The Wireless Multiple-Input, Multiple-Output Channel: Measurements, Double-Directional Parameters, and Capacity

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ABSTRACT

Results obtained from several indoor-office and outdoor (urban and rural) channel measurements in the 2GHz band are presented including a high speed vehicular outdoor field trial. We aim at the identification of the radio propagation MIMO (Multiple Input Multiple Output) channel and the characterisation of its spatio-temporal properties. In the trials presented in this contribution, the double-directional channel parameters for the arrival- and departure angles are estimated using two antenna arrays: a fifteen-element uniform circular array for transmission and an eight-element uniform linear array at the receiver side. We estimate the delays, arrival and departure angles and the temporal dynamics of the signal space.

The Directions of Arrival (DoA) and Directions of Departure (DoD) are estimated by a Conditional Maximum-Likelihood Estimator (CMLE). The CMLE is one of the simplest to implement and has considerably lower numerical complexity than the Maximum-Likelihood Estimator (MLE) for several wavefronts carrying stochastic signals.

MIMO systems have raised quite some interest recently through their ability to transport high data-rates in rich scattering environments. While the former work mainly focused on (Monte-Carlo) simulations of the offered capacity in a random, independently Rayleigh-fading channel, the performance of systems operating in a real-world environment can only be assessed with appropriate measurements. While the assumption of rich scattering allowed statistical evaluations culminating in high capacity, this assumption cannot be verified in many practical propagation environments.

The wideband measurements of the high-speed trial show a dominant line-of-sight component and low angular spread for both, DoAs and DoDs, allowing to anticipate only limited diversity gain.