LITERATURE REVIEW

Wireless Communication technologies have a great progress in recent years and the markets, especially the cellular telephone, have been growing enormously [2]. Moreover the next generation communication services will use higher frequency band area and require more channel capacity and wider bandwidth for a high-speed data communication. As a large increase in channel capacity and high transmission rates for wireless communications, the technologies for the power saving and efficient frequency usability are required.

One of the technologies that can contribute to the improvement of wireless systems is the adaptive/smart antenna. Smart antenna can form a beam pattern at an intended direction by applying digital signal processing algorithm with the digitized data from each antenna element [3][5]. By software algorithm this system at the transmitter is capable of steering the maximum radiation pattern toward a desired mobile and the system at the receiver can spatially separate and reject multi-path fading energy hence higher bit rate services can be provided [1][6].

Methods which extract this information from the incoming signals are called Direction of Arrival (DoA) Estimation Methods [7][8][9]. The first method is called Spectral Estimation Methods. They include the MVDR (Minimum Variance Distortion less Response) Estimator, Linear prediction method, MEM (Maximum Entropy Method), MLM (Maximum Likelihood Method).

The second category is formed by the Eigen structure Methods. They include the Min-Norm Method, the CLOSEST Method, the ESPRIT (Estimation of Signal Parameters Via Rotational Invariance Technique) algorithm, and others [10].

Several algorithms have been introduced and used to estimate Direction Of Arrival (DOA) and the most basic ones are Capon Maximum Likelihood (ML) and MUSIC algorithm
introduced by Dr. Schmitt [11]. The numerous researches done in this field have improved MUSIC algorithm which led to the ROOT-MUSIC and Spatially Smoothed version of MUSIC. ROOT-MUSIC algorithm creates polynomials and determines its root and estimates the angles and solves the deficiency of MUSIC algorithm to detect in spaces related to estimation parameters [12][13][14].

An earlier literature by B. D. V. Veen and K. M. Buckley introduced beamforming as a versatile form of spatial filtering [15]. Started with the basic concept, associated the explanation with FIR filtering. Beamformer was classified into data independent and statistically optimum beamformer. Independent of the received data, the first class of beamformer chose a fixed antenna arrays weights. The later class use statistical information of received data to select the weights.

Adaptive beamforming comes into picture [16] for the fact that the data statistics are often unknown and varying over time [4]. Two basic adaptive approaches, block adaptation and continuous adaptation were discussed. In block adaptation, the statistics are estimated from temporal block of array data while continuous adaptation the weights are adjusted as the data is sampled. Two basics adaptive algorithms, LMS and NLMS also introduced. Partial adaptivity was highlighted [17].

Lal. C. Godara contributed a thorough study on antenna arrays application in mobile communication. Part I gave a brief overview of mobile communications, antenna array terminology, the usage of antenna arrays in mobile communication systems, the advantages and improvements that it brings, design issues, and the feasibility in implementation [18]. Part II presented a detail depiction of various beam-forming schemes, adaptive algorithms, DOA estimation methods, and some issues on error sensitivities. Relevant details and references were provided for further research on each topic [19].

Simplicity of Least Mean Square (LMS) algorithm makes it widely been used for tap coefficient adaptations of an adaptive processor in antenna array. However, this continuous adaptation approach algorithm causes signal acquisition and tracking problems due to its slow
convergence in multipath fading channel. This is not suitable for mobile communication and some other measures need to be taken if this algorithm is to be used such as power control or normalized LMS algorithm. Converging faster than LMS algorithm, SMI has attracted to be applied in mobile communication.

However, implementation difficulties need to be considered since its complexity requires advance hardware capability and the use of finite precision arithmetic may cause numerical instability. RLS can be seen as the solution for the slow convergence of LMS and high complexity of SMI. This is provided that SNR is high and setting of a fading rate dependent forgotten factor is correct by J. Litva, and T. K. Lo[20].

In this research we have proposed the MUSIC algorithm which has comparative with the LMS, NLMS, ESPRIT algorithms [21][22][23].