LITERATURE REVIEW

This chapter is organized in subsections and present the review of literature related to the work carried in research. In the section ‘background’ researcher gives brief idea about introduction and history relate to the research under taken. In the next section ‘multiple user communication’, the reviewed information is provided related to the signal direction finding, power and location estimation, interference rejection and angle spread estimation. The ‘adaptive beamforming’ section describes feasibility and performance improvement, digital beamforming, angle of arrival, linearly constrained beamforming, adaptive beamforming, comparison in beamforming and direction of arrival with beamforming.

Next section is ‘direction of arrival’. It gives the reviewed information related to the theoretical comparison, capabilities and limitation, Angle of elevation for MUSIC in beamspace by self initiating, beam pattern effecting DOA, iterative AOA estimation, MUSIC and ESPRIT algorithm in smart antenna. The ‘different DOA techniques’ section gives reviewed information about improving DOA resolution, MUSIC employing conjugate symmetric. Next section is related with the characteristics of MUSIC which gives the information about the sensitivity analysis, a statistical characterization, effects of model errors, comparison of adaptive super-resolution and MUSIC algorithm resolution. Last section is related with more additional information about adaptive algorithm.

2.1 BACKGROUND

Wireless Communication technology in recent years has seen a massive progress and the market especially for the cellular telephones is growing enormously [2]. For high speed-data communication the subsequently invention in communication system make use of advanced band of frequency, more channel capacity and wider bandwidth. The technology demands efficient frequency usability and power saving because of high transmission rates and increase in channel capacity.
One of the technology that are contributed to improve the wireless systems is an antenna using adaptive array system. An antenna using adaptive array forms pattern of beam at intended direction by applying digital signal processing algorithm to the digitized data from each antenna elements. [3]. By algorithm used in digital signal processing, the transmitter is capable of steering the maximum radiation pattern toward a desired user. The receiver does it spatially and not only separate but also reject multi-path fading energy hence channel capacity and higher bit rate services is provided.

There are several methods used in an adaptive array antenna. Method used for information to be extorting starting the inward signals is called Estimation Method of Direction of Arrival (DOA). This method is called Spectral Estimation Method. The authors have included, first category is formed by the Spectral Estimation Method that contains Minimum Variance Distortionless Response (MVDR) Estimator, Linear prediction method, Maximum Entropy Method (MEM), Maximum Likelihood Method (MLM). The second category is formed by the Eigen structure Methods that includes the Min-Norm Method (MNM), the CLOSEST Method, the Estimation of Signal Parameters Via Rotational Invariance Technique (ESPRIT) algorithm, and others [4].

More than a few algorithms have launch and utilized for evaluation of Direction of Arrival (DOA). Hence a fundamental one is a Capon Maximum Likelihood (ML) and MUltiple SIgnal Classification (MUSIC) algorithm founded by Dr. Schmitt. The many researchers have completed work in the said area to superior MUSIC algorithm that leads to the ROOT-MUSIC and Spatially Smoothened description of MUSIC [5] [6].

An previous literature by B. D. V. Veen and K. M. Buckley initiate beam forming as a adaptable form of spatial filtering. FIR filtering is begins by the explanation by the fundamental theory. FIR filtering is commenced with the understanding of the basic concept. Beamformer can be divided into two classes like data independent and statistically optimal beamformer. Sometimes the records figures are frequently unidentified and vary over the time. The second class use received data of statistics in sequence to choose the weights.
Adaptive beam forming so that comes into the picture. Two fundamental adaptive techniques as continuous adaptation and block adaptation are also discussed. Functions carried out in block adaptation and information are predictable commencing a data array of temporal block with unremitting adaptation and the weights are changed with respect to the sampled data. The basic adaptive algorithms are two which introduced as, LMS and NLMS. The article highlights partial adaptivity [7].

L. C. Godara, in his overview of mobile communication part first, gives the array definition, mobile communication system, its advantages, design issues and shows the improvements related to implementation of the application in the antenna using adaptive array. In a second part of the overview, he gives the beamforming schemes, adaptive algorithm, DOA estimation methods and error sensitivity of the relevant issues. The details and references given are useful for research on each topic such as DOA assessment techniques and a quantity of matters sensitive of error. Applicable information was given in details for research on each topic.

In adaptive antenna array, digital signal processor widely uses adaptation coefficient for simplified least mean square (LMS) algorithm. However, the acquisition and tracking of multipath fading channel causes problems due to the slow convergence of continuous adaptation approach. This is not suitable for mobile communications. Power control or normalised LMS algorithm is the fastest converging algorithm used in mobile communication. The limited capacity and the necessary precision arithmetic in hardware have implementation problems and causes statistical instability in normalised LMS algorithm. LMS algorithms have slow convergence due to the high complexity updating steps used for calculating weight vectors.

On the other hand, implementation difficulties require to be measured. This intricacy needed more improved hardware capacity and give numerical instability because the use of finite precision arithmetic. In this article RLS found to be one of the solution against LMS which has poor convergence speed and SMI with high complexity. This would provide the high SNR by correcting dependent factor setting the fading rate is done by J. Litva, and T. K. Lo [8].
After studying the design concept and the complexity of software algorithms used in the adaptive array antenna, the research scholar has proposed the Multiple Signal Classification algorithm. Finally, MUSIC algorithm proposed in this research is compared to the LMS, NLMS and ESPRIT algorithm [9].

2.2 SMART OR ADAPTIVE ANTENNA

In the article author R. S. Kawitkar and R. Shevgaonkar stated the personal and mobile communication service such as using of wireless communication applications is growing rapidly. Approximately the traffic of fifty percentages will be used in a wireless communication network by the mobile phone and rest by fax, voice and multimedia data. This shows how within a decade mobile communication promoted compared to last old days.

So they suggested the use of adaptive or smart antenna arrays using spatial spectral method for an increment in the channel capacity. The smart or adaptive array signal range as well as and quality of cellular phone users may be increased with tracking facility. The quality, range and tracking region of smart or adaptive antenna system is the third generation of wireless systems in the telecommunication sector has a wide significance. The 3G systems using adaptive or smart antenna problems are to be tackled effectively. The goal of this paper is the development of 3G systems using low complexity smart antenna structures.

Smart antenna test bed has been developed using DSP structures and several DF, DOA algorithms. Smart antenna systems (SAS) which benefits are accomplish through using some of a existing base station system with a low power consumption in mobile terminal, range extension, inter symbol interference lessening, superior statistics rate maintain and simplicity of assimilation are included. Monetary settlement, systems of antenna with adaptive array in operation at the base station, base station in terms of the increased costs, without compromising the system performance dramatically, often by more than 50 percent of total system costs, increase the area of coverage of each cell site. The test -bed competence and excellence of service in wireless communication applications can be used to explain in the system

In years of modern era, the limitations of antenna technology for broadcasting on the excellence, capability, and coverage of systems in wireless had been on the dot progression in
the elementary design and antenna role in a wireless system for communication. Antenna has been completed with a smart or intelligent by two changes. Initially adding up extra elements can be modifying its structural design. Secondly, an antenna can turn into the system of antenna that can be developed to reallocate signals prior to broadcast at every one of a successive element as a result composite effect has found in an antenna.

In reality, systems are smart not because of smart antennas are used in this. Normally co-located by means of a base station, combines an antenna array of a smart antenna system with a digital signal-processing potential to pass on and be given in an adaptive, spatially responsive approach. In further expressions such a arrangement can automatically modify the path of its emission patterns in reaction to its signal location. One ought to state digital signal-processing provides smartness reside in their facilities.

Smart or adaptive antenna has been contest multipath fading, as well as restrained intrusion signals. It utilizes multiplicity and adaptive merging systems. Smart or adaptive technique due to consumption of high power and complexity high in the system mostly has been so far considered for the base station. In recent times, an antenna technique using smart or adaptive technique has been functional in to handsets or mobile stations.

An adaptive beamformer is competent to by design modify the weight vector, in order to take apart preferred signals from intrusive signals. Adaptive beamfoming can be completed in a lot of way. A lot of algorithms are present for lots of purposes, changeable in difficulty. It is proficient by means of software and advanced signal processing. The technology combines the contribution of several antennas (from an antenna array) to structure extremely fine beams on the way to separate users in a cell.

Adaptive beamforming was well thought-out costly for marketable application in which a modern signal processing is required. The cost of processing a large scale deployment of a broadband wireless network for a cost effective solution has reduced the commercial market related to beamforming. Wireless communication system with digital beamforming has the received signals with complex digital information available with it. So a radio receiver for each antenna, a digital baseband signals must change the conventional RF signals.
This paper can serve as a common reference for testing the adaptive antenna array and algorithms as well as complete systems combining the signal of a smart antenna test-bed prototype of the design and development.

Smart or adaptive antenna systems have the advantage as

- Coverage increased,
- Quality of link improved,
- Capacity is increased,
- Data rate increased,
- Reception is more sensitive,
- Consumption of power is lower in handset,
- Cost is reduced and return are more on investment,
- Direction finding gives help for user location finding,
- Multipath dispersion can be provided,
- Suppression of interference,
- Broadcast energy is detained in the narrow beam,
- Conventional antennas compare to adaptive antennas cause coupling of the unwanted signal to desire signal,
- Specific absorption rate is lower,
- Alleviation in opposition to dead zones at FDD network of adjacent channel and base stations operators,
- Both the levels of carrier to interference ratio and signal to noise ratio are improved by means of combining signals in a specific direction from antenna,
- Using diversity of antenna co-channel interference at the handset is reduced,
- Space division multiple access technique is used,
- Multi-path fading is reduced and
- Reliability in call improvements.
The technology used in a broad concept is a smart antenna and achievements vary from uncomplicated techniques that occupy switching between lobes to highly developed algorithms make best use of the established signal-to-interference ratio. The choice of a smart or adaptive antenna recipient and algorithm is very much reliant on the air interface and its parameters.

To get better performance of network, smart or adaptive antenna recipient structure and algorithms ought to be optimized according to the transmission and intrusion environment, taking into account projected passage and users movement in the unit. These constraints can be shown as a creation of planning in radio network. At the similar moment in time, smart or adaptive antenna receiver constraints are significant for capability, exposure and intrusion development. They as well firmly act together with system be in charge of procedure at dissimilar layers.

Promising solution is systems that use smart antenna for improving the system performance of PCS’s cellular and CDMA applications is their development [10].

Authors designed and built the eight half wavelength antenna elements spaced along the direction of arrival based smart antenna for GSM 1800 base station. The processing steps in the direction of arrival (DOA) estimation are included customer recognition, pathways, signal renovation and beamforming. Authors displays in DOA estimation, correctness is not a most important anxiety but the strength of the system. The new parameter can be evaluated by the estimated variety. Reliable tracking of user DOAs only enhances toughness aligned with intrusion. Hopping thought version is well-matched with tracking. They show carrier-to-interference ratio and signal-to-noise ratio through the quantity of benefit in an actual transmitted data to quantify the benefits of smart antenna with both measured at 90 or 99 percent.

User and the interferer signals overlap with large angular spread in the urban environment has carrier-to-interference ratio reach up to 18 dB gain. Interferer is unacceptable widely especially if carrier to interference ratio increases and the angular spread is greater robustness. Signal to noise advantage by beamforming and diversity, its contribution gives important imminent interested in the different performance. In Uplink, the processor can absorb angular variation. DOA based smart antenna processing steps to modernize the entire suite of
real time processing is possible in demonstrating within less than 1ms. The solution in this article does not necessitate some transform to the GSM norms.

Smart or adaptive antennas make use of the spatial measurement. They limit the ability of systems to remove the second-generation by third-generation systems with towering and stumpy statistics rate users are strong option to coexist. Smart antennas affect the link budget positively, meaning that they can enhance coverage. Selecting one strong multipath out of many will reduce frequency selective fading and increase maximum possible data rate. Smart antenna technology is on the edge of commercial realization. Although there is enough room for pioneering work of theoretical nature, at this stage another issue is of importance. Smart antenna technology must be proven practically.

In real function using implementation of smart antenna technology has a challenge for the development of hardware and array processing. Some GSM and third generation systems approach to the study of smart antenna technology are introduced. Most of these plans only include process in uplink or downlink and communication with different mathematical solution. From the assessment of DOA based adaptive antenna, authors at the present discuss on the necessary components for a doing well design [11].

This section of the signal impinging on an antenna array element for estimating the AOA currently gives the general idea of some of the more popular methods. Because the direction finding (DF) methods exist and discussed here with emphasis cellular most applicable to the radio environment is located on the methods. More details on the algorithms discussed here can be found in the cited references. In particular, the following observations are a good source of background information on the problem of estimation of AOA.

In the Figure 2.1 form event at an angle of arrival estimation of AOA signal to measure one or more components of the phased array antenna base station is accomplished by using a directional antenna. In general sensors that are antenna element make use of to determine the space of the AOA of the signal carrier frequency is on the order of half a wavelength. Relatively close distance in the elements of antenna with the array gives a phase shift in the signal seen by the proliferation delay time allows in the element. This is referred as narrowband model and the AOA estimation algorithms are believed to be suitable for development.
The accuracy of the narrowband model depends on the quality of the receiver hardware, signal bandwidth and the antenna element spacing. The signals in a similar way (down, convert, filter, etc.) are processed for the each antenna element, this indicates narrowband model is absolutely accurate. This means that each receiver channel (Each antenna element RF front-end) has approximately the same frequency response which is very linear and all the mixing and sampling operations must use the same oscillator frequency. The receiver of this kind is commonly known as a coherent receiver.

AOA estimation system used in the receiver antenna a cost is increased with enlarges the quantity of the components in the array of antenna when components (and therefore the quantity of receiver channels) enlarge. So keeping it to a minimum the quantity of rudiments in the array antenna is very important. The required quantity of elements in the array antenna signal environment and the signal employment will depend on the precise AOA assessment algorithms. The most serious statement completed for DF practice of the antenna signals are less stringent than the number of elements.

After discussing the incident signal properties are exploited, this requirement can be relaxed for example a well-known training sequence consists of a sequence which can be estimated. Adaptive beamforming to implement, it should be noted that the same type of coherent receiver. Smart antennas (i.e., the adaptive phased array) base stations are deployed, the
AOA estimates typically be involved with additional signal processing and antenna systems for the emerging high-capacity wireless systems. Carefully measure all corners of the array as well as on the frequency and temperature must be calibrated. The periodic array calibration using both computational and storage in terms of time, it is a time process.

