ANTENNAS AND PROPAGATION

Modeling, Simulation & Measurements

Edited by

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Chapter 15

Analysis of Beamforming Algorithms

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15.1 Introduction

The beam pattern can be changed by applying nonuniform amplitude and phases in an array antenna. The complex weights are calculated by using adaptive beamforming algorithms which are analyzed in this chapter. These beamforming algorithms include Maximum Signal-to-Interference Ratio (MaxSIR), Minimum Mean-Square Error (MMSE) and Least Mean Square (LMS). The simulation results using Matlab 7.0 is presented in this chapter. The information from the DOA algorithm is fed to the beamforming algorithm to create complex weights and hence steer narrow beams towards the direction of the desired user. Therefore, the performance analysis of the available DOA algorithms is necessary as discussed in the previous sections. Nevertheless, the beamforming algorithms used in this research assumes angles which could otherwise be provided by the DOA. That is, the algorithm uses reference or training signal. Due to this, only brief analysis about the other beamforming algorithms is presented here, while a comprehensive analysis on LMS is discussed. The analysis of the other beamforming algorithms is hence to provide clear understanding on the concept of beamforming.

15.2 Maximum Signal-to-Interference Ratio

This algorithm enhances the received signal and minimizes the interfering signals by maximizing the signal to interference ratio (SIR). It controls the array pattern based upon this criterion.

According to [4], if the signal and the interference are received by an M-element linear array with M potential weight, additive Gaussian noise included in each received signal at element m. The time is represented by the kth time sample. The weighted array output y is defined as:

$$y(k) = \bar{w}^H \cdot \bar{x}(k) \qquad (15.1 \quad 2.23)$$

where $\bar{w} = [w_1 \quad w_2 \quad \ldots \quad w_M]^T$ is the array weights, and

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