Ultra-Wideband Phased Array Optimization in MIMO Configuration for Increased Channel Capacity

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Enhancements to the performance of wireless communication systems are critical as they allow for greater usage of the limited spectrum and the growing data speeds for a variety of applications. As a result, there is an increasing need to develop robust platforms that can reach the maximum achievable channel capacity of present day systems. In this regard, Multiple Input Multiple Output (MIMO) systems exploit spatial diversity to create multiple communication channels. High data transmission rates can then be achieved through simultaneous usage of these channels. Similarly, the increased operational bandwidth leads to higher data capacity and enables multi-functionality. When employed in the context of phased array, these systems add spatial filtering with beamforming to significantly increase signal-to-noise ratio (SNR).

This paper presents a novel wideband communication system that combines beamforming and MIMO in the context of an ultra-wideband (UWB) phased array. In this architecture, multiple communication channels can be used to realize MIMO by decomposing the array into smaller sub-apertures. The subaperture serves to emulate a distinct channel for a user. As such, MIMO capacity is enhanced via multiplexing and filtering techniques. The communication system can also be optimized to maximize capacity and operate across multiple frequencies. Of importance is the offered flexibility, critical for future software radios. The same platform can be reconfigured in adverse environments by adapting spatial filtering to improve link reliability

At the conference, we will present a study of the proposed optimal array configuration and sub-aperture subdivision to enable beamforming and multi-channel communication. Performance evaluations will be provided to determine the maximum number of users for optimal transmission data rate. A hardware testbed will be presented that consists of an in-house phased array using a software defined radio emulation to demonstrate the proposed system and verify the improved capacity and security for future wireless systems.