DYNAMIC POWER ALLOCATION INMULTIPLE INPUT MULTIPLE OUTPUT – NON ORTHOGONAL MULTIPLE ACCESSWITH USER MOBILITY

A project report submitted in partial fulfillment of requirements
for the award of the degree of

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IN

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CERTIFICATE

This is to certify that the project report entitled **"DYNAMIC POWER ALLOCATION IN MULTIPLE INPUT MULTIPLE OUTPUT – NON ORTHOGONAL MULTIPLE ACCESS WITH USER MOBILITY"** submitted by S.Narendra (318126512172), M. Manasa (318126512153), S.Harinadh (318126512173), D.Deepthi (318126512L14) in partial fulfillment of the requirements for the award of the degree of **Bachelor of Technology** in **Electronics & Communication Engineering** of Andhra University, Visakhapatnam is a record of bonafide work carried out under my guidance and supervision.

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ABSTRACT

In 4G, the using of Orthogonal Multiple Access techniques (OMA) which does not fulfill the massiveincreaseinMobilenetworksandalsoIncreasingTechnologylikeIOT.Itwaslimiting the number of users that can be supported by the number of orthogonal resources available, as it was not fulfilling the exponential growth in Mobile network like low latency, massive connectivity and energy efficiency etc.

So to overcome the problems with OMA in 4G, In 5G NOMA was implemented which overcomes problems to some extent. Like it uses the same resource block. It transmit multiple users'signalsfromthetransmittertothereceiver.Byallowingmultipleuserstosharethesame resource elements, be it in the time, frequency, space, or code domain. The main advantage of NOMA is it uses power domain technique for transmission ofsignals.

The power allocation strategies for NOMA plays a crucial role to ensure different information signals to be properly received by designated users. This project one of such strategies called as Dynamic Power Allocation (DPA) has been discussed.

AsNOMAisversatiletechnique.WecancombineitwithMIMOalso using DPA toincreasethroughputaswell as to increase spatial multiplexing to increase achievable rates.

Ourmainaimofthisprojectistoshowtheoverallperformanceimprovement ofNon-Orthogonal Multiple Access when combined with MIMO (MIMO-NOMA) by allocating power using DPA technique with user mobility. The performace of NOMA when DPA is used and SPA is used are compared and also conventional NOMA is compared to the performance of MIMO-NOMA by using few parameters as average sum rates , outage probability , Successive Interference Cancellation (SIC) etc.

A system model for MIMO is assumed for the three-user scenario. A Rayleigh fading channel is assumed between the Transmitter and the receiver. By using Rayleigh fading channel coefficients, calculated the achievable rates and SNR equations for all techniques and then compared each parameter with others.

Finally, the simulation results are provided to facilitate the performance analysis of MIMO-NOMA, conventional NOMA are compared and also demonstrate the accuracy of the developed analytical results.

CONTENTS

LIST OF ABBREVATIONS:

- OMA - Orthogonal MultipleAccess
- NOMA - Non - Orthogonal MultipleAccess
- MIMO-NOMA - Multiple Input Multiple Output Non - Orthogonal MultipleAccess
- SIC - Successive InterferenceCancellation
- SNR - Signal to NoiseRatio
- BER - Bit ErrorRate
- SPA - Static PowerAllocation
- DPA - Dynamic Power Allocation
- CC - ChannelCapacity
- BS - BaseStation

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CHAPTER-1

INTRODUCTION

CHAPTER-1

INTRODUCTION

Non Orthogonal Multiple Access (NOMA) is imagined to be utilized in fifth era (5G) versatile organizations as a resultsof its predominant spectral efficiency . This Key thought of NOMA is to investigate the domain of power area , which has not been utilized for multiple access (MA) in the past ages of portable organisations. Explicitly NOMA clients in a single cell reserved by a base station (BS) in a similar time/code/recurrence channel, and their signs are multiplexed by utilizing unique portion coefficients.

The oddity of NOMA comes from the way that clientswith more unfortunate channel conditions are apportioned more transmission power . Thusly, these clients can interpret their own messages by treating the others signals as commotion, since the power level of their messages are higher.Then again, the clients with better channel conditions will utilize the successive interference cancellation(SIC) technique, i.e., they initially disentangle the messages to the clients with more unfortunate channel conditions and afterward decipher their own by eliminating the other client's signs.

