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算法研究

MIMO系统工程应用分析及其SHPCA多天线系统3维信道容量

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摘要:

从实际工程应用的角度出发，首先对MIMO系统中的各种假设条件做了分析，认为当MIMO信道中的各个子信道相互独立时，可以采用基带联合检测(joint detection, JD)技术实现MIMO信号的分离与合并；如果考虑实际应用场景且当MIMO系统中多根天线发送同频信号时，JD技术无法分离出细多径信号，会使得系统空分复用(space division multiplexing, SDM)增益下降。为此基于对Shannon公式和相控天线阵系统（phase-controlled antenna array，PCA）的讨论，提出了一个新颖的多天线系统-SHPCA系统，该SHPCA系统能够有效地利用相控阵天线产生的定向窄波束来实现SDM功能，提升多天线系统的性能。SHPCA系统容量可用一个三维信道容量公式来描述，空间为第三维度。与传统信道容量度量相比，该模型能更直观的反映SHPCA多天线系统的空分复用作用和收发天线配置对系统容量的影响。

关键词： MIMO 通信容量;相控天线阵

Analysis of MIMO Systems in Practical Engineering Implementations and 3-Dimensional Channel Capacity Formula for SHPCA Multiple-antenna systems

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Abstract:

With the aim of implementations in practical engineering, the multiple-input multiple-output (MIMO) systems are analyzed. In ideal MIMO systems where the sub-channels are independent mutually, the signals from transmitter antennas can be separated and then combined by employing joint detection (JD). However, in practice MIMO wireless environment, since the signals from transmitters are transmitted over the same carrier frequency, the sub-channels of MIMO systems are dependent, which results in that the JD technique is infeasible and the decrease of spectral efficiency. To overcome the problem, based on the analysis of both the Shannon theorem and the phase-controlled antenna array (PCA), a multiple-antenna system model is presented, which is referred to as SHPCA model. In the presented SHPCA model, the PCA technique is used perfectly to produce narrow directional radio beam with very higher power efficiency to form space division multiplexing (SDM), by which the performance of the multiple-antenna systems is improved greatly. At the same time, for the SHPCA model, we also present a novel engineering capacity formulation called 3-dimensional channel capacity formula (3DCC), in which the 3rd dimension is the space dimension. The presented 3DCC formulation indicates clearly the effect of the SMD and the equipments of antenna on the capacity of multiple-antenna.

Keywords: MIMO channel capacity;phase-controlled antenna array (PCA)

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