World Academy of Science, Engineering and Technology
International Journal of Electronics and Communication Engineering
Vol:13, No:03, 2019

Signal Processing Techniques for Adaptive Beamforming with Robustness

Authors : Ju-Hong Lee, Ching-Wei Liao

Abstract : Adaptive beamforming using antenna array of sensors is useful in the process of adaptively detecting and preserving the presence of the desired signal while suppressing the interference and the background noise. For conventional adaptive array beamforming, we require a prior information of either the impinging direction or the waveform of the desired signal to adapt the weights. The adaptive weights of an antenna array beamformer under a steered-beam constraint are calculated by minimizing the output power of the beamformer subject to the constraint that forces the beamformer to make a constant response in the steering direction. Hence, the performance of the beamformer is very sensitive to the accuracy of the steering operation. In the literature, it is well known that the performance of an adaptive beamformer will be deteriorated by any steering angle error encountered in many practical applications, e.g., the wireless communication systems with massive antennas deployed at the base station and user equipment. Hence, developing effective signal processing techniques to deal with the problem due to steering angle error for array beamforming systems has become an important research work. In this paper, we present an effective signal processing technique for constructing an adaptive beamformer against the steering angle error. The proposed array beamformer adaptively estimates the actual direction of the desired signal by using the presumed steering vector and the received array data snapshots. Based on the presumed steering vector and a preset angle range for steering mismatch tolerance, we first create a matrix related to the direction vector of signal sources. Two projection matrices are generated from the matrix. The projection matrix associated with the desired signal information and the received array data are utilized to iteratively estimate the actual direction vector of the desired signal. The estimated direction vector of the desired signal is then used for appropriately finding the quiescent weight vector. The other projection matrix is set to be the signal blocking matrix required for performing adaptive beamforming. Accordingly, the proposed beamformer consists of adaptive quiescent weights and partially adaptive weights. Several computer simulation examples are provided for evaluating and comparing the proposed technique with the existing robust techniques.

Keywords : adaptive beamforming, robustness, signal blocking, steering angle error
Conference Title : ICCSP 2019 : International Conference on Communications and Signal Processing
Conference Location : Tokyo, Japan
Conference Dates : March 25-26, 2019