AOA estimation approach is the easiest phase interferometry. The phase difference between the signals directly found in many pairs of antenna elements is measured and estimated the AOA using the interferometry. This comes within reach of mechanism very fine for more signal to noise ratio but for well-built co-channel intrusion and/or multipath, it is fail. Another concept is relatively simple beamforming approach. Angular field of interest of this method on the array beam steering the beamformer can be seen as a measure of the output power. The AOA is an estimate of the true spatial distribution of the power spectrum that is to be received.

Beamforming concept is illustrating in the Figure 2.2 weight ‘w’ of beamformers is used for spatial response to be control in the beamformer.

![Figure 2.2: Beamforming Block for Phased Array [12].](image)

Capon method is closely related but has better angular resolution. However, these methods do not work well in multipath coherent. Techniques with the purpose of exertion fine in multipath maximum likelihood (ML) can be obtained using the framework. A variety of different assumptions about the algorithms and the event signals are obtained. The so-called deterministic
and stochastic method leads in ML. The ML method used in multipath environments that will estimate each path of the AOA. However, these methods are necessary for the implementation of composite multi-dimensional explore. Measurement of the exploration in use through every one of the conventional signals is equal to the entirety figure of its path. The search is further complicated in fact.

Estimates of the entirety figure of paths known a priori and that are obliged to be calculated. An additional group of technique i.e. Multipath will toil well with subspace-based algorithms can be obtained by combining spatial smoothing. Examples include MUSIC and ESPRIT subspace methods.

These methods usually fail to multipath but instead of a simple covariance matrix using a space that allows them to work properly. Spatial smoothing methods directly estimate the spatial signature of the property absorption is associated with adaptive beamforming methods. Spatial signature vectors estimated from the observed data of AOA estimates have several advantages. The main advantage of the search path AOA requires all signal paths to contribute to the estimated spatial signature estimate is an estimate that is reduced. Another benefit is more multipath components can be processed by a fixed array.

ML methods are very useful property of stochastic processes in the event of unknown signals, rather than assuming it is known and can be obtained from incident signal. This allows the exploitation of most digital cellular standards of training that is exists. Code Division Multiple Access (CDMA) was proposed for AOA estimating signals methods problem which can be approximated an interesting program. AOA proposed algorithms to estimate the number of antenna array so far exceeds the number of co-channel signals. This is clearly a very large number of co-channel signals are not practical for the CDMA therefore, the discussion over the AOA estimation method is applicable to any CDMA.

Also detect weak signals, multipath and interference that help to reduce the impact on the fully adaptive array base station by using the adaptive array antenna system. AOA will provide an increase spectral efficiency for cellular networks. Certainly, multipath and co-channel interference will require the development of computationally efficient and more robust new
algorithms. This is challenge for researchers and they needed more precise temporal-spatial channel model tools capable of creating maps and spatial-temporal models.

This article is being presented for a survey of the position location technology which has provided the future of mobile communication. Service providers and professional are already interested in wireless location finding systems. Yet many challenges must be met before widespread low-cost position location becomes available. In GPS, distance, and geographic location of the wireless status appears to be the leading contender. Much work is needed to develop solutions for ubiquitous location and its treatment in the future. It will expect to solve the problems for the system position location in future [12].

The paper supports the learning of the system i. e. Space Division Multiple Access (SDMA), smart antenna, the tracing of electromagnetic ray. The finding of beam is useful to the learning of communication of wireless systems. Cell site design has conducted on the low spatial resolution and high resolution data so that can see rapid fading effect. Downlink signal to interference ratio and Uplink diversity gain of communication signals in SDMA systems with limited basic performance criteria understanding some of the mobile user environments are simulated.

In this paper, tracing of electromagnetic trace procedure can useful to the learning of adaptive antenna array systems. By means of this advance the location of user and the surrounding can be firmly restricted and applications can be fully replicated. The controlled outside mobile surroundings are more practical state compared as well as simulated the size of the complex before the vector channel propagation characteristics in the simple form are studied. In addition, simulations of only receive information is done but furthermore in different circumstances an arithmetic explanation of system performance can be repeated.

At last, the channel vectors for a variety of outdoor environments accurate computer simulation of the subsequently invention of systems space division multiple access exclusive of prototype hardware is studied. In the past, most of these studies consider either one or the cell site antenna systems designed for this purpose have been run on a low spatial resolution. However, can be seen when the effects of fast fading, the study of the high resolution creates information vector channel. To make the situation real, fast fading and high-resolution
measurements on the celestial sphere is not exactly practical to anticipate loss, while the performance of the system allows to study in depth.

The study assesses the presentation of the system SDMA is a comparatively innovative region. Signal to noise ratio of the strict requisites of the bit error rate presentation of the scheme to feature a high level of communication may be easier to view and can be considered a much more on the forces. Winters7 communication system performance suggests three main limiting factors for expensive field measurements are studied.

These are:
- Interference due to co-channel
- Delay spread
- Multipath fading

The methods utilized for such learning are scrutinize and limited every single one of above three factors. Though, in this paper, only the first two will be taken into account in the study.

Multipath fading can be easily understood in this paper using the tracing of beam technique. Transmitters to receiver in certain environments are starting to receive radiation. These rays travel in a different path to the receiver via transmitter so can comprise different number of phases as well as amplitudes. Superposition theory illustrate as the entire field is a summation of the individual rays contributions at a receiver end. On a receiver side rays and interferes with each other constructively are destructive. The position, orientation is extremely sensitive to the environment because of the interference level to be low. Thus, total production reaching the receiver is referred to as multipath fading will experience large fluctuations. Constant bit error rate to maintain combat multipath fading usually increases the power of transmitted signal.

Co-channel interference (CCI) system from all other mobile users specifically refers to the energy of the signal received by the mobile user. Another indication of a mobile user intervention contributes to all users, increasing the transmit power alone is not a feasible solution. A communications system that can tolerate the amount of co- channel interference. The maximum capacity of the system is closely linked. Winters7 used in SDMA systems research has
the basic limitations on the performance of the communication system can tackle all three factors are mentioned above. Authors mention the purpose of this study is to select the quantity of spurious comparison with conventional single antenna systems and SDMA systems explains how to get rid of these limitations is to quantify.

DOA dominant method:

Arrival (DOA) of the dominant directional beamforming methods of communication is the most intuitive. In opinion for a specified cell phone user, it received a great power in the uplink direction and focuses all the energy that is transmitted. This concept is point up in Figure 2.3.

Figure 2.3: Dominant method [13]

In the above figure, the arrow of mobile users each base station can transmit energy to different paths. The arrows highlight the dominant mobile user will be used for the DOA method is explained. The dominant DOA at an angle $\theta_{\text{DOM}}$, focus all the transmitted energy towards its direction by downlink regardless of chosen maximize the value of spatial spectrum during uplink. The dominant method of DOA and transmission as much as possible to focus on
promoting the flow of communication for each array element is needed to choose a weight. Simply select the weights of the angle \( \theta_{\text{DOM}} \) are steering vector.

**DOA Pseudoinverse method:**

The principal method pseudoinverse of DOA method is equally simple. In addition to carrying a DOA direction of the preferred customer, at the non dominant on both sides of the antenna radiation pattern deep nulls are placed. In other, wanted consumer direction each and every one the DOAs of some extra mobile users has sharp peaks in the structure. In pseudoinverse method increased in the preferred signal power is achieved by decreasing the power in the unwanted customer direction. While in the dominant method this can be done by increasing the power in the wanted customer direction only. This idea has been demonstrated in the Figure 2.4.

![Figure 2.4: Method of Pseudoinverse](image)

**Spatial Signature Simple method:**

For the communication of the cell phone user a spatial signature (SS) simple communication systems that encourage the current weight vector spatial signature of the mobile
user is using. Instead of only the desired mobile user DOA direction of the dominant signal energy is concentrated in the first two methods differs the beam energy to pick up the signal in every one guidelines to the cell phone user. And uplink spatial signature represents the relative strength of the different directions of energy coming from the stage of encapsulation; the information in the same way by using this method of communication is applied. This idea has been demonstrated in the Figure 2.5.

As shown in figure 2.5, the dark line of the beam is transmission of signal by base station to the cell phone user 1 should be taken to explain the directions. The relative strength of each of the beams used for the transmission and uplink is showing the relative strength and phase.

Spatial Signature Pseudoinverse method:
This paper considers the communication beamforming method spatial signature (SS) pseudoinverse method. Easy spatial signature method tries to maximize signal to noise ratio with no introduction of NULLs, when entering the spatial signature pseudoinverse method tries to maximize signal to noise ratio. Specifically, NULLs are inserted on the spatial signature of the DOAs in the additional cell phone users in the system. This idea has been demonstrated in the Figure 2.6.

The bold line in the spatial signature of the cell phone user 1 illustrates the components of the DOAs. Dashed lines indicate the identical data for the cell phone user 2. For transmission to the cell phone user 1 and user 2 of the spatial signature of the method according to the original idea behind placing NULLs when the beam is directed with respect to the cell phone user 1 of the spatial signature.

In particular some of the findings of this study SDMA system performance are verified. Effective to reduce the multipath fading, the ability of the antenna array was demonstrated in all cases. Beamforming methods of communication, especially in terms of the direction of transmission and signal to interference ratio, good performance of both methods dependent on DOAs were difficult to distinguish situations of mobile users [ 13 ].

In mobile system the area of the base station (BS) and mobile station (MS) link between the BS use omnidirectional or sectoral antennas. MS location is fixed at a certain moment, because in this case, the main part of the radiated energy is wasted for no purpose. Only the direction of the transmitted signal is assigned to a particular MS and MS according to its movement can be changed and it will save a lot of energy. Spatial properties of the radio traffics in the direction of the signal source can be generated by beamforming. Therefore, frequency, code, and already well-known parameters such as the time a reservation i.e. degrees of freedom can add in the wireless systems. The moment authors get the fixed version of the code is the only
individual who assigns direction of arrival (DOA). The idea of smart antenna systems (SAS), which is referred to as adaptive antenna arrays, it can take place with digital signal processing.

Using smart antenna systems signal to noise ratio is increasing. The base station (BS) allows a radio coverage zone in a radial distance. It excludes unnecessary because the antenna array radiation pattern of signal propagation in good directedness, multipath propagation constrains. In addition, a strong source of interference in the shape of the radiation pattern can be minimal.

DOA Estimation and Beamforming:

Smart antenna has two main functions. In each function signal processing algorithms is used. The first function use adaptive antenna arrays which consists the number of sources based on environmental analysis, estimates DOAs that split the signal and noise sources. Algorithms in the second functions gives maximum peaks in the route of preferred signal and minimum peaks in the path of the noise signal by calculating the weight coefficients of the beamforming. This cycle is repeated periodically for MS monitoring purposes. Therefore, it is implementing to estimate the number of sources and DOA estimation algorithms in beamforming.

Authors categories parameters in two parts are namely the parametric approach and spectral base parameter estimation techniques. Former is spectrum as a function of the parameters of interest for example DOA. The utmost peaks of the utility in different locations are recorded as DOA estimates. On the other hand, parametric techniques are required in the look for for every one the parameters. The latter approach is often at the outflow of enlarged calculation difficulty, however, resulting in a more accurate estimate.

In this article discussed spectral-based methods are classified into

- Techniques of beamforming,
- Methods of subspace-based.

Parametric techniques lead to more accurate estimates of the fact however these estimate the parameters in real standard uncertainty leads to incomparably more computational complexity. Therefore, the immediate future spectrum -based methods are preferable.
Techniques of Beamforming:

Signal in the antenna array using beamforming technique automatically localize the source. It is thought that at the time the array is a steer and it measure the output power. Maximum power estimates by DOA technique yields the steering locations. The peaks of power correspond to the source. Bartlett beamformer analyze array sensor data which is classical Fourier -based spectral analysis. For an assortment of random geometry, the algorithm for given input signal maximizes the output power in certain direction.

Regrettably, the spatial spectrum of the Bartlett method does not transgress the restrictions of decision reason by the aperture of the antenna array. The beam width at a distance closer than two sources of power to solve the limitations of the beamformer authors had proposed several changes. A well-known method was proposed by Capon. Capon's beamformer is diminish the power supply by noise and any signals imminent from extra guidelines while maintaining the gain in the look direction.

Algorithm for the beamforming is as follows...

• Spatial covariance matrix estimation
• Spatial spectrum calculation
• Spatial spectrum findings

Subspace- Based method:

One of the majority important involvements came concerning when the eigen-structure of the covariance matrix was explicitly invoked and its intrinsic properties were directly used to provide a solution to an underlying estimation problem for a given observed process. A number of sources are estimated equally for all subspace-based methods. Using the Gram-Schmidt method, transform the spatial covariance matrix.

Therefore, it is compulsory to set the threshold. The antenna geometry and system can be serviced by the largest number of sources. The following stapes in the algorithm is to find the number of sources:
• Spatial covariance matrix estimation
• Decomposition of eigenvalue
• Computes eigenvalues which are larger or determined threshold decision.

These are a number of sources.

The algorithms for estimating the sources of the subspace based methods are common. In conclusion based on the spectral subspace beamforming techniques, offers a clear performance improvement compared to methods that are used. These results of the existing algorithms are also working parallel on a minute numeral of antenna rudiments and displays simple antenna geometry. Subspace based methods, the quality in the practice is highly important. Even more, the state-of-the-art capabilities in digital signal processor or erasable programmable logic devices that allow for the calculation of the complex matrix [14].

2.3 MULTIPLE USER COMMUNICATION
A) MULTIPLE SIGNAL DIRECTION FINDING

Many physical problems in sonar, radar, seismic, etc. signal processing utilized the records of multiple sensors to locate one or more sources of coherent energy—generally assumed to be a point source, omni-directional emitters. Naturally, the feeler yield enclose the source waveforms as customized in amplitude and phase by the standard among the sources and the array elements and the transfer function of the array elements themselves. Essentially all the arithmetical in sequence is prearranged in a locate of pair wise cross correlations connected with the feeler yield and arising from the proliferation of the directional wave fronts across the array.