MIMO is a fundamental element of future wireless communication, where a two antennas are at receive and transmit side and get radio wire plot is viewed as the gauge downlink setup .Four antennas are supported radio wires are additionally upheld. For the uplink, transmission with only one communicate receiving wire including radio wire determination is upheld . For the downlink, the standard contains both communicate variety and spatial multiplexing .

Due to the enormous number of scatters and reflections, The channels of the mobile communication is prone to multipath fades. The impacts of the multiple-path occurrence are mitigated via diversity approaches. A particular minimal signal level at the receiver end is required for a communication system to work satisfactorily. When the signal level is less than this minimum threshold, the system is in a fade. This phenomenon is more often defined as the constructive/destructive interference between signals entering at the same antenna via separate paths, producing in varying delays and phases, resulting in unpredictably high signal levels at the receiver. The diversity method, which entails equipping the receiver with a large number of copies of the same message, is commonly regarded as useful in countering channel damage caused by multipath fading.

To address these issues, DPA for NOMA with user mobility is presented in this research. . This paper's contribution can be summarised as follows:

DPA in NOMA with MIMO is described, which takes into account NOMA SIC, total transmit power and outage probability limitations. The most efficient power distribution will be found by employing these limitations. To examine the performance of both DPA and SPA, a simulation of MIMO-NOMA and mobility of user is run. Because user mobility is taken into account, each of the user is able to shift positions at a randomised speed and direction. It has been demonstrated that the DPA achieves a greater sum rate than the SPA when using this model

1.1 MOTIVATION:

Different multiple access schemes are acquired from First Generation (1G) to Fourth Generation (4G). All the proposed schemes from 1G to 4G are common in one particular subject. That is the signals that are transmitted from the transmitter to the receiver must be orthogonal to each other. OMA is one of the multiple access schemes which uses orthogonal resource allocation among individual users to avoid intra-cell interference. Using of Orthogonal Multiple Access techniques (OMA) which does not fulfill the massive increase in MobilenetworksandalsoIncreasingTechnologylikeIOT.Itwaslimitingthenumberofusers that can be supported by the number of orthogonal resourcesavailable.

As it was not fulfilling the exponential growth in Mobile network like low latency, massive connectivity and energy efficiency, NOMA technique is introduced. It uses same resource block for transmission of different users signals from transmitter to the receiver. So, it can increase the number of connections at a time and increase the speed of communication. Allocating power plays a key role in this regard. The power allocation should be done in such a way that overall power consumption of system is optimized.

InordertogetgoodachievableratesandSNRratesMIMOsystemisincorporatedwith NOMA multiple accessschemes.

Ourmainmotivationisto compare the overall performance of NOMA when different power allocation techniques are used by using some parameters like total transmit power, outage probability and SIC. By doing so, we can know how different power allocation techniques makes the performance of NOMA vary so that we can find the better power allocation technique.

1.2 PROJECTOBJECTIVE:

The main objective of this project is to observe and analyse the performance of MIMO-NOMA when Dynamic Power Allocation is employed and how it overcomes the performance of MIMO-NOMA when Static Power Allocation is employed.

These MIMO-NOMA, NOMA performance was analysed by considering the parameters like power allocation, outage probability, SIC etc.

1.3 PROJECTOUTLINE:

This document is presented over the four remaining chapters. Chapter 2 gives an overview of coding techniques of communication systems. Chapter 3 describes briefly about the system model of NOMA, used in this project. Chapter 4 describes the performance analysis of the parameters taken in the project. Chapter 5 describes the features and uses of MATLAB. Chapter 6 portrays the parameters specifications and techniques values for three different users and Chapter 7 follows with the conclusion.

