Approach for Real-Time Synthesis of Simultaneous Radar and Spatially Secure Communications from a Common Phased Array

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A system that must perform simultaneous radar and communication operations using a single aperture is an inherently real-time system. If hardware economization were the only concern, it is likely that time multiplexing the aperture would deliver better performance for both types of operation since different sets of system configuration optimizations could be implemented. Certainly radar and communication have technical objectives that would often be characterized as being at odds, so trying to carry them out from the same aperture at the same time would not typically be recommended. Attempting simultaneous radar and communication is therefore not a prospect to be entered into lightly, and the compromise to both radar and communication performance is only warranted by the urgency that requires conducting the operations at the same time.

Additional coexistence and spectral sharing requirements in unpredictable dynamic environments also necessitate the agility of a real-time solution. Zero-forcing multi-beam directional modulation is a familiar linear technique from communications that is recognized for its computational economy and enabling efficient synthesis of transmissions having specified phases and relative signal strengths in a finite set of specified directions. This computationally-driven technique calculates a baseband-weighted vector used in developing the excitations for a multiple driven-element antenna that in turn forms the desired far-field signal. Linearity is required to obtain satisfactory communication performance and to implement effective directional modulation.

Methods of physically securing the information contained in communication signals against recovery by unintended receivers are also of interest. Provision of physical security must also be real-time for real-time communication signals.

This work describes a computational basis of a system for simultaneous radar and secure communication in real-time. Linear phased array antenna excitation synthesis uses zero-forcing multi-beam directional modulation and Barker codes, with radar, communication transmit, and communication receive operating on distinct frequencies to separate functions spectrally. Spectral and security scenarios are considered. Security of communication information and radar performance are simulated and discussed.