

Doctoral Dissertation Abstract

The doctoral dissertation deals with the development and evaluation of signal processing techniques for reducing the hardware complexity of MIMO systems. Despite their potential of dramatic improvements in terms of link reliability and spectral efficiency, the practical application of MIMO systems has been limited, mainly due to the increased manufacture cost and energy consumption of the RF chains. The research results of the dissertation are presented in two parts: In the first part, the performance analysis of HS/MRC receivers operating over independent and identically distributed (i.i.d.) K fading channels is evaluated through a moments generating function based approach. The K distribution is known to accurately approximate the Rayleigh-lognormal distribution, which is commonly used to model fading over terrestrial mobile or land mobile satellite environments. In the second part, *antenna subarray formation*, a novel RF preprocessing technique for reducing the hardware complexity of MIMO systems, is developed and explored. With this method, each RF chain is allocated to a combined and complex weighted response of a subset of antenna elements. Therefore, the performance is dramatically improved with respect to conventional antenna selection and can even approach the performance of the full complexity system. Novel, analytical, antenna subarray formation algorithms based on either instantaneous channel state information or long term channel statistics, are introduced. The capacity performance of the proposed algorithms, as well as the system parameters affecting it, is thoroughly examined. Furthermore, the impact of hardware and signal processing non-idealities on the performance is examined. Finally, tight theoretical upper bounds on the ergodic capacity of the proposed technique in rich scattering environments are derived.

The dissertation is available online in Greek at <http://thesis.ekt.gr/17400>.

Publications List

► Publications in international scientific journals

- P. Theofilakos, A. G. Kanatas and G. P. Efthymoglou, "Performance of Generalized Selection Combining Receivers in K fading channels," *IEEE Communications Letters*, vol. 12, no. 11, pp. 816 – 818, Nov. 2008.
- P. Theofilakos and A. G. Kanatas, "Maximising Capacity of MIMO Systems with Receive Antenna Subarray Formation," *IET Electronics Letters*, vol. 44, no. 20, pp. 1204 – 1205, Sep. 2008.
- P. Theofilakos and A. G. Kanatas, "Capacity Performance of Adaptive Receive Antenna Subarray Formation for MIMO Systems," *EURASIP Journal on Wireless Communications and Networking*, vol. 2007, Article ID 56471, 2007. doi:10.1155/2007/56471

► Publications in proceedings of international scientific conferences

- P. Theofilakos, A. G. Kanatas, "Reducing Hardware Complexity of MIMO Systems with Antenna Subarray Formation," in *Proc. EuCap 2007*, Edinburgh, UK, 11-16 Nov. 2007.
- P. Theofilakos, A. G. Kanatas, "Receive Antenna Subarray Formation for MIMO Systems in Correlated Channels," in *Proc. IEEE PIMRC 2007*, Athens, Greece, 2-7 Sept. 2007.
- P. Theofilakos, A. G. Kanatas, "Robustness of Receive Antenna Subarray Formation to Hardware and Signal Non-Idealities," in *Proc. IEEE VTC 2007 Spring*, pp. 324–328, Dublin, Ireland, 23-25 April 2007.
- P. Theofilakos, A. G. Kanatas, "Frobenius Norm Based Receive Antenna Subarray Formation for MIMO Systems," in *EuCap 2006*, Nice, 6-10 Nov. 2006.
- P. Theofilakos, A. G. Kanatas, "Reduced Hardware Complexity Receive Antenna Subarray Formation for MIMO Systems Based on Frobenius Norm Criterion," in *Proc. IEEE ISWCS 2006*, Valencia, 6-8 Sept. 2006.