EFFECT OF DISPLACEMENT VECTOR IN THE DIRECTION OF ARRIVAL ESTIMATION

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ABSTRACT

There is a relationship between the direction of a signal and the associated received steering vector. Therefore, it should be possible to invert the relationship and estimate the direction of a signal from the received signals. An antenna array should be able to provide for direction of arrival (DOA) estimation. There is also Fourier relationship between the beam pattern and the excitation at the array. This allows the DOA estimation problem to be treated as equivalent to spectral estimation. This paper clarifies the effect of variation displacement vector in estimating the DOA in a smart antenna application. The objective is to find the optimum value of element spacing where it will give the best DOA estimation of signal impinging on a uniform linear array (ULA). The algorithms used in detecting the DOA are the Multiple Signal Classification (MUSIC) and Estimation of Signal Parameters via Rotational invariance Techniques (ESPRIT). The two algorithms produce an ambiguity in the estimated direction-of-arrival results, when the antenna element spacing on a linear array is more than half a wavelength.

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INTRODUCTION

1.1 INTRODUCTION

The demand for wireless mobile communications services is growing at an explosive rate. It is expected that communication to mobile devices anywhere around the world at all times will be available in the future. As a result, there are many efforts on the design of smart antenna arrays and the associated beamforming algorithms. An array of antennas placed on vehicles, ships, aircrafts, satellites and base stations is anticipated to play an important role in realizing the dream that a smaller size of portable communication device will be available for such services.

Smart antenna generally refers to antenna array with smart signal processing algorithm used to identify spatial signal signature such as the direction of arrival of the signal, and use it to calculate beamforming vectors, to track and locate the antenna beam on the mobile or target. Smart-antenna systems provide opportunities for higher system, capacity, improved quality of service (QoS) and power control (PC) as well as extended battery life in portable units [1]. There are basically two approaches that are applied in implementing smart antennas; switched beam and adaptive array. The switched beam approach is simpler compared to the adaptive approach. In this approach, an antenna array generates overlapping beams that cover the surrounding area. When an incoming signal is detected, the beam that is best aligned in the signal-of-interest (SOI) direction will be determined by the system. The system then will switches to that beam to continue with the communication process. The adaptive array system is smarter than the first approach. This system tracks the signal continuously by steering the main beam towards the incoming signal and at the same time forming nulls in the directions of the signal-not of-interest (SNOI) or interfering signal [2].