ANALYSIS OF SPATIAL MULTIPLEXING OF LOCAL ELEMENT DIGITAL BEAMFORMING SMART ANTENNA RECEIVERS

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The Spatial MultIplexing of Local Elements (SMILE) technique has been introduced as a means to reduce the costly front end RF hardware in digital beamforming (DBF) smart antenna receiver systems. This highly integrated modular scheme reduces the necessary amount of RF hardware such as mixers and low-noise amplifiers, thus offering a reduction of overall size and power consumption while maintaining the same functionality of conventional DBF antenna arrays. This reduction can be as much as N-fold for an N-element array. Measured beamforming results validate this structure as a possible asset in practical DBF systems.

The SMILE architecture consists of an N-element antenna array, a multiplexing network, a single RF channel, a demultiplexer, A-to-D converters, and a digital beamformer. The main challenge in the operation of this structure is the multiplexing network, which uses a sequential switching technique to multiplex the received signals from N individual channels to one. This time-multiplexing process therefore places the greatest importance on the performance of the switching element.

The SMILE principle has been demonstrated with two architectures of different type of antenna elements, and different type of switching elements. The first uses quasi-yagi antenna elements with PIN diode switching elements, and the second has patch antenna elements and employs FET type switches in a low-noise amplifier configuration.

This paper will discuss and compare the two types of SMILE arrays. For application in the SMILE scheme, it is determined that choice of the switching configuration and antenna element can greatly influence performance. The switching aspect for both cases will be compared and evaluated by its effects on system performance.

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