Typical direction finding (DF) systems use techniques which are resulting presumptuous so as to a single source is organism received. A quantity of of these DF systems is nevertheless working in multiple source environments by extending the implementation rather the theoretical basis. A DF system designed to switch a particular source at a time has been predictable to work in a manifold source surroundings if single of the subsequent circumstances is true.
• The signals are well estranged in frequency i.e., by more than the reciprocal of the observation time.
• The signals are well estranged in time i.e., by more than the reciprocal of the bandwidth of the data.
• The signals are well alienated in direction of arrival (DOA); i.e., by more (in radians) than the reciprocal of the diameter (in wavelengths) of the array collecting the data.

However, if the system is receiving signals from several sources that overlap in frequency, overlap in time, and have DOA’s within an array beam width (i.e., overlap in DOA), additional competent dispensation techniques, such as those based on the signal subspace approach, are needed.

The author intends as a performance report on an experimental method based upon the signal subspace approach to multiple signal DF and source parameter estimation. There are few approaches processing array data but that are not implemented in this system. Few are not available in the literature with the competence to completely treat the general problem, thus these are not actually compatible with the implementation. Few of these are categorized as follows.

• Traditional beam steering, i.e., either physically or electrically turning an array with a known main beam response and regarding a maximum in the perceived power (Plotting the reciprocal of a steered-null response provides a very sharp maximum when compared to a steered-beam response. Thus, the approach has led to what is known as high-resolution methods. Of course, no actual beams are formed, that are sharper by the traditional beams) as a DOA estimate.
• Null steering, i.e., either physically or electrically turning an array with a known null response and regarding a minimum in the perceived power as a DOA estimate.
• Computational signal processing, i.e., the sensor voltages are subjected to computations that separately detect the presence of multiple signal sources, estimate the parameters (e.g., DOA, strength, polarization, correlation) between the multiple sources and designed sets of weights to be applied to the sensors which has suppress all the sources but one in the order to reconstruct the waveform of the selected source.
The signal subspace approach has a high resolution and computational approach. The principle high resolution approaches include Capon, Burg, and Pisarenko. Many variations on these approaches have appeared in this literature [15].

B) MULTIPLE EMITTER LOCATION AND SIGNAL POWER ESTIMATION

The all-purpose difficulty considers antenna with random locations and arbitrary directional characteristics, i.e., gain, phase, polarization in a noise or interference environment of the arbitrary covariance matrix. The multiple signal classification approach is described; it has been implemented as an algorithm to provide asymptotically unbiased estimates of

- Number of signals;
- Directions of arrival (DOA);
- Strengths and cross correlations among the directional waveforms;
- Polarizations; and
- Strength of noise/ interference.

These techniques are very general and of wide application.

Special cases of MUSIC are

- Conventional interferometry;
- Monopulse direction finding (DF), i.e., using multiple co-located antennas; and
- Multiple frequency estimation [16].

C) BEAM FORMING, DIVERSITY, AND INTERFERENCE REJECTION FOR MULTIUSER COMMUNICATION

Non-coherent channel uses many modulation schemes. That is in IS-95 standard, Walsh codes decoded the uplink channel connected non-coherently. Orthogonal modulation as well as non-coherent frequency-shift keying is the similar cases of this standard. The other common
system of encoding uses phase difference at a time and receive the data symbols assigned to the analysis process. Two dimensional array model of M x M vector of the array use to analysis the present and previous information. M x M array constellation is the efficient structure that has transmitted vector in two dimension form representing the information bit for last and existing.

The author has considered quite a few additions of the non-coherent multi-user recognition for M x M array communication channel has a fading applied to the multiple-antenna. In this article, he utilised models with basic two channels. The primary case has assumed constant fading process to every user across the face of the array. The primary case referred as a coherent wave front fading. In second model fading channel, each sensor does receive a duplicate of the relevant factors with dissimilar weakening parameter. The channel has a correlated fading. The coefficients of the fading in this channel may be correlated.

The coefficients of the fading in each case are constant for every symbol. Independently or even arbitrarily these are changing from symbol to symbol. Such a block fading form is used in a quickly fading channel or/and frequency hopping and block interleaved systems. In the blind detectors applied to communication channel by assuming the channel is synchronous, then this assumption is failed in this method for multichannel communication.

For the coherent wave front fading channel, it is talented to correlate a direction of arrival (DOA) by means of every client and utilize finding rules which develop this structure. The finding schemes are extensions of the widespread maximum-likelihood (GML) and the minimum mean-squared error (MMSE) detectors, the main dissimilarity creature the insertion of the DOA. He proposed a technique for estimating the DOA which is enthused by the multiple-signal classification (MUSIC) algorithm.

Non-coherent channel uses many modulation schemes. That is in IS-95 standard, Walsh codes decoded the uplink channel connected non-coherently. Orthogonal modulation as well as non-coherent frequency-shift keying is the similar cases of this standard. The other common system of encoding uses phase difference at a time and receive the data symbols assigned to the
analysis process. Two dimensional array model of M x M vector of the array use to analysis the present and previous information.

Non-fading channel with multiple antenna arrays, the author considered suitable multiuser M x M array. Channel that is used based on the two essential models. The first case, the fading progression for each user is expected to across the face of the array. The wave is consistent with the fading. In second model fading channel, each sensor does receives a copy of the relevant factors with different fading parameter. The channel has a correlated fading.

In every case for each symbol period fading coefficient is taken to remain constant and these are allowed to change randomly from symbol to symbol. The block fading model is used in fading channel or frequency-hopping and block-interleaved system. Multiuser communication channel is considered to be contemporary and it relaxed when blind detector are used. In other words, falls off for the wave front fading channel and element-to-element fading channel with receive antennas is a number of division among the signal subspace and the intrusion subspaces of the previous users [17].

D) ANGLE OF ARRIVAL AND ANGLE-SPREAD ESTIMATION OF MULTIPLE USERS

In micro diversity using several schemes feature of capacity is increased and reduction in interference achieved by increasing the current at base station. These schemes are diversity, sectorisation and switch beams. However in advanced smart antenna array problem is resolved by fully adaptive and cost-effective solution at the base station. Interference with in cell or intra cell is minimized using spatial filtering by separating overlapping signals. The capacity is increased using space division multiplexing.

In the phased array, angle of arrival (AOA) provide signals as of the base station to the handset antenna using the super-resolution methods using a MUSIC or ESPRIT estimation technique. This information can be used for bore sighted handset antenna beamforming algorithm to make certain antenna pattern. In addition, AOA knowledge of each handset gives current requirement which help to locate the caller cell phone automatically using triangulation between two or more base station.
Figure: 2.7 Base-station employing an adaptive antenna array to estimate the AOA of two mobile handsets [18]

However, for many mobile radio environments, particularly urban environments, the signal from each handset has been scattered and this give rise to large errors in the AOA estimate due to angle-spread. Figure 2.7 illustrates that each signal from the handset of a mobile radio environment especially in urban environments are scattered because of the spread of the AOA. Subsequently, the figure displays, several handsets at the same time is almost angle spread indicates the spatial overlap of the scatter signals from several sources are transmitted. The AOA and particular angle spread signals of the particular cell is the best information at the base stations to classify the received signal de-interleaving of the handset and gives optimum beamforming [18].

2.4 ADAPTIVE BEAM FORMING

A) PERFORMANCE IMPROVEMENT, FEASIBILITY, AND SYSTEM CONSIDERATIONS

Mobile satellite communications using a directional antenna require familiarity of the route of the satellite to guide the ray toward it. Using satellite antenna beam directed toward the desired user requires information of mobile satellite to steer beam towards it. In a moving vehicle, satellite tracking is important depending on the type of antenna systems that tracking accurately. For example, antenna beam pattern and array bore sight of the satellite in the
direction of the main lobe fixed mechanically steered array system and electronic steered array by phase adjustment in the beam. The beam can be adjusted in order to extend a half bandwidth.

A conventional closed loop method in which a signal received from the satellite and the difference signal generated is known as the Monopoles scheme. The sum signal form by accumulating the two signals in phase and utilizes to retrieve data from satellite. The difference between the satellite signal beams is pointing phase redundant and array is formed in symmetrical elements by adding two signals. Open-loop feedback system is not use signal from a satellite as feedback. Such as magnetic compass and optical fiber-gyro output from the sensor and the satellite signal is not the static.

An open-loop scheme does not necessitate the signal as of the satellite as of feedback. It make use of the productivity from sensors such as a magnetic compass and optical fiber-gyro and is helpful in circumstances everywhere the satellite signal is not stable. This is the crate for a land-mobile communications scheme contrast with a maritime communications scheme. Array has been utilised in different formations for the communication system of mobile, out of which considered here base station mobile system. The schemes consist of a base station located in a cell and serve a set of mobiles within the cell.

It put on the air signals to each mobile and be given signals from them. It monitors their signal potency and organizes the handoff when mobiles irritated the cell boundary. It provides the relation among the mobiles inside the cubicle and the respite of the set-up.

The use of array at a base Station

A base station having manifold antennas is from time to time called to as having an aerial assortment or space assortment.

- Formation of multiple beams: In its easiest structure, Base station is using the multiple antennas such way it can produce multiple beams to cover cell entire area. For example, multiple antennas are used in the cell to cover entire area of the cell. Manifold ray shaped by this aerial are 3 beams in 1200 bandwidth of each or 6 beams in 600 beamwidth of each. Each one acts as
individual cell and operates with fixed assigned frequency. By handoff process each cell is utilize by the mobile user moving across a distance.

- Formation of adaptive beams: The base station used antenna such way its array has an ability to form independent beams. The assortment is used to locate the position of every mobile, and after that beams are shaped to cover different mobiles or groups of mobiles. Each beam has been considered as a co-channel cell, and thus may be able to use the same frequency or code, as the case may be. Fig. 2.8 shows a typical setup involving different beams covering various mobiles along with the directions of moving mobiles. It illustrates the situation at two time instants.

![Figure: 2.8 A typical setup showing different beams covering various Mobiles [19]](image)

- Null formation: It is necessary in antenna pattern to create zero response towards the interference. Also same response can be used practically towards the unwanted user in the cell at the same time desired user receives the signal.

The antenna pattern generates nulls to lessen the co-channel intrusion by co-channel mobile. In the transmit mode energy given to co-channel mobile reduce the interference of the mobile from base station.
Optimal combining: The signals inward from a variety of antennas are combined in such a means that interference or unwanted signal is reduced. This process of combining signal enhances the desired signal. Due to that co-channel interference reduced and receiver operated more effectively.

The direction of arrival of interference is not much important but protecting the desired signal from it is important.

Dynamic cell formation: The impression of adaptive ray forming has been comprehensive to energetically altering cell shapes. In its place of having cells of fixed size, the utilize of antennas allows the arrangement of a cell based leading traffic needs, as shown in Fig. 2.9 [19].

![Figure: 2.9 Cell shape based upon traffic needs (a) Cells of fixed shape. (b) Cells of dynamic shape [19]](image)

B) BEAM-FORMING AND DIRECTION-OF-ARRIVAL CONSIDERATIONS

Optimization Using Reference Signal: A narrow-band beam-forming structures that make use of a mention signal to approximation the weights of the ray former is shown in Fig. 2.10.
The array yield is subtracted as of an accessible mention signal $r(t)$ to produce an error signal $\varepsilon(t) = r(t) - w^H x(t)$, which is used to be in command of the weights. The weights are attuned such that the MSE among the array output and the reference signal is minimized.

The scheme shown above has used the poor signal and weights are adjusted to get unidirectional pattern. A unidirectional pattern is provided by setting interference to zero along weak signal with jammer in presence of weight. The developments begin to reduce weak signal later than interferences. At the same time when the output signal consists of strong interference, signal cannot cancel but the interference is reduced.
Wiener-Hoff equation is estimated in favour of the adaptive weight vector in a direction strong jammer is cancelled and nulls are adjusted in that direction. Using the reference signal adjusting zero weights is called power - inversion of the adaptive array. The MSE reduction method is the closed- loop Wiener filter method while MVDR is of the open-loop filter method.

In general, the Wiener filter provides higher output SNR compared to the ML filter in the presence of a weak signal source. The signal is distorted in this scheme because increased in SNR by the Wiener filter. The optimal weight is used to achieve the undistorted signal using the filter and the beamformer created by it is called optimal beamformer. The reference signal used in the above method is generated by the many different ways with respect to its use in the application. In the field of digital communication for mobile, starting signal is a synchronisation signal. Later signal used in the system is reference signal which one is a detected signal.

Beam-Space Processing: In dissimilarity to element-space dispensation, everywhere signals imitative from every element are weighted and summed to create the array production, beam-space dispensation is a two phase method where the first phase takes the array signals as put in and produces a set of manifold outputs, which are then weighted and pooled to construct the array output. These multiple outputs has been thought of the output of multiple beams. The dispensation done at the first phase is by fixed weighting of the array signals and amounts to construct multiple beams steered in different directions. These weights are in general not adaptive, that is, these are not attuned during adaption cycle. The weights functional to dissimilar beam outputs, to create the array outputs are optimized to meet precise optimization criteria and are attuned during the adaption cycle.

SPECTRAL MUSIC: Music uses eigenstructure technique in DOA method is relatively simple and efficient. Samples in spectral MUSIC estimates noise subspace. The noise subspace estimation is done by singular value and eigenvalue decomposition of data and correlation matrix respectively. The matrix columns are signal vectors or snapshots and this estimates noise subspace. Noise subspace and steering vector are orthogonal which gives the search direction. This search direction normally finds peaks in MUSIC spectrum.
BEAM- SPACE MUSIC: Beams are form and pre-processed by an algorithm using parameter. Modified DOA evaluation in beam-space has compensation such as improved resolution, low sensitivity to error ratio, bias and reduce threshold. The array has number of elements with a beamformer has been used for reducing a number of beams and reduced data is processed for DOA estimate.

ESPRIT: It is a working out well-organized and vigorous method of DOA estimation. It make use of two matching arrays in the intelligence that array elements require to form coordinated pairs with an the same dislocation vector, that is, the moment element of every duo ought to be expatriate by the similar reserve and in the similar route comparative to the first element. This, though, does not denote that one has to have two disconnect arrays. The array geometry should be such that the elements could be particular to have this property.

