Abstract

Hybrid beamforming is a quite promising technique for the future mobile cellular communication networks. In conventional fully digital beamforming, one dedicated radio frequency (RF) chain is essentially required per antenna element in an array. It is not feasible on practical grounds when large number of antennas are deployed at base station (BS) in conjunction with millimeter wave (mm-Wave) technology. This fully digital precoding increases the cost, power consumption and hardware complexity to the system. These factors lead to the hybrid beamforming solution where fully digital precoder is decomposed into low-dimensional digital part for baseband processing and high-dimensional analog component for RF processing. In beamforming process, analog component is only responsible for the phase adjustment of the signal. Therefore each element of analog precoder has constant modulus and simple phase shifter network is employed for practical implementation. Hybrid beamforming design reduces the number of RF chains to a great extent to address the challenges of conventional beamforming while having performance comparable to the optimal precoder (fully digital). This study presents three hybrid beamforming techniques for point-to-point MIMO systems under different communication scenarios to overcome the challenges associated with conventional fully digital precoding. First hybrid precoding scheme considers the flat fading channel model with geometric mean decomposition (GMD). This technique has inherent potential for much better bit-error-rate (BER) in comparison to singular value decomposition (SVD) based precoding. In particular, the transceiver becomes simple by introducing GMD in hybrid beamforming framework. Hybrid beamforming for broadband systems having frequency selective channels is the primary concern in second technique. There is only one analog precoder over whole frequency spectrum and different digital precoders corresponding to each frequency channel that makes the design quite challenging. Third technique addresses the hybrid beamforming solution in relay assisted MIMO communication. It is highly desirable when long distance communication is involved under hybrid beamforming paradigm. From simulation results, it is obvious that the performance of proposed hybrid precoding techniques is close to the optimal pre-coder.