CHAPTER-2

CODING TECHNIQUES

CHAPTER-2

CODING TECHNIQUES

2.1 NOMA

Non-orthogonal multiple access (NOMA) principle emerges as a solution to improve the spectral efficiency while allowing some degree of multiple access interference at receivers. In NOMA, multiple users can utilize non-orthogonal resources concurrently by yielding a high spectral efficiency while allowing some degree of multiple access interference at receivers.
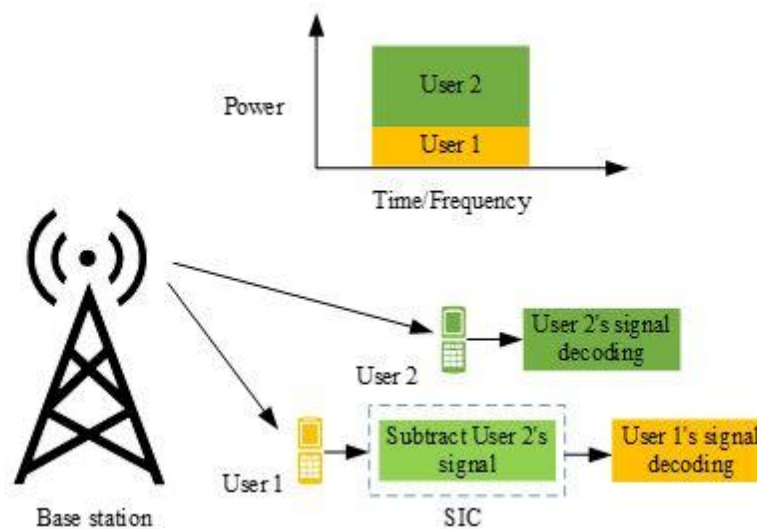
Fig.1 : NOMA system with 1 base station and 2 users

NOMA uses superposition coding at the transmitter, to combine the all user's signals into a single signal. Successive interference cancellation (SIC) receiver can separate the respective user's signal both in the uplink and in the downlink channels.

In 1G, 2G, and 3G, frequency division multiple access (FDMA), time division multiple access and code division multiple access were introduced, respectively. In Long-Term Evolution (LTE) and LTE-Advanced, orthogonal frequency division multiple access (OFDMA) and single-carrier (SC)-FDMA are adopted as an orthogonal multiple access(OMA) approach. Such an orthogonal design has the benefit that there is no mutual interference among users, and therefore good system-level performance can be achieved even with simplified receivers. However, none of these techniques can meet the high demands of future radio access systems such as 5G.

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The increasing demand of mobile Internet and the Internet of Things poses challenging requirements for 5G wireless communications, such as high spectral efficiency and massive connectivity. In this article, a promising technology, non-orthogonal multiple access (NOMA), is discussed, which can address some of these challenges for 5G.

2.2 OMA

The cellular standards use a variety of multiple access (MA) techniques to harmonize the access of multiple users, a situation that can degenerate in blocking when the number of available resources for transmission is low. These techniques include frequency division multiple access (FDMA), time division multiple access (TDMA), code division multiple access (CDMA), and orthogonal frequency division multiple access (OFDMA). All these techniques can be viewed as a form of "orthogonal" MA, where the users theoretically do not interfere with one another as they share the wireless medium. However, they are, with perhaps the exception of CDMA, limited to the number of available resources that make them orthogonal to each other. In FDMA, the spectrum is divided into frequency channels to be utilized by different users. In TDMA, time is divided into time slots to allow different users to access the wireless medium. In CDMA, the information is multiplexed using code sequences such as pseudonoise (PN) sequences and orthogonal codes, which are usually combined and transmitted over the entire frequency channel. In OFDMA, groups of subcarriers at different time slots are allocated to users. While used for the downlink in long term evolution (LTE) systems, OFDMA is used for the next-generation cellular system 5G in both the uplink and downlink, where the different numerologies, i.e. the utilization of different subcarrier spacing and time slot durations, add more flexibility and scalability to support wide-varying requirements and use cases. Some of the types of the Orthogonal Multiple Access are given below

2.2.1 FDMA

FDMA can be considered as the earliest technique for orthogonalizing the transmission of multiple users. For instance, the first generation (1G) of mobile communications implemented FDMA in order to divide the analog channel allocated, individually, to each user. Basically, FDM divides the available bandwidth into subbands providing orthogonal and independent channels. In this sense, as occurs in 1G, each channel may be allocated to a specific user. However, currently, FDMA is mostly employed for orthogonalizing groups of users that are categorized within cells, sectors, clusters, or other classification entity. From a practical perspective, it is worth remarking that FDMA is mainly
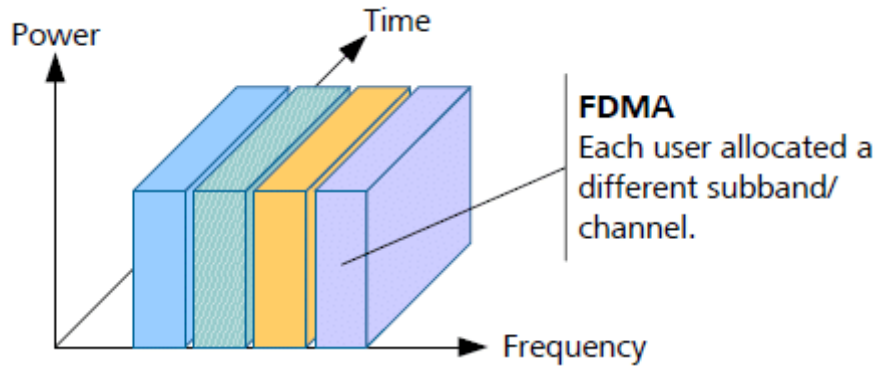
Fig.2 : FDMA diagram