Lal C. Godara in his article gives clear analysis on the presentation of route judgment using several measurements. The measures of the performance analysis are CRLB, basic, resolution, probability of resolution and variance. Among these mostly studied the MUSIC for direction finding. This performance analysis is carried out on the basis of sample testing rather than arrange for the direction finding more snapshots are required for correlated source compare to uncorrelated source for finding the angles of arrivals to the equal power using a spatial smoothing with forward or backward in MUSIC.

With context to snapshot, SNR and inverse changes in the direction of the source occurs. Snapshots in lower number are used at less SNR gives bad resolution. For the limited samples a comparison in terms of standard deviation between fine music and mean-norm indicates the standard deviation for min-norm is more at low SNR. While MUSIC has highest bias and the CRLB unbiased estimate of the covariance has minimum price. Using a MUSIC system with a large SNR, antenna array elements and a great numeral of example can be considered the best estimate for the direction of the sources are uncorrelated.
At specified threshold level, define SNR is minimizing by choosing the beamforming matrix and the direction of arrival estimation using the MUSIC algorithm. Compare with traditional method, the MUSIC has lower threshold resolution.

Resolution property of MUSIC is based on the figure of snapshots and geometry of the array. This is also depends on the angle of separation in the sources and signal to noise ratio. Estimate the probability of behaviour is predicted by the resolution of the MUSIC, and it is modified with respect to various parameters. An Eigenvector method in comparison with other MUSIC methods gives more sensitive performance. The performance is more sensitive performance. The influence in the performance of the supposed quantity of foundation is sensitive to the actual uses of the resources. The number of resources used in the MUSIC, direction of arrival estimation needs more basics knowledge of the sources. The array geometry as well as the distance between the two sources indicates the performance. This will give benefits to the estimated range of angles [20].

C) ESTIMATING THE ANGLES OF ARRIVAL

The comments given in this article on method of estimating the angles mention in order further for multiple plane waves. Every one process execute well at soaring SNR. At lower SNR method-I (proposed by Schmidt, Bienvenu and Kopp) is fewer than acceptable, since the phantom peaks are compound in many of the trials though forged peaks are absent. Weighting the eigenvectors inversely by the equivalent eigenvalues does not unavoidably get better the situation. The presentation of methods-II (Compute the coefficient vector) and method-III (Singular value decomposition (SVD) based linear prediction method) are the same and seem to be better than method-I.

However, at lower SNR values methods-II and III will begin to demonstrate forged peaks and unification of spectral peaks, etc. But it appears that the propensity for this to come about in methods-II and III or for the spectral peaks to combine is at lower SNR values than in other method [21].
D) LINEARLY CONSTRAINED BEAM FORMING

Linearly constrained beam forming is a controlling and adaptable system of spatial filtering. The weights in a linearly controlled beam former are a purpose of the data covariance matrix which is frequently unidentified. One general approximation of the covariance matrix is the sample covariance matrix. The sample covariance matrix is the highest likelihood estimate specified with no prior limitations on the covariance matrix. The beam former output is a utility of the covariance matrix approximation as a result it is a random variable with allocation reliant on the statistics of the covariance matrix approximation. In this connection, the distributions of the output power, mean-squared error (MSE) in the deficiency of the required signal, and the excess MSE due to the occurrence of a required signal are derived.

Quite a lot of scholars have deliberated the convergence description of adaptive beam formers so as to utilize the sample covariance matrix inversion algorithm (commonly referred to as the SMI algorithm). Reed, derive the distribution of a normalized signal-to-noise ratio (SNR) presumptuous the beam former weights are depents on signal data vectors. Capon and Goodman obtain the allocation of the output power for a least amount variance beam former issue to a single linear limitation. Monzingo and Miller take care of adaptive convergence of SNR and MSE for a range of arrangements of beam former normally utilize in narrow-band processing; some of these are the same to a least amount variance beam former matter to a single linear constriction. This correspondence gives opinion to all-purpose linearly controlled beam forming problem. These clearly show the adaptive convergence advantages of partially adaptive beam forming [22].

E) ADAPTIVE BEAM FORMING ALGORITHMS

The application of the space-division multiple access method has been provoked by the ever growing requirement of capacity of mobile communication. Space-division division multiple access has been prompted by the increasing demand for mobile communication capabilities. Signal from the carrier frequency is separated the spatial domain of broadcasting
smart antenna array. Mobile system gives improved network performance by advantage of the capacity in existing cell is increased. Smart antenna in the spatial domain related to DOA in the direction of the antenna so need sparsely space element. It needs to improve the training sequence as a reducing reference and enable to enlarge the convergence rate. In turn, it reduces the bandwidth required to transmit data.

The author compared LMS and NLMS algorithms to decide which one has been best to use in the smart antenna systems. The smart antenna beamforming algorithm LMS and NLMS are compared. This comparison is studied with changing number of antenna array elements and spacing distance between them. When executing the LMS and the NLMS, NLMS algorithm is better and has the convergence which shows more stable and faster measurement takes more time. In addition, the radiation pattern is good, hence this algorithm implemented. NLMS and LMS are performed, shows the NLMS is faster and more stable error convergence. However, NLMS has a little longer more computations than the LMS to calculate the weights [23].

F) COMPARISON OF SOME ALGORITHMS FOR BEAM FORMING

B. G. Wahlberg, Iven M. Y. Mareels, and Ian Webster have been shown how covariance matrix based systems can be utilize in adaptive beam forming examples everywhere merely output power capacity are obtainable. The design is to calculate approximately covariance matrix of the sensor outputs using perturbations of the nominal beam former weights. Three different beam former algorithms have been investigated.

- Direct SMI schemes, with the sample covariance matrix approximation change by the estimate obtain by the perturbation method.
- A generalization of SMI scheme, using an eigenvalue decomposition of the covariance matrix estimate.
- The DOA’s of the incoming wave fronts are approximate by means of subspace methods. Founded on these DOA approximations the beam former weights are resolute.
Investigational exertion has stimulated a numeral of nontrivial alterations that have noticeably enhanced the algorithm’s performance. These alterations comprise the utilize of eigen space decomposition move towards to the estimation of the covariance matrix. This decreases the outcome of finite word length on the calculations. The prefaces of planned perturbations trim down the result of relationship of the received signals. Investigational exertion proved that the matrix techniques offer as good as null steering performance by means of a important lessening in the figure of power capacity illustrations as evaluate to adaptive LMS methods.

In this paper Bo G Wahlberg presents adaptive beamforming or null steering covariance based matrix method for single receiver for single receiver array. It also indicates that single system with signal power and updating weights have advantage over a coherent system. Coherent system is one in which a single receiver is used in per antenna element. So obviously the first has advantage over the coherent system.

Gradient based adaptive beamforming method is introduced for the single receiver antenna. This one uses the disturbed weights to developed gradient so that can used LMS method for weight changing. These methods do not use the optimum weight find directly from covariance matrix.

Author has estimated two cases for how to determine the covariance matrix. These cases are

- Desired signal observe without reference signal.
- Observe with reference signal.

In the first case, with the intimation of direction of arrival of reference signal, beam former weights are calculated from covariance matrix. By separating the interference signal from noise by eigen analysis gives better performance using ML estimation. In the second method, direction of arrival estimation used signals from covariance matrix. The location searching for source is one of the problems in narrowband signal. Several high resolution directions of arrival
approaches are present. MUSIC and Capon’s methods are most well known conventional beamforming approach.

Further in this paper DOA estimation improvement possibility is mention. Getting better superiority of beamformer weights is advised by using specific array geometry to approximate the DOA of the unwanted or intrusion signal. This one has a drawback because of amplitude modulation application and coherency can not affect multi dimensional search. Finally from experimental result, they show the comparisons between gradient based technique and eigen structure method [24].

G) DIRECTION OF ARRIVAL ALGORITHMS FOR adaptive beam forming

In the literature different beam forming algorithms are exist like Side-lobe cancellers, Least Mean Squares (LMS), Linearly Constrained Minimum Variance (LCMV), Recursive LMS, and Direction of Arrival (DOA). Out of this MUSIC and ESPRIT algorithms in the Direction of Arrival (DOA) play the most important role. The performance of these two algorithms was executed and the comparison between them is studied. For the next generation DOAs were obtained by simulating the algorithms at different levels of the signal in wireless system. Meanwhile in beamforming, ESPRIT found as good DOA estimation suited for the uncorrelated sources.

Using an adaptive beamforming algorithm will improve the operation of next generation wireless greatly. Spectral efficiency of wireless communication system raises the variety of reception and protected broadcast increases significantly the performance of beamforming by reducing interception. Maximum radiated signal is steering in the desired direction by estimating the signal arrival and eliminating the signal from the other direction at the same frequency. This is accomplished by using array antenna system in which each sensor weight is altered.

So, the ESPRIT DOA algorithm has been treated as an extra tough and faster estimation technique as related to MUSIC. The calculation is also fewer composite relatively. However, ESPRIT has the disadvantage of not being capable of handling correlated sources. Finally, this
accurate direction has been used to obtain better beam forming, which is very essential for next-generation wireless systems.

Nevertheless, it is unable to handle the correlated resource link. This will help to get the best beamforming in very accurate direction, in the next generation wireless system. Using an adaptive beamforming algorithm will improve the operation of next generation wireless greatly. Spectral efficiency of wireless communication system added to the variety of reception and secure transmission enhance significantly the performance of beamforming by reducing interception. Maximum radiated signal is steering in the desired direction by estimating the signal arrival and eliminating the signal from the other direction at the same frequency. This is accomplished by using array antenna system in which each sensor weight is altered.

Spatial filtering use in the beam forming to differentiate the spatial features of the SOI, noise and the obstruct signals. Transmission and reception of signal work on the principal of beam forming in wireless communication. This is achieved by using sensors or arrays of antenna. So beamforming and spatial filtering properties are used to identify the noise and interfering signal. These rules apply to both broadcast signal reception and beamforming. To proceed with beamforming, it is necessary to observe a few basic assumptions. Firstly, the detector array far away from the original signal can be considered as a plane wave. Time delay version of signal received by the second number of sensor element is a part of detector. The several number of beam formation is possible by N number of element beamforming system. Beamformer guides the desired signal in a particular track and nulls in to a direction of intrusion. This is done by DOA exactly same on signal at the received output in the array and finds the DOA for all input signals. It is known as the beam steering angles in the network of beams required for the computation of complex weight vectors [25].

2.5 DIRECTION OF ARRIVALS

A) THEORETICAL COMPARISON FOR BIASES OF MUSIC-LIKE DOA ESTIMATORS

Several DOA estimators in MUSIC like, such as Likelihood MUSIC, Beam spaces MUSIC, Min-Norm, FINE and FINES have been planned to get better the presentation of
MUSIC. While in the complex estimation condition, the bulky model bias of MUSIC becomes the main estimation error, a relative learning of biases of MUSIC like estimators in these cases is essential for their performance valuation. The authors have first identified the dominant part of the bias of MUSIC for twin sources which are narrowly spaced. Then present a hypothetical study of a hierarchy of the presentations of this MUSIC-like estimator found on their capabilities at dropping main part of the bias and keeping the asymptotic difference of MUSIC. Result mentioned in this article is analytically studied and its performance is evaluated. A lot of earlier examinations result from mathematical working out and simulations are helpful for mounting new MUSIC-like algorithms with a decrease resolution threshold over present MUSIC [26].

B) LIMITATIONS AND CAPABILITIES OF DIRECTIONS-OF-ARRIVAL ESTIMATION TECHNIQUES

DOA Estimation Methods: A variety of DOA estimation techniques are re-evaluate in this section

• Spectral Estimation Methods

This method determines the spatial spectrum maxima using DOA and then computing estimate. Most of the roots in time series analysis used these techniques. Bartlett method is a first method of spectral analysis. This method finds directions by the arrival of a small power steering array channel.

Mechanically, steering power output of the array measures the direction using the same method. Side lobes of the implication that have contributed to the point where the power output of the array with the side lobes are considered.

• Linear Prediction Method

Linear combination of the sensor output is calculating the least amount square error. Subject to the union of the sensor array obtained the weight by small power output of the array. This
The parameter is the appropriate criteria for the selection of the elements, the effects of SNR, resolution capacity and is depending on whether the source is in the past direction.

- **Eigenstructure methods**

These methods may have two subspaces, noise subspace and signal subspace spanned by the eigenvectors. The routing vectors related to the bearing source and the noise subspace is orthogonal to each other. This method depends on array correlation matrix has differentiate into two subspaces. Principally, eigenstructure based method look for element directions include steering vectors that are orthogonal to the noise subspace and signal subspace.

Pisarenko method based eigenstructure, minimum variance and linear prediction methods have difference between them, it gives the better resolution in first DOA Estimation. This method is suitable for the execution of the system off-line. SI uses a real time simple implementation. Vector array gradient algorithm is utilized to differentiate the signal as of the noise subspace.

- **MUltiple Signal Classification (MUSIC)**

MUltiple Signal Classification (MUSIC) method is comparatively easy and competent eigenstructure DOA estimation method. This method is very popular because of many variations are used in it.

- **ROOT – MUSIC**

It requires to find a polynomial for the DOA uniformly spaced linear array (ULA). This is known as ROOT-MUSIC method. It is used to identify a ULA spectral intensity and spectral peaks MUSIC localization using a polynomial rooting problem. ROOT-MUSIC gives improved presentation than the spectral music.

- **ESPRIT METHOD**

This is a working out well-organized and vigorous method for DOA estimation. Two array elements have the difference between the first and the second part to form a displacement vector.
direction. This vector will move in relation to the sense of matched pairs with the two same
arrays and does not mean that these are two different arrays [27].

C) BEAMSPACE SELF-INITIATING MUSIC FOR ELEVATION ANGLE ESTIMATION

MUSIC is an extremely accepted eigenstructure (subspace) direction finding (DF) method
pertinent to arrays of unequally spaced sensors. Eigenstructure (subspace) direction finding
methods, unlike the computationally more intensive maximum-likelihood (ML) method, this is
needed a present knowledge of the joint probability density describing all sources and noises, but
only the noise’s second-order statistics. Moreover, eigenstructure methods such as MUSIC give
way asymptotically impartial and competent estimates of the directions-of-arrival (DOA).

