SMALL-APERTURE SMART ANTENNAS WITH BROADBAND OPTOELECTRONIC SIGNAL PROCESSING

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This paper addresses the problem of adaptive reception of N unknown wireless signals with the smallest possible antenna aperture of N elements. In conventional smart antennas, in order to resolve spatially N sources, typically an array of M¿N elements is needed, with unfavorable square-law scaling. In this work we present a smart antenna array with analog processing that requires the theoretically minimal number of elements, M=N to separate N sources. The sources can spatially be within an antenna beamwidth and a small-aperture array with high inter-element coupling can be used by virtue of adding processing gain to replace antenna gain.

In this paper, we present a multibeam lens array front end with a electrooptic processor that performs two-signal Principal Component Analysis (PCA), i.e. adaptively extracts the strongest component in the signal space. The experimental prototype receives signals modulated onto a 10-GHz carrier with a 130-MHz IF and demonstrates a 26dB/dB enhancement power ratio between two signals. The processor is based on dynamic holography and performs signal decorrelations in analog hardware with up to a 3-GHz signal bandwidth. All the components of the system will be discussed: the receiving antenna, microwave receiver, electrooptic multichannel modulator, analog processor and electronic output circuit.

The more general problem of separating unknown signals adaptively is referred to as Blind Source Separation (BSS), and one of the algorithms that can be used to perform BSS is known as Independent Component Analysis (ICA), which is an extension of PCA. The talk will present new developments at the University of Colorado at Boulder in extending the PCA hardware to the ICA problem for broadband RF wireless signals. Measurements on a 2-signal extractor with voice signals will be presented and compared with existing state-of-the art digital solutions.

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2. B - Fields and Waves

3. (a) B Antennas for wireless

4. P, Program chair: John Volakis

5. No special instructions