MIMO terminals performance evaluation in a local propagation context

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Multiple Input-Multiple Output (MIMO) is a technology of growing importance in present and upcoming wireless network standards (WIFI, 4G, 5G), as it is anticipated to provide large performance gains, mainly in terms of link/network capacity and link robustness (through diversity). However there is no free lunch and implementing MIMO is neither simple nor always beneficial. Among the several problems encountered is the fact that the operating conditions of MIMO terminals are, often, far from ideal and subject to a set of impairments. In particular, the antenna signals are not uncorrelated and not identically distributed, as often considered in historical and simplistic MIMO system models. What's worse is that these impairments are not uniquely defined for a given terminal but they critically depend on the electromagnetic environmental conditions, both regarding the immediate vicinity of the device (user body, supporting hardware...) and the farther distant local propagation context (indoor, outdoor... environment). In other words, many sources of joint antenna-channel impairments do affect the MIMO terminal performance, which should be identified and modeled for an educated understanding and an accurate performance evaluation and optimization of wireless networks.

Among the classical (non physical) channel models used to evaluate MIMO system performance, the Kronecker approximation is both very simple to use and reasonably accurate, as long as the number of antennas is small. It is based on a separation of the correlation between the entries of the channel matrix, into transmit and receive side correlations, which allows characterizing the terminal independently from the base station/access point. In a Rayleigh channel, modeling the MIMO system is then extremely easy. Unfortunately, we have shown in a previous work (A. Sibille and A.J. Braga, *IEEE APS URSI*, Toronto, 2010), that this does not apply to the case of terminals subject to varying environmental conditions, due to the lack of Gaussianity of the channel coefficients.

In the present work we investigate the various factors impacting MIMO performance, in relation to environmental variability. We particularly involve non identical antenna behavior (power gain, radiation patterns) and the correlation between antenna signals resulting from a moderate multipath angular spread. According to the magnitude of these impairments and their degree of variability, common performance criteria such as ergodic capacity and diversity gain are evaluated and compared to simplified models. Some consequences are discussed, in relation to relevant use cases for 4G and 5G and in the context of MIMO terminals performance evaluation and MIMO terminals model standardization.