Unevenly arranged selection are extensively used, for instance, to scramble antennas on
the corpse of an airplane or to lengthen array aperture by spacing array elements over the
maximum Nyquist half wavelength. For such irregularly spaced arrays, ESPRIT the other
popular eigenstructure method would be inapplicable since ESPRIT needs the array to consist of
twin matching but translated subarrays. Thus, MUSIC represents an appropriate choice of
direction finding algorithm for irregularly spaced arrays.

A vector antenna contains the six spatially co-located non-identical non-isotropic sensors
independently calculating the incident wave field’s three electric field components and three
magnetic-field components. Vector antenna can make use of any polarization diversity between
the imposed sources. That is, multiple resources incident on an array of vector-sensors from the
similar arrival angles can be determined on description of their separate polarization states.
Polarization, along with an incident source’s direction-of-arrival, frequency, phase, amplitude
and time-lag, completes the total target information obtainable from radar returns. The vector-
sensor would fail to resolve these sources only if their arrival angles and their polarization states
are all near-identical.

Considering each vector antennas six component sensors as a sub array unit, identical
polarized rays in two (angular) dimensional spaces may be formed at each individual vector-
sensor. In dimensional space vector-sensor six antenna elements, each individual vector -sensor
has two polarized beams in the same sub-array unit. The vector-sensor based sensor azimuth beams decouple the problem of DOA estimation from the polarization components reducing iterative search from 4 dimensions to 2 dimensions over elevation. MUSIC repeated the search feature for more rapid convergence of several global optima [28].

D) THE BEAM PATTERN OF ANTENNA ARRAY AFFECTING THE DOA ESTIMATING ERRORS

The author has discussed the operation of the MUSIC algorithm, they summarised that combined asymptotically Gaussian distributed with zero value.

- DOA distribution pattern

In this they simulate the system with single incident signal and low SNR using computer. It finds that the errors are not asymptotically jointly Gaussian distributed. The probability, that the DOA estimation is very small near 76° or 104° and high near 68° or 112° respectively. This causes that the probability of the DOA estimation is very large near angle. It is much larger than other directions even if the SNR is very low. These show that the distribution of DOA estimation and the antenna pattern are relational when the SNR is low.

- SNR threshold

SNR threshold should be different for different directions of arrival, at the condition of confidence interval of ± 2 SNR and the situation is under 95%. It represents the beginning of a SNR. DOA Estimation algorithm use for this is MUSIC, and the MUSIC gets different performance in different arrived direction. It is because of the different direction of the antenna patterns are different [29].

E) ITERATIVE AOA ESTIMATION OF COHERENT SIGNALS

The angles-of-arrival (AOA) estimation and beam forming by an array antenna participates significant function in MIMO communication systems. In multipath environment,
more or less conservative subspace advances by means of or exclusive of the eigen decomposition accepts the spatial smoothing (SS) using multiple subarrays.

For multipath environment, eigen decomposition or spatial smoothing multiple is applying to the traditional subspace method. AOA of partially or fully coherent signal sub arrays adopting the spatial smoothing. The covariance matrix of the reconstructed signal is eliminated by coherent component using algorithm.

A significant advantage of the present method is generally to use small size of the sub arrays to improve angle resolution compared to SS based method. The algorithm is used in non-uniformly spaced linear array and circular array without use of array transformation [30].

F) MUSIC ALGORITHM IN SMART ANTENNA

The author describes adaptive beam forming and the direction of arrival in smart antenna systems. Adaptive antenna can eliminate multi-path effects and interferences with guiding the beams in a route of nulls which allows the good quality of signal transmission. This good quality communication is achieved with the help of required signal path towards user and unwanted in the path of the incursion.

MUSIC is a subspace-based method depends on the covariance of the EVD (or correlation) matrix and the It is extremely complex to procedure in real-time for the reason of its weighty calculation difficulty and load. MUSIC has covariance (or correlation) matrix subspace-based method to process real-time calculation of the weights and this EVD method is complex. Smart antenna system evaluated by means of MUSIC DOA estimation algorithm in a radio an echoic cavity. In general DOA algorithm gives excellent resolution and evaluates the recipient signal. In the resolution method, in addition, the vector direction is necessary to compute musical spectrum [31].
G) DOA ESTIMATION USING MUSIC AND ESPRIT ALGORITHMS

Rapid growth demand of mobile communication service needs improved spectrum efficiency for wireless link design. A more potential approach to achieve this goal is the base station and mobile station uses a smart antenna. To obtain complete benefit of this system sophisticated space time signal processing must be constructed. The RF signal is the key aspects of the DOA estimates. The development process is used to improve the operation of the channel. In fact it drives emitting beams to the recipients and interference is rejected.

The most recently published papers describe the operation of the system with three signals. Smart antenna system, in this paper used one of the primary goals of the MUSIC algorithm that is step by step process. Additional objective is to find a detected signal quality in stipulations of accuracy when RF incoming signal increased to five.

Smart antenna system is easily been understood. AOA system is designed to detect a signal at the same time submit in five numbers. Use of MUSIC and ESPRIT DOA algorithm provides step by step simulation in a noiseless environment. In this system the multipath problem is ignored. Once these algorithms are used in a practical environment, they need spatial smoothing algorithm for pre-processing.

In this paper, all authors Atman, Saubhi, Rammal Neveux, Vaudon, and Michel proposed six port reflectometers used antenna system in which five incoming RF signal direction of arrival angels are detected by MUSIC and ESPRIT algorithm. DOA estimation is used to enhance the response of the channel. In which the desired beam of emission was directed to the receiver and introduce null towards interference signals.

Eigen structure efficient and simple MUSIC method uses subspace decomposition technique. This technique estimates complex frequency sinusoids. Power of the sinusoids power sinusoids is found from diagonal matrix. The largest value of eigen in a set of eigen vectors. Span substance signal and referred as principal eigen vectors. The subset of eigen vectors spans noise subspace. Signal and noise subspace are orthogonal. So that sinusoidal vectors of a signal in the signal space are orthogonal to the subspace of noise. Big the MUSIC algorithm signals in
the incoming sides are separate from the noise and needs accurate detection of arrival angles [32].

2.6 DIFFERENT DOA TECHNIQUES

A) IMPROVING THE RESOLUTION BY EIGENVALUE ANALYSIS

The following sequences of computations constitute the eigenvector method.

- Relational matrix is derived
- Its eigen values and eigenvectors decomposed
- Finding independent signals
- Beam energy linked
- Main peaks in the spectrum give number of source.

Don H. Johnson in his article gives information about motion adaptive beam forming method. The mechanism causing the energy vector in the correlation matrix are evaluated by the weighted sum of eigenvector or correlation matrix eigenvalue eigenvector. The sum of the weighted eigenvector of the acoustic field with the MUSIC and eigenvector technique to distinguish the two steps is a result of the eigenvalues of the correlation matrix found by referring to the change. The two differences are spurious peaks and the sound spectrum [33].

B) IMPROVING DOA RESOLUTION

Eigen structure sensors covariance matrix based spectrum algorithm determines the direction. The algorithm in different noise spectrums is good for its capacity to complete by Cramer Rao. DF accurateness limits for the narrowly spaced emitters to provide SNR is sufficient to determine sharp tips in the estimates. The method mentioned in this article is polynomial rooting and pole zero for improvement in the resolution. The former method is due to the spectrum of the polynomial. This method is used in a similar distance spaced sensor array.
Later method of resolution has the ability to modify the reasonable signal space eigenvectors spectrum function with capability to improve resolution.

In this article in order to achieve the desired resolution, with respect to reduce the signal to noise ratio of the two methods is mentioned. In the first method, the spectrum is polynomial in the original investigation. The method used the same distance between the antenna array elements is used. The second method is used for signal subspace eigenvector properties in which the resolution increases. This property defines the pole zero or reasonably spectrum function. In low signal to noise ratio at the top of the MUSIC spectrum, but at least the heights of the peaks of the original root method using more than one can find the original signal source locations.

The root of the conventional spectral method has resolution that is better than indicated by the simulation of Monte Larlo with a limit of spectral method. This limitation is related to the antenna array geometry. Uniform linear array is limited. The usual array of techniques improve the resolution by the pole-zero. The pole-zero method results suggest that improved spectrum is achieved by using this method [34].

C) MUSIC EMPLOYING CONJUGATE SYMMETRIC BEAM FORMERS

Eigenstructure techniques such as MUSIC and others have establish common utilisation in giving more resolution estimates of the arrival angles of narrowband wave fronts to impose in the lead sensors of an array. As the computational burden of the eigenanalysis of the sensor covariance matrix increases dramatically with the quantity of sensors, there has been significant attention in the utilisation of a beam forming pre-processor to diminish the dimensionality of the data snapshot vector whereas, at the same time retaining the degree of resolution connected among element space operation.

As MUSIC and other algorithms provide the extensive use of high-resolution estimates of the arrival angles of a narrowband wave front impinge on sensor in an array using eigen structure technology. The computation of the matrix uses eigen analysis with the performance of the processor is involved in resolution beam forming to trim down the aspect of the vector data snapshot and maintain the number of sensors at the same time. A properly designed pre-
processor, a sensor beam space barriers with element space gives the ability to solve a robust estimation in addition to the less calculation.

Beam formers are the conjugate symmetric to compute nose eigenvectors of the sample covariance matrix of beam space in small eigenvector of the actual part with a uniformly spaced linear array. Prior to the change in real beam space covariance is equivalent to obtained by forward-backward average to beamspace transformation. Thus the signal decorrelation is applied in the direct eigenanalysis of beam space with minimum computation.

Analysis is extended to provide bias and variance for several DF and MUSIC algorithm. The sample covariance matrix beam space real part is not Wishart distribution, the previous part makes it possible to select results. Nevertheless, the approach adopted in the sample covariance matrix of spatially smoothed asymptotic distribution eigenvectors determine bias derives from the MUSIC spectrum.

Music eigenstructure technique using an antenna array on the sensor is a narrow band signal arrival at an angle has wide application in high-resolution. There is more emphasis on the implementation of the eigenstructure technique with further calculations. Two signals space closely will be resolved with the help of the processor.

Beamformers conjugate symmetry covariance matrix with five uniformly spaced linear arrays can be calculating the real part of the noise eigenvectors. Five of the real part of the calculation of covariance using the application for a change feed forward / backward is the same as that of the average beamspace transform. Thus preserving the real eigen analysis indicated that the calculations can be obtained by decorrelation.

Theoretical analysis of the MUSIC algorithm using the pole-beam is mentioned in this paper. It is an alternative to time-consuming calculations, so the concept was popular. There is used to find bias and variance of the MUSIC spectrum. Not far from the square matrix beamforming processor change should not be applied. Eigenvector in specific cases of non-symmetry must be co-ordinated. Eigen vectors are derived by beam space covariance referring to the real parts mention in this article by author. At a beamspace vector conjugate symmetry only
the real part is processing. Beamspace MUSIC theoretical discussion or study is explained by its performance [35].

2.7 CHARACTERISTICS OF MUSIC

A) A SENSITIVITY ANALYSIS OF THE MUSIC ALGORITHM

Eigen-decomposition based covariance matrix processing of the received signal is widely used in an advanced array system has been discussed in this article. Computer simulations and experimental techniques for the system in a limited number shows advanced concert evaluated to the formal process. In spitefulness the latent benefits of the high-resolution technique, it has limited application in real system. One of the major factors for this method is a comparatively high sensitivity cause error. Elements of array and the corresponding phase and gain characteristics of the recipient with the element locations by imprecise information seriously degrade system performance.

Careful calibration of the experimental system reduces the error. In operating system implementation of such calibration is sometimes difficult or impossible. High-resolution sensitivity of the array processing has been observed experimentally and attempts to overcome this problem.

In this article, eigenstructure-based method quantifies the sensitivity analysis by the first order of the music algorithm. Knowing covariance matrix perfectly can study the effective modelling error. In particular, two closely spaced sources and receiver array parameter affect the phase and gain, cause error in the location of the array element.

Covariance matrix of the received signal in advance to the eigen decomposition techniques are discussed by Benjamin's in this article. By computer analysis mechanisms it is proved that bi covariance matrix gives superior performance preferable to that of two diagonal methods. But this system has a limitation. The main reasons for the high sensitivity of this method for a variety of system errors are given. Phase of the array element and inadequate knowledge of the gain of element could not give proper location and reference receiver. Small or
a practical system to carefully calibrate the system can eliminate these errors. The calibration is
difficult in a commercial system. High-resolution array processing method, a system error is
experimental sensitivity. Eigenstructure method is used to reduce the sensitivity of the self-
calibrated by a class technique is developed. Uncertain parameters are eliminated by the analysis
of unknown method.

This article contains a MUSIC sensibility using eigenstructure-based algorithm. True
array manifold and assume deviation shows an effect on the error model. And phase deviation of
array elements effect is studied by considering two sources which are closely spaced. The theory
is based on a formula derived model of errors and eigenvector-based method to solve an impact
on the accuracy of the MUSIC algorithm. Eigenstructure of the results achieved from the sources
indicated that the algorithm used in the search. Direction of arrival estimation algorithms in a
modeling error signal has multiple errors introduced. The sensitivity to errors in modelling found
the errors arrival in the direction of the arrival estimation and this is ratio of error. Sensitivity is
in reverse relative to the space calculated between the different sources.

Modeling errors increase the value of the mathematical operation that reduces in
eigenstructure based MUSIC algorithm. This error may be the last to be completely fails to
resolve the two sources. Unsuccessful to determine the two sources of error for the malfunction
threshold value of the algorithm can be referred. Square of the distance from the source is
proportional to the value of the failure threshold. Sources differentiated by a fraction of a fixed
beamwidth, the sensitivity of the array of modeling errors decreases with increasing array
aperture [36].

