Electrical & Computer Engineering

S E M I N A R

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An Algorithm for Adaptive Smart Antenna Systems

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Abstract—The demand for wireless communication systems has exploded throughout the world. The limited bandwidth available for these systems has created problems that all wireless providers are working to solve. Other problems faced include complex multipath propagation, limited battery lifetime, limited cell size, high infrastructure and operating costs, and growing demand for services with high data rates.

In seeking schemes solving these problems researchers have turned their attention to *adaptive smart antenna systems* which employ antenna arrays coupled with signal processing at the base station. By exploiting the spatial dimension they allow multiple mobile terminals to transmit co-channel signals, thereby increasing capacity and extending cell coverage. To operate appropriately, adaptive smart antenna systems should be capable of estimating the *array response vector*, which represents the unique propagation pattern between the mobile terminal and the antenna array at the base station. For N samples and an M-element array antenna the *singular value decomposition* (SVD) method requires $O(NM^2)$ time to calculate the sample covariance matrix and $O(M^3)$ time for the decomposition. Even though the performance of the SVD method is good in general, the computational cost may not be practical for real time implementations.

A fast algorithm for the estimation of the array response vector which requires $O(NM)$ computations is proposed. Statistical analysis of the array gain using the proposed estimation algorithm is performed for the single mobile terminal case. Experimental measurements were performed to validate the proposed method using the smart antenna testbed. Application of the proposed method is also extended to a multiple mobile terminal case for an uplink adaptive smart antenna system making use of code division multiple access (CDMA). Using the channel parameters given by the International Telecommunication Union (ITU) for the third generation (3G) standardization, indoor and vehicular test environments are considered.

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