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MULTICHANNEL SIGNAL SYNTHESIS IN FREE SPACE

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A two antennae, software controllable phased array was built to study the generation and transmission of short, nanosecond, non-periodic pulses. This system allows transmitting a train of properly scaled and time-shifted non-periodic signals to generate received signals with major frequency components adjustable from approximately 600 MHz to 1.5 GHz. The main components in the system include two digital to analog converters (DACs), two data pattern generators (DPG), and two power amplifiers which drive two TEM Horn antennas. A user created data vector is uploaded to two DPGs (Analog Devices Data Pattern Generator 3) via a laptop USB connection, to be played back by attached, high speed RF DACs. The DACs chosen here are Analog Devices 9129 (AD9129), 14-bit RF DACs capable of a 2.8 GSPS data rate, that can play baseband signals up to 1.2 GHz. Two synchronized clock signals operating at 2.4 GHz are connected to the DACs, which will also provide the clock signal for the DPG3. An external trigger source connected to the DPG3 is used to begin playback of the user defined data vector.
The focus of this experiment is the transmission of a set of short, non-periodic pulses (akin to wavelets in signal theory) to create a signal of different amplitude or frequency at a specified point in space. Signals synthesized by the AD9129 are fed into a 20dB power amplifier (Mini-Circuits ZFL-2500VH+) to be transmitted by a TEM Horn antenna. Each antenna was constructed with a Chebyshev taper and a Microstrip-type balun to achieve a wide frequency response and sensitivity to fields in the time and frequency domain. Thus far, 100 ps synchronization between channels was achieved, and signals of varying shape and amplitude have been received via the shifting and inverting of Gaussian input pulses defined by the user data vectors. This paper presents an experimental evaluation of the hardware used to generate the phased array, the ability to steer the signals and generate signals of varied frequency via superposition in free space.

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