B) A STATISTICAL CHARACTERIZATION OF THE MUSIC

An arbitrary number of emitters on the link in this article are the usual array using
MUSIC gives sample null spectrum observed a statistical characterization. A really easy term for
spectral covariance matrix gives covariance result with mean spectral Gaussian characterisation
in the surrounding of the emitter. The sample spectrum is presented in specific direction of each
emitter.
Hary B. Lee, in his article explained in the detection finding, high-resolution is the most important technique in covariance matrix eigenstructure MUSIC with a high-resolution performance. The ratio of signal to noise threshold derived expression of MUSIC in the similar way as that of other. Deviation from the mean value of the signal spectrum will be derived from the respective small value based on the average value of the signal spectrum. This Mean value is the sample of spectra. Geometrical depiction of the null spectrum is the main result of this paper.

- Wishart distributed characterisation value of spectra,
- Stranded deviation is less than spectra means and
- Resolution of probability compare to the SNR.

In this paper it is clearly shown that mean spectral analysis gives MUSIC null spectrum compete characterization in the locality of emitters. At the asymptotic condition and in the exit emitter direction, total characterization is completed. Wishart distributed null spectrum samples and covariance matrix used for the distribution \([37]\).

C) EFFECTS OF MODEL ERRORS ON WAVEFORM ESTIMATION

In their study, the authors investigate the problem of estimating the effect of the error signal model. Two-step algorithm uses the estimated direction of arrival using the MUSIC algorithm and signal combiner that attempts to cancel interference signal. Accuracy is specified by the formulas with this antenna array and it is related hardware is calibrated to achieve the required performance level.

Particularly significant impact on the quality of the signal reconstructed for enough small aperture and closely spaced array analysis shows modelling error. Nonetheless, this model error is not currently accessible in a comparative study of the sensitivity of the different techniques.

Benjamin in his article mention that desired signal along with noise and interference signal are used in important application of sensor arras. In his paper explain open loop and closed loop adaptive methods. In closed loop system output signal of linear combiner is changing
the weights of the same combiner which feeds the output to adjust weight. While in open loop system the weights are changes directly from the input array at which collected data is present.

In this article, there are two stages of MUSIC algorithm, in first stage direction of arrival signals is estimated. While in the second stage array output gives estimated signal from its linear combiner was designed in such that is give the preferred signal by suppressing the intrusion signal and considered only measured noise. Even through the DOA estimated signal will be distorted by interfering signal. So that eminence of the signal is expressed in terminology signal to noise ratio (S/N) and signal to interference ratio (S/IR).

In this article model error effect on the signal determination is given two ways that is DOA estimation and signal estimation from linear combination of array. The weights are calculated in the linear combiner who has array response information and direction of signals. The difference between assume and antenna response is known as model errors. In the long observation time and related to performance of array, model error was a limiting factor. Direction of arrival accuracy was decreases and the performance was poor because of uncertainty added into the reaction of the array. Even through the path of arrival is perfect and the interference signal would not totally diminish. The null of the array was disturbed because of the model error.

This article explains error components model errors are assumed as random with statistical properties from this Benjamin derived the formulas for signal to noise and signal to interference ratio. There proportions are the purpose of model error in statistics. Sensitivity of the estimated signal was gain by evaluating formulae. Sensitivity of the estimated signal was gain by evaluating these formulas. The superiority of the desired signal and presentation of the array have significant impact of a modelling error. In the application of small aperture array and closely space signal, the model error has a significant effect [38].

D) COMPARISON OF ADAPTIVE SUPERRESOLUTION WITH MUSIC ALGORITHM

Non-stationary ability suitable in environment is given by adaptive super-resolution algorithm. Output array and the average signal to noise ratio relative to the array is low and
variation in power recursive suppression algorithm gives better resolution compared to MUSIC. The recursive algorithm is one of the simple adaptive super-resolution algorithm which gives better performance compare to MUSIC in presence of array rotation with power variation.

A simple adaptive super-resolution system as illustrated in Figure 2.11 can be represented into two sections. Antenna array elements output is given to adaptive filter communicated to the adaptive algorithm adjusting the weight gives pattern and it is corresponding to small direction. Weights are applied to array processor which calculates the value of the weights gives an array pattern. This array pattern gives local minima at specific angle and falls below the threshold. A specific angle provides estimate bearing to the signal.

![Diagram of adaptive super-resolution system]

Figure: 2.11 Adaptive super resolution systems [39]

Music algorithm system is illustrated in Figure 2.12. The correlation matrix estimates is produce by combined outputs of array. Analysis of the correlation matrix calculated associated eigenvectors. The processor processes the eigen vectors gives Music DF function and generates peaks which estimates bearings of the received signal.
Several features of statistical performance and high resolution competence made the eigen structure MUSIC algorithm renown. Resolution probability is one of its importance performance measurement parameter. Zang in his article presents a thorough examination of the resolution probability of multiple signal classification algorithm.

This resolution probability was resulting on the origin of spectral magnitudes of joint distribution. He mentions a probability density function related to the quadratic form which gives resolution [39].

E) RESOLUTION OF THE MUSIC ALGORITHM

Two spatially separate array signal processing MUSIC algorithms are studied by the author. The problem is tackled within the framework of statistical decision, and previous work
specified angle of the reference signal resolution are articulated in conditions of the dissimilarity among the spectrums. The sensor data are in quadratic form of the sample covariance matrix eigenvectors of received signal. Indefiniteness, uniform and singularity are the features of the quadratic determine the probability density function. Firstly, the linear prediction method using the uniform Wiener solution removes singularity.

This is not only at specific SNR which gives the resolution capability of MUSIC algorithm but study the dynamic behaviour with changes in number of snapshots, array elements and spacing between them. Resolution probability depends on SNR, angular separation and snapshots in the signal direction have been studied in this article [40].

2.8 OTHER TOPICS RELATE TO ADAPTIVE ALGORITHM

Adaptive digital beamforming performance of broadband communication:

This paper examines the result of adaptive array bandwidth in a broadband system. Author tapped delay line with taps every element of L is followed by the 'a' with a linear array of elements is based on the similarities. The minimum distance distortionless response (MVDR) method of using a multi frequency constraints, orient and wideband interference signal at the frequency response of adaptive nulling (relative bandwidth > 20 %) indicated that they have to get on top.

Authors carry out simulations for the bandwidth control signal and the interference model to present and discuss methods for Distortionless frequencies to get a response. INR (interference to noise ratio) against the array of adaptive interference graph showing attenuation and interference rejection feature. Theoretically, they prove that the whole sequence of taps MVDR change between samples and the weight of the bandwidth is not able to improve the process. The comparison between wideband and narrowband adaptive beamforming features is related to the bandwidth.

In satellite communications, satellite communications capacity crowd of synchronous orbit slot is formed to look up. Raising the communication system capability can only be
obtained by growing the bandwidth. However, the electromagnetic spectrum unintentional and intentional interference with a spread of narrowband and broadband are becoming more and denser. Therefore, demand is steadily growing on antenna performance. In this case, the digital beam forming (DBF) is a commanding method to improve antenna performance.

From the signal and interference models, they can found transfer function instead of the array version of the carrier frequency, which depends on the relative frequency. Thus, a simulation result in common applies to a dissimilar carrier frequency. Extensive simulations are carried out and the performed results are presented.

In broadband digital beamforming, beam pattern are given; broadband and narrowband array to compare the frequency of transfer functions. Broadband interference attenuation features an array of features. The results are obvious benefits of broadband adaptive array. It is applied to the adaptive digital beamforming broadband communications system that follows from the consequence offered in this article:

- Communications system bandwidth increase,
- Adjacent to suppress interference in broadband communications systems.

Broadband communication system benefited greatly from the increased frequency reuse factor in communications system [41].

In this paper, authors have demonstrated non-orthogonal or correlation effect of codes in CDMA wireless communication system that employs an adaptive array. The study is twofold first, to explain the nature and extent of the work of degradations in cross-correlation between the system performance of the user code, and the second is different because this work explore the possibility of using the immense non-orthogonal code instead of a limited number of series that are usually employed.

The growing command of mobile wireless communications services effectively need to develop recent techniques for the use of the frequency spectrum is induced. In the wireless
communication system this can be approach using adaptive antenna at the cell site which substantial increased the capacity.

In adaptive antenna communication systems code division multiple access (CDMA) are employed, resulting in better performance that can achieve by better interference rejection capability. This is likely to increase the ability of the scheme By means of increasing numeral of users in the scheme, need a great quantity of users to assign codes. These are commonly used to limit the number of capacity range. Therefore, such sequences are limited to indirect systems generated number. Therefore, explore the possibility of employing a large number of the correlation code.

Adaptive Array:

This adaptive array antenna element of the general configuration appears in Figure 1. The received signal of each antenna, instead of the weight is multiplied with both the amplitude and phase of the received signal. These signals are then added together to produce the array output. The weight in mean square error between the array output and the mention signal is not reduced by the adaptive processor.

The reference signal, itself the array output is generated by the process. Adaptive processor used here is based on the use of Hopfield neural network. This approach is commonly used in the Least Mean Squares (LMS) algorithm is very fast compared to the rate of convergence results depends on the amount of cross-correlation between the desired and interfering code. In other words, the performance of CDMA system is very sensitive to the cross-correlation values.

In this paper, authors employ CDMA receiver in conjunction with an adaptive beamformer. The next section, they present the results of simulation for THS combined multiple performances. They found a result that respects the user's code (non-orthogonal) to handle calls related to system access.
A simulation with an eight element linear antenna array of the spacing between the elements is half wavelength. Authors embed code signals between the user and the receiver that generated the synchronization is complete. They assume that the existence of such a power control signals users are obtained with the same power.

Cross- correlation among the required user code as different as the output signal to interference ratio and an interfering user code and with input signal to interference ratio and signal to noise ratio is 0 and 20 dB respectively.

The result suggests that adaptive beamformer is at rest able to reduce the involvement of the interfering signal to the user's correlation coefficient (P) values 0.7. It is found, However, slight decline in output SIR at p= 0.45 and then an exponential decrease is observed. In fact, the code is very involved in the case the adaptive beamformer forms a ray in the route of the required and interfering users.

The correlation coefficient values 0.21, 0.45 and 0.69 respectively for a case that illustrates the behaviour of the learning curve. Interfering code with the data need to increase cross correlation between desired user, the adaptive algorithm has better convergence increases. There (P < 0.2 in) is the relationship window, however, the correlations are present in the output SIR code that employs an adaptive CDMA system performance in terms of speed and convergence that is the same as employing orthogonal codes.

Code requires the user to increase the cross- correlation with the performance of a CDMA system users can add an effect to explain. SIR is reduced by increasing the number of user input means, adding more interference in the translation. Increase the number of users and the output SIR quickly after the threshold point, the low cross- correlation coefficient value moving towards beamformer without sacrificing performance.

In this paper, we demonstrate the effects on the performance of the correlation code CDMA communication system that employs an adaptive array. This study clearly indicates the cross- correlation coefficient of the user's code is kept below acceptable limits, without sacrificing efficiency improvements because such a system can be employed in non- orthogonal
code. This is a CDMA system in the adaptive beamformer is to offer added protection against interference [42].

Based on unique spatial signatures of the users preferred time slot capacity is increased and quality improved. The paper shows improved beamforming techniques and algorithms have been improved significantly smart wireless LAN (SWL) dynamic slot represents an upgraded computer simulation. The simulation results show the advantages and disadvantages of various algorithms are presented and analyzed. This improved beamforming algorithm (MSINR) are also presented and evaluated.

The development of computer networking and wireless communication systems has produced an increasing requirement for services of wireless data. Unfortunately, the rapid growth in demand comes close to matching the increase in available bandwidth. As a result, a technique for increasing bandwidth in wireless systems is a significant. Smart antenna systems have demonstrated significant promise to overcome this problem. It also expands the range of the base station to the handset's battery life increase and smart antenna systems, while improving system reliability and capacity of the system can increase the flow has been shown.

Smart antenna concept has been widely studied but most of the research activities, cellular (CDMA and GSM), wireless LAN or satellite system and the specific requirements of the system, such programs have been devoted to the neglect. The SWL, a worldwide standard IEEE 802.11 is wireless standard to solve many of the limitations of the smart antenna. SWL gives rich spatial diversity by exploiting existing space between different terminals on the 802.11 protocol to achieve throughput multiplication. A spatial variation in amplitude and phase vectors of the data gathered by the antenna array pattern is displayed. Each transmitter in the spatial signature (SS) is a unique pattern. SS has acquired, through a variety of co-channel signals, beamforming can be distinguished based on their unique SS.
As shown in Figure 2.13, we significantly without interfering with each other in the same time slot to transmit multiple terminals, enabling a "VI" can increase the number of time slots. In addition to increased throughput, and easy implementation of the new protocol, different bandwidth applications, enhanced network security, bandwidth distribution to ensure fairness, and with the ease of adaptability for multimedia traffic as additional features adaptation for 802.11 wireless standards. Also the protocol for multimedia applications such as voice or video links to allow for delay sensitive packets priority level designations adds.

Smart antenna systems in WLANs can be fully before many of the key issues that must be studied. Such a point is added to the interference from other users with the ability to network with and influence each user must be studied to optimize the dynamic allocation of slots. It is the neglect of traditional wireless research (802.11 standards) in their work eliminating the need for a user dynamic slot allocation in one band at a time allows you to carry the issue.

Figure 2.13: Frame of SWL [43]

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Figure 2.14: Uniform Linear array [43]
One element (\(M = 6\) here) with two impinging wave fronts in a linear antenna array is shown in Figure 2.14. The array elements are separated by a distance equal to one, usually half of the wavelength of the transmission. Figure 2.14 and the subsequent argument of (D) correspond to the base station in the uplink transmit to the multiple wireless terminal.

Significant multipath signals less than a chip delay let's assume that in the interval. Therefore, model of narrow band signal is applies here, and this is an event with multiple sources of signal received. The SWL dynamic slot allocation algorithms assess in terms of worst case SINR performance and capacity. SINR for the worst case, their influence began to gather SNR was high enough, the SFT algorithm, the FCFS technique has outperformed. Sorted in ascending order of power users SNR was high when conditions were bad and the minimum benefit was found to be important for the system performance. The system's ability to sort out the minimum benefit was seen and the capacity of the system when conditions were bad effect SNR also saw a small increase.

