SMART ANTENNAS FOR MIMO APPLICATIONS

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***Abstract**: MIMO systems employing smart antennas are a promising candidate for future mobile communications due to their tremendous spectral efficiency. RF engineers have to find new antenna solutions for MIMO applications, especially the integration of MIMO antennas into small handsets is a challenging task.*

FUTURE MOBILE COMMUNICATIONS

The most pressing problems in Wireless Communications will be spectral efficiency and interference in the next decade. Wireless Internet, mobile video and data communication will push the spectrum to its limitations. In the same way interference with other services will be increased by the increasing use of spectrum. A typical candidate for interference in both directions is for example Ultra-Wide-Band. Taking this into the account the most prominent task for communication scientists is to increase the spectral efficiency and to introduce measures for interference reduction. Access to these improvements is in nearly all layers of the OSE model. During the last few years the more efficient use of the available power at receivers proofed to be highly promising.

Smart antenna systems may revolutionize future communications systems. So far, only the spectrum, the time and the code domain are exploited for communications systems. The resources spectrum and code are very limited. Smart antennas exploit the spatial domain, which has been almost completely unused so far. For multiplex transmission within one communications link, i.e. a parallel transmission of several data streams at the same time and frequency only separated by the spatial domain, multiple transmit and multiple receive antennas (multiple input multiple output - MIMO) are required. MIMO systems promise to reach very large data rates and therewith high spectral efficiencies.

MIMO ANTENNA ASPECTS

The challenge for RF engineers is mainly to understand the complex systems starting with the transmitter and ending with the receiver. It is not enough to investigate only single components of the communications link. The antennas are an integral part of the MIMO system. MIMO systems exploit the multipath structure of the propagation channel. The antennas are adapted to the propagation channel. For a comprehensive study, both antennas and propagation channel have to be treated together and described statistically to take many channel realizations of a propagation environment into account. Correlations among channel coefficients are influenced by the antenna properties. As the antennas are colocated in a MIMO array, mutual coupling effects may occur. All these effects should be considered when designing an antenna array for MIMO systems. In this contribution, a method will be presented for accurately modelling both antennas and the propagation channel.

A major concern in MIMO systems is the integration of several antennas into small handheld devices. Finding feasible antenna configurations is an integral part of enabling the MIMO technology. Design rules will be given in the presentation, and different antenna configurations will be compared. Several examples will demonstrate how compact MIMO antenna arrays can be integrated into handsets, see Figure 1. The user employing the MIMO handset has an impact on the MIMO performance, too. The influence of the user's head and hand will be investigated, see Figure 2.

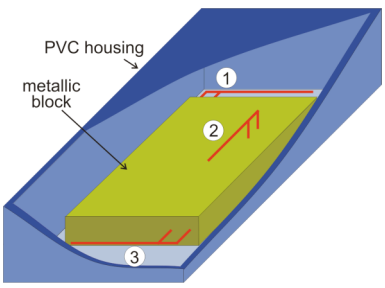

Figure 1: Model of a MIMO handset with three Inverted-F antennas

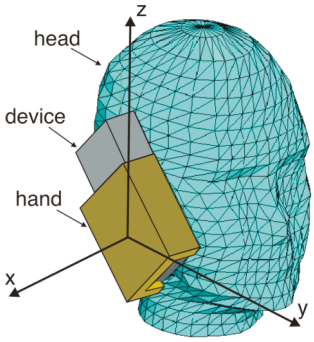

Figure 2: Small MIMO hand-held device attached to a human head and hand