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HIGH PERFORMANCE ULTRA-WIDE BANDWIDTH SYSTEMS VIA NOVEL PULSE SHAPING AND FREQUENCY DOMAIN PROCESSING

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Abstract. Ultra-Wide Bandwidth (UWB) systems have recently emerged as a strong candidate for high-throughput short range wireless communications. Because of the UWB systems' fine time resolution properties, a large path diversity gain can be exploited. However, to exploit this path diversity gain while avoiding inter symbol interference between data bits, the repetition period of data-modulated pulses must be larger than the time delay spread of multipath fading channels. This significantly reduces the throughput of UWB systems (making it spectrally inefficient, e.g., 0.05 b/s/Hz). If a larger throughput is desired (e.g., a throughput requiring information-bearing pulses separated by less than the time delay spread), the BER performance degrades rapidly. In this work, we propose a novel pulse waveform referred to as the Carrier Interferometry (CI) pulse waveform for use in UWB systems: CI supports significant increases in throughput with negligible performance loss. Specifically, the CI pulse waveform corresponds to the superpositioning of N orthogonal subcarriers. At the receiver side, the received pulse is decomposed into its subcarriers and recombined to exploit diversity in the frequency domain. This frequency domain processing provides resistance to inter symbol interference (from data-modulated pulses positioned within the delay spread of the channel). As a direct result, much higher throughput is supported with small performance loss when CI pulse waveforms are employed. Simulation results over indoor channels confirm that the novel CI-UWB system is capable of significantly outperforming current UWB systems: at a fixed BER performance level of 10-3, the proposed system can provide up to 64 times the data rate of current time domain UWB systems.
Keywords. UWB, Carrier Interferometry, Pulse Shaping, ISI mitigation, frequency processing

1 Introduction

Ultra-Wide Band (UWB) systems have recently attracted both scientific and commercial interest [1-8] and are now considered a strong candidate for high-throughput short-range wireless communication. A UWB system is charac-