The SFT regular increase in computational complexity with the balance regularly performed better than FCFS. It is less than the number of users in a frame and SNR high performance level of the FCFS algorithm reaches the SFF is important to note. Also sort of regular high SNR values seem to offer limited benefit. Therefore, FCFS algorithm can be used in the system to reduce the computation [43].

Adaptive antenna array system consisting of processor can perform filtering interfere with the direction of the signal to reduce the sensitivity of the receiving system, both in space and frequency domains. Signal processor automatically lower average adjusting by least mean square (LMS) algorithm based on a simple adaptive technique.

During adaptation injected the pilot signal of the desired from the look direction. This is one of the main lobes of the directivity pattern of the array so that a clear view of the direction of the "training" allows. At the same time, array processing system antenna directs null in the direction of unwanted or rejected signal and the direction of propagation of signal in the desired or wanted user. The array is determined by the pilot signal and the bandwidth with its direction.
to form one of the main lobe and signs or mean square error as well as the minimum occurring outside the main lobe adapts itself to reject the noise or unwanted signal.

Some examples illustrate the convergence of the corresponding Wiener optimum solution is to adapt to the LMS. Adaptation, the theoretical prediction and experimental verification of solutions is observed. Good significant noise reductions techniques are described and applied in computer-simulated experiments have demonstrated the signal to get the array for use on a wide range of frequencies.

Interference with the signal to noise sources and the sensitivity of the array to receive the output of the individual array elements can be reduced by proper process. The combination of space and frequency of the array acts as a filter. The paper media with minimal distortion of the sound signals to the extract obtained from the direction of the antenna system for the design of adaptive beamforming techniques express a scheme that is applied. The system called adaptive array. The adaptation process is based on the LMS algorithm, minimizing the mean square error.

The expression adaptive antenna earlier done by Van Atta and others in the direction from which it receives a signal from an antenna system reradiates describes aspects of the self. To carry it with - out all previous information of the path so such kind of method is termed as adaptive. This paper described a system called adaptive receiving array and the clarity of such a system called adaptive array which can be used in broadcast system.

The term in the adaptive filter of the signal waveform at random intervals are frequently occurs, the noise of an unknown signal extraction system that describes by Jakowatz and Shuey. Unidentified signal waveform in the existence of white noise variance is describing a method for estimating. Glaser suggested unknown waveform in a pulse signal suitable for detection of the adaptive system is described. Signal processing of the array is directly related to the article with the previous work was designed by Bryn, Mermoz and Shore.

Additive Gaussian noise signals of the array reporting the problem assuming that the antenna elements, the Bayes maximum detector traditional K2, followed by a linear filter can be implemented. By either showing that Bryn was studied the beamforming in each possible signal
for the direction or in every possible direction indicated by the linear filter. In either case, correlation by matrix inversion of size \(2K \times 2K\) on a huge numeral of signal frequencies of the band was required.

Mermoz projected signal-to-noise ratio as a result measure by using the scheme for known narrowband signals. Shore proposed narrowband pulse signals and a signal-to-noise ratio to detect the criteria used. The need for a specific matrix inversion was circumvented by noise free pilot signal and the output power ratio between the output power of the slope calculation and using a descent method. At the similar period, the numeral of dimensions necessitated in relation to every action in the alteration of the processor for 4K, by using Shore's operations. Mermoz and Shore suggests the possibility of direct adaptation.

In this paper, the actual time required to update the array represents a potential simple plan. The minimum mean square error is used to determine operational result. Statistics of the signal is assumed to be identified except no previous awareness or through measurement of the noise field is necessitated for this work. Considered in the study of adaptive array processor automatically according to simple iterative algorithm (adapted) can be adjusted and the direct correlation coefficients calculated or not the inversion of matrices. Input signals as those take place in the adjustment procedure are used only once. There is no requirement to accumulate the enter data, the processor needs to accumulate the modified values, that is, the processor weight coefficients (weight).

Spatial and Directional filtering:

A receiving antenna with linear array example is made known in Fig. 2.15 (a) and (b). Figure of the antenna 2.15 (a) has the wavelength \(\lambda\) of the centre frequency \(f_0\) and array placed in a straight line with the \(\lambda / 2\) spacing distance among each seven isotropic elements. The output signal is produce by an array of received signals. The directivity model i.e., the comparative compassion in reaction to signals from different instructions in a plane at an angular range \(-n/2 < 8 < 42\) for centre frequency are plotted in this figure. The sample is symmetric about the vertical line \(\theta = 0\). \(\theta = 0\) is resolute in the most important lobe. The largest - side lobe
amplitude, $\theta = 24$, has the sensitivity of 12.5 dB below as that of the main lobe maximum sensitivity. Other than center frequency plot at various frequencies has a pattern that will be different.

The array construction is shown in Figure 2.15(b). However, in this matter, each element of the output has introduced delay time before it happens. The resulting directivity pattern of the theta angle in radians has the main lobe, where $1/(4f_0)$ proposed (i.e. 90 phase shift) cycle of the frequency $f_0$. Summation of the weighted signal gives the output signal, and the weight of the unit values is set because the directivity pattern at frequency $f_0$ is the symmetry as made known in the Figure 2.15 (a).

In support of point with design, an obstruct right way sinusoidal noise of frequency $f_0$ occurrence on the array is shown in 2.15 (a), publicized through the dashed arrow. The angle of noise incidence (45.5) at theta less than the main lobe of the directivity pattern with a sensitivity of only 17 dB is to be found on the side of one of the lobes.

If in Figure 2.15(b) a weights are place that point outs the directivity pattern at frequency $f_0$. At this situation, almost unchanged in the main lobe is seen into the Figure 2.15 (a) and (b) as indicated, even as the exacting side lobe that formerly interrupted the sinusoidal noise in Figure 2.15(a) has been changed, now there for a null is positioned towards the direction of noise. 77dB sensitivity is present in the direction of noise under the major lobe compassion, enhancing the noise elimination by 60 dB.
Adaptive Signal Processors:

For example as shown in Figure 2.16 from each aerial element associated to the network has been chosen. The next step is to achieve the necessary spatial and frequency filtering can be used to automatically adjust the weight of the product development process is an adaptation. Nulling out interfering noise sources with a clear view of the process in the direction of the array should produce array gain.

This component was joined through a quantizer produced signal then an adaptive threshold logic unit is included. One element of such an "Adaline" or threshold logic unit (TLU) is Adaptive threshold element and practical applications of pattern recognition systems, adaptive control systems have been made.
Adaptive spatial filtering:

Adaptive antenna array elements radiated signals received by the signal components plus the unexpected noise, the signal will again generate (and away from the noise) as the best at least mean squares so that the required resultant of the adaptive signal processor itself a signal. The signal however is generally not available for adaptation purposes. It was available, no require for a recipient and a receipt array.

Here a description of the adaptive antenna system gives the desired response signal indicating an artificially injected signal and usually this is perfectly known at the receiver will produce a "pilot signal". The pilot signal from the signal of interest is the same as the spectral and directional characteristics. These features in some cases are commonly characterized in approximate constraints of the interested signal, known as a priori.

Adapted signal in a bearing of the pilot signal and the pilot signal fundamentally has smooth spectral response of a linear phase shift inside the pass band causes an array to form beam. In addition, impinging on the antenna array is an array of directional noise reduction
respond (nulling) to their direction with their pass bands. This is verified by try-out which will be expressed below.

Pilot injection signal receiver block and its output can be rendered useless off the signal. To overcome from this difficulty, there are two adaption algorithm suggested. These are “Mode One” and “Mode Two” algorithms. “Mode Two” has an alternate process on pilot signal that can appearance the beam and adapts on inputs with off the pilot signal to remove the noise. Pilot signal is turned off, while the second mode is useful outputs. “Mode One” allows the algorithm to listening all the time but more resources are needed for its implementation.

The Figure 2.17 shows the adaption algorithm really need to look in the direction of the array antenna located some distance from the signal transmitted by the pilot to provide a mechanism to explain adaptation.

![Mode One and Mode Two adaptation](image)

Figure 2.17: Mode One and Mode Two adaptation [44]

Figure 2.17 provide pilot signal with a more practical method. Processor inputs ("the One" during) the actual antenna element is connected to the output or ("the Two" during) delay signals derived from the pilot signal generator. Array received pilot signal as of required appear path, the antenna directivity pattern for the intended direction of the main lobe.

Through out the adaptation of the adaptive signal processor input signals taken from the pilot signal as well as the preferred result of the adaptive processor itself. Pilot sinusoidal signal
at frequency $F$ is used for instance, a mean square error of the particular amplitude and frequency and the appearance of a certain phase shift in the direction of the antenna array will reduce pressure to accept the weight.

Mode-Two in the course of adaptation, all signals are received by the actual noise field of the antenna elements are applied to the adaptive processor. In this case the necessary response to the adaptation process is set to zero because all the received signals further away. In the continuous operation mode-Two because of all the weight values are zero and the system is closed. However, Mode-One often alternate between the state and condition of each mode and the adaptation of the weight vector. Since only minor changes, it is necessary to maintain the appearance of the direction of the beam possible to diminish the noise of the event power.

The pilot signal as the sum of sinusoids of different frequencies can be selected. Mode-One then edited the pilot signal frequency and phase of each antenna in the direction of the view that certain values will constrain. Numerous experimental directions of spurious signals are added together, the addition is convenient in the array with a different version. Using this, it will be possible to constrain the values with respect to bandwidth and beamwidth provides some control. The Mode-Two adaptive processes is essentially uncorrelated with obstruction of pilot signals received by the antenna elements, the signals are mean square value (the product) or a beam of less gain in the predetermined values of phase frequencies by the pilot signal components angles.

Adaptation Algorithm:

In the mode Two adaptation algorithm, the beam is formed during mode I, and the noises are eliminated in the least-squares sense (subject to the pilot-signal constraints). Signal reception during mode one is not possible since the processor is associated to the pilot-signal generator. Response can therefore transmitted or take place only during mode two. This complexity is get rid of by the performance of both mode one and mode two can be proficient at the same time. The pilot and the received signals go into an supplementary, adaptive processor, now as described previously. For this processor, the needed reaction is the pilot signal $P(t)$. A second
weighted processor (linear element) produces the actual array output signal, but it carry out no adaptation. Its input signals do not hold the pilot signal. It is slaved to the adaptive processor in such a way that its weights track the equivalent weights of the adapting scheme, so that it certainly not needed to receive the pilot signal.

In mode One, the pilot signal is incessant. Adaptation to reduce mean-square error will strength the adaptive processor to replicate the pilot signal as closely as probable and at the similar occasion to refuse as well as likely (in the mean-square sense) all signals inward by the antenna elements which are uncorrelated with the pilot signal. Thus the adaptive process forces a directivity pattern having the correct main lobe in the look direction in the pass band of the pilot signal (satisfying the pilot signal constraints), and it forces nulls in the route of the noise and in their frequency bands. Typically, the stronger the noise, the deeper are the corresponding null.

The adaptive filtering process method can be functional to one of the individual components output of the receiving antenna array. Processing is product in condensed sensitivity of the array to interfering noise sources whose characteristics may be unknown a priori. Arrays and processor combination has been shown to act as the automatic tuned filter in space and frequency [44].

The process for adaptively optimizing the signal-to-noise ratio of an array antenna is accessible. Optimum constituent weights are imitative for a arranged surroundings and a given signal direction. The beginning is extensive to the optimization of a widespread signal-to-noise ratio which permits requirement of favourite weights for the usual quiet situation. The relation of the adaptive array to sidelobe cancellation is shown, and a real-time adaptive performance is discussed. For example, adaptive linear array presentation is presented for a variety configuration of jammer.

Array antennas consisting of a lot of convenient radiating elements are very versatile sensors. The pattern of the array can be steered by applying linear phase weighting across the array and can be shaped by amplitude and phase weighting the outputs of the array elements. The array resolution compromise between gain and lower side lobes are designed to produce the
patterns which are constructed with a fixed weight. Adaptability of the antenna array however, even the more complicated techniques used for weight. Particularly, it can respond to a changing environment that is known as adaptive schemes. In this article, jamming or interference susceptibility is reduced by applying the adaptive antenna array. The noise sources in the occurrence of any spatial arrangement of the array output signal to noise ratio would enhance the weight of the array by the control law.

Signal to Noise Optimization:

It is fine recognized so as to a equally weighted array gives the utmost SNR when the noise contributions from the element channels have equal power and are uncorrelated. These conditions are approximately valid when receiver noise and uniformly distributed sky noise are the predominant noise contributions (They pertain exactly in linear half wave space array antennas). However, when there is directional interference from other in-band transmitters, jammers, or natural phenomena, the noise out of the element channels will be correlated, and uniform weighting will not optimize the SNR.

Figure 2.18: Optimal Linear Combiner [45]
As shown in Figure 2.8, Authors assumed in the discussion, all signals has band pass frequency spectra. All signals are represented by their complex envelopes. This is clearly a reference to the common carrier is expected to increase.

Common Signal to Noise Optimization:

Weight is adaptively controlled so that it is used to designed an array, then the array designer forced to normal "quiescent" environment (no jamming) including all noise environments criteria that forced to accept a SNR. However, array designers are willing to compromise on SNR in order to obtain some control of the pattern shape, particularly sidelobe levels. For example, Dolph-Chebyshev weights can be used to obtain 30 dB sidelobes with less than 2 dB loss in SNR. Authors suggested that there is need of new criteria for the control of array weights that will give more flexibility in beam shaping.

Adaptive Linear Ray:

It explains the concept and the results of the previous section, a linear weight are according to the ideas of uniformly spaced array. In the quiescent environment element channel has the same power and noise output which are uncorrelated. The covariance matrix after quiescent environment would in the form of a diagonal matrix.

Side lobe Cancel:

The present article is a generalize concept of the coherent sidelobe cancellation technique. For example, for the sake of completeness and application concepts, side lobe cancel can be seen as a special case in adaptive array.
Figure 2.19: Side Lobe Cancelation system [45]

A side lobe cancellation system is shown in Figure 2.19. It has channel whose output is “0” and the auxiliary antenna. A major antenna gain pattern roughly average level of side lobes according to auxiliary antenna gain. Indication of the amount needed to achieve the target is negligible compared to the main channel of the target signal. Purpose of cancellation jamming signals in the side lobes of the pattern is to provide independent replicates [45].

