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SMART BASE STATION ANTENNA

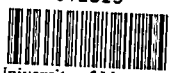
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Submitted in partial fulfillment for the degree of
Master of Engineering in Electronics & Telecommunications

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DEDICATION

To my Alma Maters St. Sebastian's College, Moratuwa and University of Moratuwa (Formally University of Sri Lanka, Katubedde Campus) for fine education I received...

To my mother and late father for enabling that education against all the odds...

To my wife Shanthi, and children for understanding, tolerance and encouragement...

...this really is your achievement.



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S. A. S. Punchihewa



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ABSTRACT

Telecommunications incur a strong impact on the society. Out of its many sectors, mobile communications experienced an unprecedented growth around the globe in recent times. Service providers will have to satisfy this increased customer need using a spectrum, which does not grow proportionately. Several multiple access systems such as frequency division multiple access, time division multiple access and code division multiple access are used at present to increase the efficiency of spectrum utilization.

The smart antenna, consisting of an array of elements, monitors its signal environment and forms a beam towards the wanted signal. Thus, on top of the existing access methods it provides an additional multiple access method namely space division multiple access in which several users access portions of space simultaneously. There exist different methods or algorithms for formation of the beam towards the desired signal. Some of them form a beam and rotate while monitoring the satisfaction of certain conditions, which indicate the correct formation of the beam. Some others find the directions of arrival of signals (DOA) and then form the beam towards the desired direction of which the resolution is higher. In spite of high-resolution capability, these algorithms demand knowledge of the propagation characteristics of the mobile channel. This necessitates modeling of the channel after theoretical or empirical considerations.

This dissertation presents the work carried out to determine the DOA of a desired signal which is to be used in an adaptive antenna in a variety of propagation channels.

The suitability of MUSIC (Multiple Signal Classification) algorithm was investigated. It was necessary to find the ability of the algorithm to estimate the DOA of impinging signals. However, the channel modeling was also a necessity. To determine the accuracy of the estimation, the error between the actual and estimated DOA was determined and analyzed. MATLAB was used for simulations because of its capabilities to handle large amount of matrix related computational activities efficiently.

An artificial channel with free space conditions was initially used to test the method of estimating the DOA, and to check the suitability of error analysis as a method of determining the accuracy. In this artificial channel, estimation of several DOA was performed for different conditions of environment monitoring and different antenna array geometry. Different number of signals was used with different angles of arrival. Hence, the dependence of errors on the above different conditions was determined and thereby the suitability of the error analysis to determine the accuracy was examined.

The algorithm was tested for different channel models. The COST207 models developed by European Union were used and the performance of the MUSIC algorithm in different channel conditions was analyzed. Using the measured signal value data in the Colombo Fort area, the channel was mathematically modeled and MUSIC algorithm was tested for Colombo Fort.

MUSIC algorithm was found to be suitable for use in adaptive cellular base station antenna.

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LIST OF ABBREVIATIONS

CDMA	Code division multiple access
DOA	Direction of arrival
FDMA	Frequency division multiple access
MUSIC	Multiple signal classification
SDMA	Space division multiple access
TDMA	Time division multiple access
SNR	Signal to noise ratio

