

Abstract

We present results of an experiment using a digital HF receiver approach to measure the Doppler spectrum of high-frequency back-scattered radar signals in a bistatic mode. The shift of the first order sea scatter Bragg lines from their expected values can be used for radial ocean surface current estimation. Targets appear in the Doppler spectrum with amplitude proportional to radar-cross-section (RCS), while the Doppler shift is proportional to the radial velocity. This is the first experiment that validates the capability of utilizing direct digitization of the radio frequency echo to achieve a minimum of 60-dB dynamic range, and milli-Hertz Doppler shift accuracy for radial velocity resolution, operating in a bistatic mode. Two independent GPS-coupled rubidium oscillators were used to generate the transmitted waveform and A/D timing clock generation, respectively. Data were recorded with four receive loop antenna elements and A/D cards, and data were digitized at a 60 MHz rate and stored for off-line processing. Results of Doppler analysis of ocean sea scatter and target detection for pulse-to-pulse switching of 32 frequencies over the 3-30 MHz band are presented.

The experiment validated a methodology being used in the design of a single real-time eight-channel transceiver PC card. It will allow real time digital down-conversion filtering and recording of data from an eight-element array at the intermediate frequency under Windows OS control. This filtered data will be stored at a rate commensurate with the transmitted bandwidth, thus reducing volume of data significantly from the results presented above. This design utilizes a pair of DDS chips to provide both a variety of transmit pulse waveform generation (simple pulse, FM pulse, FM-CW, noise, phase-coded) and coherent digitization on a single PC card. A separate sister exciter card uses the same PCB footprint of the transceiver, but only exercises the exciter chip component portion, for use with a bistatic transmitter. Each card has capability of a rubidium clock input, under GPS time control, suitable for bistatic radar operation. GPS time allows coordinated interleaved pulsing between sites, for as many bistatic sources as one desires. The transceiver and exciter are in final stages of construction, and prototypes will be available for viewing at the meeting.