A smart antenna for greatest improved quality, capacity and exposure of the most effective is the leading research. Different adaptive beamforming algorithm for smart antenna system in a systematic comparison of the performance has been broadly considered in this study work. Simulation results of the recursive least squares (RLS) and least mean squares (LMS) algorithms, such as requiring the user to train the rank beamforming (the main form parts) are the best, however they have restrictions towards the discard of interference.

Constant modulus algorithm (CMA) beamforming and interference rejection satisfactory answer to give good results but the bit error rate (s) CMA is greatest in the matter of a single element antenna. It would be the best option for RLS, LMS is faster than the rate of convergence that is being undertaken. LMS algorithm has been studying the effects of changing the step size.
Signals from other directions, the interest of smart antennas for mobile communication has enormous interest worldwide in recent years without the need of additional capacity enhancements signals. MIMO wireless cellular communications has experienced a decade, many practical algorithms have been suggested in up to date years. The use of the Internet, multimedia, data transfer and video conferencing interference in the direction of the antenna pattern to press their advantage to maximize the multimedia services, new techniques demand for wireless. Signal required to meet this demand and considerable attention has been given in the past to triumph over the inadequate capacity and the evolution of the traditional single input single output (SISO) is still interested in using systems such as genetic algorithms (GA).

Multiple element antennas (MEAs) under consideration for the use of smart antennas have the potential to reduce noise. Many of the input signal to noise ratio increases and the system output (MIMO) to enhance the competency greater than the capability offered. Quite a lot of approach have been studied in SISO. The multiple antennas, GSM introduced in IS-136 smart antenna technology and communication through a variety of third-generation systems can be used to increase reliability. They are believed to be mostly or spatial multiplexing or base stations are far higher data rates.

Recently, it is been a grouping of both smart antennas at the mobile station or handset to refer to a group. Also to reduce co-channel interference and reduce fading effects, 3GPP (Third Generation Partnership Project) systems, to enhance the quality of the system is the wireless personal communications of third generation of the antenna technology. Co-channel base stations to the mobile station antenna diversity is needed and optionally interference but increases the cost of fabrication systems to communicate with the limiting factor. In fact, by means of a M similar quantity of components in the selection elements. By the smart antenna array antenna simply to maximize the signal to guide the beam in one route, requiring users interest (SOI) of induced signals, including signal processing.

An author shows application of these in radar, sonar, medical imaging and communications areas. Smart antenna is a block from the other direction with the spatial filtering that is possible to achieve a energy from certain direction. The property of locating other sources
is a extremely efficient tool for become aware of radiation from the smart antenna. Switched beam smart antennas and adaptive array system is classification of smart antenna. This paper investigates the adaptive array and adaptive beamforming smart antenna model. In it used the objective is to make the right pattern, such as gain and phase of each antenna element is arranged to adapt the beam.

Response LMS, RLS and is considered to CMA. It is large arrays of antenna elements select the element and the distance increase. The most important negative aspect of this approach is the appearance of an unexpected direction of the main lobe of the replicas and the grating lobes are known. Amplitude of the beam pattern is acquired by taking the assessment obtained by 20log10. From the amplitude response of the user in the direction of maximum signal strength from the main lobe of the RLS and LMS algorithm is the best that it is too obvious. Interfer with the signals that are produced can be seen in CMA is better interference rejection. In response to the amplitude of the signal and the interference from the user is rather than by hand. The return demodulated signal was present at the bit to get the output signal (the minimum is shifting keying modulated environment) demodulating. Then the bit of the original signal has been subtracted from the values of the bits.

Return values are modules of the subtraction of BER values. CMA bits require any training and it does offer relatively low returns Blind sequences algorithm. LMS error signal by subtracting the original plot of the output signal is required to be drawn is that the training sequence algorithm. The intensity of the plot is drawn. It has been experimental that the lower the degree of error SNR. Minimum and maximum error in RLS and CMA has been noticed.

Many of the algorithms and mathematical models that are expected to perform poorly on a particular problem because the field does not stand for the actual physical science that will fail completely. Operators in real life so it is imperative to check the performance (8 to 12 in this case) by escalating the numeral of elements in the array antenna beam becomes narrower. Uses less power than a narrow beam, wide beam at the end of the operator saves power.
By comparing the amplitude responses can increase the beam size of the antenna array which is reduced as well ascertained. SNR for performance comparison is considered the worst condition. The interference signals have been reduced and the user smart antenna system performance limiting factor for the given angle is very close to each other.

Vector array is updated when it does not require to familiar with the arrival time of the incident rays. It is not necessary to sample the received signal with the clock time. RLS algorithm is designed to provide you with any change in the environment and other key parameters. The close co-channel interference that may occur in the real. As commercially problematic, it is not desirable to implement the technique. That by means of the most excellent result in all circumstances is consummate by RLS.

Comprehensive comparison between adaptive algorithms, beam pattern, the amplitude of the response and error is studied. The system also has a strong SNR environment are analyzed. CMA has a maximum error of the co-channel interference to focus on the more reliable results than the LMS and RLS. A null in the direction indicated by unwanted interference rejection capability of the thesis to the results obtained from the simulation is accomplished by a CMA. Interference and the user's expectation, close up to every previous but then had BER in CMA additional than one antenna element.

RLS algorithm, LMS algorithm is include more than the secured side of the main lobe of the co-channel interference and to provide good feedback. With the convergence of RLS is faster than the rate of MI has been disclosed. RLS algorithm so that at the base station is the most excellent algorithm for execution on a smart antenna system has been proved, the minimum return and the magnitude of the error signal is found [46].

In this paper, a beamforming algorithm for flexible adjustment of side-lobe antenna is analyzed in the adaptive beamforming arrays. In adaptive algorithms (LMS and SMI) ability to implement and provide information related to the improvement in signal strength. In this algorithm, the width of the beam pattern on the very low side-lobe level places. The convergence of the algorithm is fast and requires only two to three iterations.
LMS algorithm discussed in the previous section and the covariance matrix of continuous adaptive algorithm of eigen values presented are the slow convergence. Discontinuous transmission, a block adaptive approach gave better performance than a continuous approach.

![Diagram of SMI adaptive Network](image)

**Figure 2.20: SMI adaptive Network [47]**

Such an algorithm is shown in Figure above Sample Matrix Inversion (SMI), which provides better performance. However, the amount of interferers and their condition remains constant throughout the duration of the block editing is required.

Explicitly assigned to the least mean squares error with continue iterations and at each iteration is lower sidelobe level, which means that the array pattern synthesis process is analyzed. This algorithm also gives nulls in the direction of unwanted signal or interfere [47].

**Multihop Wireless Antennas**

Smart antennas such as the increased spectral efficiency, reduced power consumption over conventional omnidirectional antennas, interference suppression, increase communication reliability and good connectivity as well as helping to deliver significant performance benefits of modern signal processing capability. For the benefit of disclosure such as wireless networks
using smart antennas increase significantly in the past few years. The term "smart antenna ", in fact multiple element arrays (MEAs) and switched beam antennas, steered beam antennas, adaptive array antennas and multiple input - multiple output (MIMO) antennas are the broad variety of antennas.

By the technology of the various techniques smart antennas in addition exploiting the benefits in different ways to achieve different performance objectives can be operated using a variety of strategies:

- Increase the capacity of the link,
- Increase the transmission range to reduce the number of hops to flow and to enhance connectivity,
- Increase or decrease of SNR in the variance, thereby increasing the reliability of the link, and
- The power to control and reduce power consumption.

In this article a multi-hop wireless ad-hoc networks of smart antenna technology and a variety of strategies to understand the performance tradeoffs. Specifically, challenge to respond the subsequent difficulty given that the antenna technology and the strategy for setting up a temporary network is an ideal choice to get the best performance.

Some recent work in ad hoc networks with smart antennas (especially on the medium access control layer) is focused on network protocols however, considered that the direction of the antenna beam switching technology mainly simple of the MIMO with interest. At the same time, different smart antenna technology, the benefits related to temporary network design suitable for real applications, network designers are not only helping the environment but also for the researchers will develop a network protocol. Switched -beam antenna MIMO links in turn are much more sophisticated than that of the adaptive array is more advanced than antenna technologies in terms of sophistication are in conical order.

However, the motivation for this work largely depends on network conditions, until the sophistication that can be leveraged in a simple observation, and the performance itself was
evolved. For case in point beneath definite network circumstances (a relatively simple and inexpensive) to switch-beam antenna can afford superior results than MIMO links. This work contributes to the antenna elements, load conditions, network density and a scattering of other environmental characteristics determined by factors including the number of different smart antenna technology with respect to various network conditions such as the trade-offs between identity and fading. The taken as a whole objective of this task is to set up the technology trade-offs between performances, authors gives the following set and adjust by:

• They comprehensively evaluate different antenna technology respective to the various network stricture and strategies to recognize result leaning,
• They have proven to be the best strategy for a variety of settings which draw on the observations for each technology,
• They make out the technologies that brings the best result for a particular network setup and
• They also look at different methods and antenna technology related to “rank “is recognized.

Related Work:

The potential benefit of antenna technology has set the PHY layer functions have been several research. However, these benefits can be efficiently leveraged on to superior levels of the set of rules stack is premature to attempt a temporary networks. Most of the existing work in this area with the emphasis being on the switched-beam antenna, antenna technology specific to distributed MAC and routing protocols is focused mainly on developing. Switched-beam antenna throughput performance bounds for ad-hoc networks have been studied. Recently, MIMO links has been increasing interest in the design of the MAC protocol use different antenna technology for use in the middle of trying to propose an integrated framework that is the first task. However, the relative results of dissimilar schemes on different antenna technology did not consider.

PHY Layer Background:

In the subsequent segment, authors give surroundings objects on the more then one antenna technology and their schemes well thought-out in this paper.
Switched Beam Antenna:

In each of the antenna elements are sent to the magnitude and phase of the signal transmitted before being weighted. Different antenna elements are applied to the weight of the composition of a particular set of antennas (radiation) is accountable for the pattern. In the matter of switched-beam antenna locate the direction of a predetermined weight gain (GD) is known as a high-rise resulting in a certain direction to point the beam.

The transmitter and receiver both know where each other in the direction of transmission with the advantage of the GT and GR respectively, in the route of the transmitter and receiver of benefits where GT = GR = K^2. K represents the number of elements of the link. Due to the large angular spread of multi-path signals scattering (scattering angle > beam width) with the radiation pattern is improved because the signal energy loss and multipath environment leads to a degradation in performance. That is scattering the transmitter and receiver, the same α is assumed to be Gt = Gr = min (K, 360/α). This is a directional antenna spatial reuse (number of probable concurrent communication) K^2 is surrounded by a factor, resulting in a non-active beam can suppress interference.

Fully adaptive array:

The resulting interference signal to noise ratio (SINR) in order to increase the beam switching, unlike the fully adaptive array antenna can adapt their weight. The radiation pattern is adaptively changing the features of multipath scattering. In accumulation to the maximum gain for the required signal, the antenna can also adjust signal interference. The gain in the required direction signal is improved in the same time the null is produce in the direction of undesired or interference signal. As the beam switching, a strong line sight (LOS) component of the spatial reuse factor is the same.

Maximization of SINR can be surrounded by an array of Ga, which is results as Ga = K2. Adaptive array antennas at the transmitter and receiver has the benefit of the angular spread
significantly larger when the switched-beam antenna, in contrast to the enlarge in the measure of multipath scattering yet, does not degrade with the prevailing near to the ground correspondence among dissimilar signal components (asymptotically gain Bounds),

\[ Ga = (2\sqrt{k})^2 = 4k \]

MIMO links:

Link MIMO on both ends of a digital adaptive arrays (DAAs) are employed. It has two modes, namely spatial multiplexing and diversity are able to operate. Each stream is transmitted with equal power being transmitted out with a different antenna array, independent data is broadcast streams by which spatial multiplexing gain can be obtained. Due to the rich multipath of each transmitted stream is usually a different spatial signature and the differences in the streams (e.g. Blast) are exploited by different receiver signal processor. The multiplexing gain asymptotic Shannon link capacity \( C \) can increase in a linear.

Alternatively, the rich multipath transmission of data streams on the receiver can be independent and therefore all the data streams at the same time the probability of a poor channel experienced a significant increase in the reliability of communication is reduced. Contribute to the diversity advantage. In turn depends on the benefits of diversity for diversity that SNR is related to a decrease in the distance. MIMO link that provided by an antenna to transmit and receive antennas to maximize the diversity.

Strategies:

Technology in every context considers the following four strategies.

Rate

For a specified modulation system, on the return link is found by the SNR. Retains its original value in the array due to the switching beam and adaptive array and the array in the
direction of benefit SNR increase the number of bits transmitted per symbol. In MIMO links increase in the capacity is a direct result of spatial multiplexing.

Range

In the series, SNR advantage in the communication range of R is increased. Increases range of multi-hop, hop length and therefore reduce the load but at the similar instant it also reduces spatial reuse. Switched beam and adaptive array the direction / arrays are used to provide benefits RF range extension factor.

REL

In REL the switch in the route of the beam and adaptive array / array having an average increase in SNR and the benefits of diversity in MIMO with reduction in variance directly linked to increase reliability and reduce the probability of packet loss. Switched beam and adaptive array with a single variety in which the return is reduced by a factor PF.

POW:

In POW, SNR advantage in the link remains the same such as reliability, power control and link points to reduce the transmit power is absorbed. Switched beam and adaptive array, the array direction and the benefits of a factor, PTF (Power by transfer function) is used to reduce the transmit power [48].

This literature review gives the clear idea about Least Mean Square and second one Normalized Least Mean square digital beam forming algorithm. The direction of arrival algorithms such as MUltiple SIgnal Classification and ESPRIT algorithm used in an adaptive array antenna systems.

This helps to construct thesis with a concise general idea of wireless communication technology in mobile cell, the adaptive array antenna fundamentals, different digital beamforming and direction of arrival algorithms. It also gives clear thought about MUltiple
Signal Classification (MUSIC) algorithm which is the best to find the desired user direction and location.