol pair-wise ML decoding such that the optimal diversity product is achieved for both <italic>general</italic> square QAM and <italic> general rectangular</italic> QAM signal constellations. Furthermore, our newly proposed optimal linear transformations for QOSTBC also work for general QAM constellations in the sense that QOSTBC have full diversity with good diversity product property and real symbol pair-wise ML decoding. We also present the optimal transformations for the co-ordinate interleaved orthogonal designs (CIOD) proposed by Khan-Rajan for rectangular QAM constellations. In the second part, some differential space-time codes with best known diversity products are given. In Chapter 3, we propose some new designs of 2×2 unitary space-time codes of sizes 6, 32, 48, 64 with best-known diversity products by partially using sphere packing theory. In particular, we present an optimal 2×2 unitary space-time code of size 6 in the sense that it reaches the maximal possible diversity product for 2×2 unitary space-time codes of size 6. In the third part, some methods to construct unitary space-time codes are considered. In Chapter 4, we first introduce the concept of isoclinic codes based on the consideration of pair-wise error probability upper bound formula. Then a differential geometry view on the construction of the codes is given. Based on this view, Grassmann manifolds are introduced and some construction methods to construct isoclinic codes are given.

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