Abstracts of Forthcoming Manuscripts

Optimum DCT-Based Multicarrier Transceivers for Frequency-Selective Channels

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***Abstract*—We derive on the impulse response and input signal of a frequency-selective finite impulse response channel to be diagonalized by the DCT into parallel, decoupled, and memoryless subchannels. We show how these conditions can be satisfied in a practical multicarrier transceiver through a novel design of the guard sequence and the front-end prefilter. This DCT-based design results in complete elimination of interblock and intercarrier interference without channel knowledge at the transmitter and at the same guard sequence overhead, compared with DFT-based multicarrier transceivers. Extensions to multi-input multi-output frequency-selective channels are also described. Finally, we present numerical examples from wireline and wireless communications scenarios to illustrate the viability and practicality of the DCT as a modulation/demodulation basis for baseband and passband signaling over frequency-selective channels.**

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Cooperative Regions and Partner Choice in Coded Cooperative Systems

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***Abstract*—User cooperation is an efficient approach to obtain diversity in both centralized and distributed wireless networks. In this paper, we consider a coded cooperative system under quasi-static Rayleigh fading and investigate the partner-choice problem. We find conditions on the interuser and user-to-destination channel qualities for cooperation to be beneficial. Using frame-error rate (FER) as a metric, we define the *user cooperation gain (G)* for evaluating the relative performance improvement of cooperative over direct transmissions when a particular channel code is used. We introduce the *cooperation decision parameter* (CDP), which is a function of user-to-destination average received signal-to-noise ratios (SNRs), and demonstrate that whether cooperation is useful or not ($G > 1$ or $G < 1$) depends only on the CDP, not the interuser link quality. We use an analytical formulation of the CDP to investigate user cooperation gain and provide insights on how a user can choose among possible partners to maximize cooperation gain. We first consider the asymptotic performance when one or both partners have high average received SNR at the destination. We then provide conditions on user and destination locations for cooperation to be beneficial for arbitrary SNRs. We illustrate these cooperative regions and study geometric conditions for the best partner choice. We also define the *system cooperation gain* and illustrate cooperation benefit for both users. All of our theoretical results are verified through numerical examples.**

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Benefit of Pattern Diversity via 2-Element Array of Circular Path Antennas in Indoor Clustered MIMO Channels

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***Abstract*—In this paper, we analyze a MIMO array consisting of two circular microstrip antennas, designed to exploit pattern diversity. We analytically derive the spatial correlation coefficients of this array as a function of the mode excited for realistic clustered MIMO channel models. We compare the performance of the circular patch array (CPA) against an array of two space dipoles. In particular, we compute a theoretical tradeoff to predict when the pattern diversity provided by the CPA is more effective than space diversity from the uniform linear array (ULA), based on the eigenvalues of the spatial correlation matrix. Through simulations, we show that CPAs yield better performance or satisfy more restrictive size constraints than ULAs in clustered MIMO channels, depending on the element spacing of the ULA, These results make the CPA an attractive solution for miniaturized MIMO arrays for portable devices or access points.**

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Noncoherent Data Transition Tracking Loops for Symbol Synchronization in Digital Communications Receivers

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***Abstract*—Starting with the maximum *a posteriori* (MAP) estimation approach, this paper derives the optimum (in the MAP estimation sense) means for performing symbol timing recovery in the absence of carrier phase information (i.e., prior to carrier phase recovery). Specifically, we examine the necessary modification of a well-known form of coherent symbol synchronizer, namely, the data transition tracking loop (DTTL) to allow its operation in the absence of carrier phase information, i.e., as a so-called *noncoherent symbol sync loop*. By employing such a noncoherent scheme, one can eliminate the need for iteration between the carrier and symbol sync functions, as typically takes place in receivers that more commonly perform carrier tracking and acquisition prior to symbol timing. The performance of both the linear and nonlinear versions of this noncoherent DTTL is obtained by a combination of analysis and simulation, and compared with that of the corresponding coherent DDTLs.**

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