based on analog signal processing, that is mainly affected by the performance of elements such as oscillators, filters, or amplifiers. This fact is especially relevant in comparison with OFDM, where signal processing is purely digital. As a consequence of these hardware impairments, it is necessary to consider frequency bands in order to mitigate adjacent channel interference. Furthermore, the division of the bandwidth into several channels leads to a very rigid resource allocation, i.e. all the users, independent of their requirements, are assigned the same amount of bandwidth. As a conclusion, FDMA may be considered as a rigid resource allocation scheme, which is more useful for associating groups of users with entities such as cells or clusters than for providing interference-free channels to users.

2.2.2 TDMA

TDMA divides the frame transmitted over a radio channel in several time slots as shown in Figure 1. In contrast to FDMA, TDMA is oriented to the transmission of digital signals. This fact is particularly relevant for the success of wireless communications since it allows the implementation of digital signal processing instead of using analog components such as filters, oscillators, or duplexers. As a consequence, the devices are smaller, cheaper, and simpler to design and manufacture.
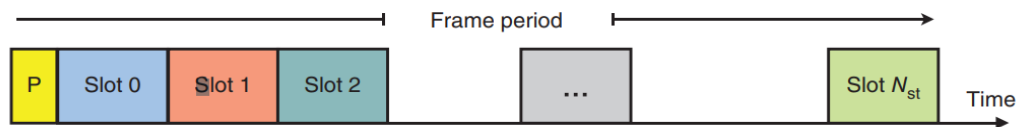

Fig.3 structure of TDMA frame

Transmission based on TDMA provides orthogonal access to multiple users within a single radio channel, that is it considers a frame structure with a specific duration divided into Nst slots (see Figure 1). Therefore, each slot would provide an orthogonal access transmission opportunity to each user. However, in practical systems, some of these slots

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must be allocated for control traffic and training data. Moreover, a frame preamble is required to ensure correct synchronization

2.2.3 CDMA

The approach based on FDMA/TDMA proposed in 2G fails as the number of users and the demand on high data rates increase. Moreover, using larger bandwidth per each radio channel leads to complexity issues due to the multipath effects and the handover among base stations. Under this paradigm, the orthogonal multiple access based on code division, referred to as CDMA, was proposed.
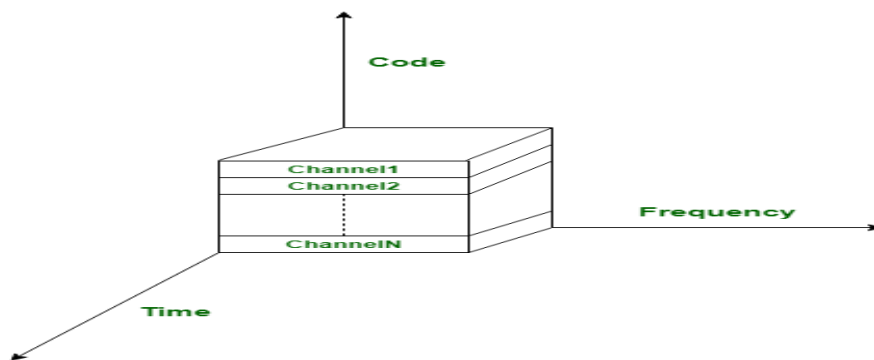

Fig.4 : CDMA diagram

For CDMA, a common signal with a wide bandwidth is transmitted to all the users. This signal can be interpreted as a clock or chip signal. Through this chip signal it is possible to assign an orthogonal code to each user so that the interference among them is avoided. At this point, the following question may be raised: How many orthogonal resources are achievable for CDMA? And the answer is that it depends on the data rate assigned to each user.

CDMA is employed in the third generation of mobile communications to provide voice service and some data services. However, it is subject to some disadvantages. First, as also occurs for FDMA and TDMA, its result is too rigid considering a heterogeneous demand on data services, for instance video, music, calls, and chat services in a multiuser environment. Moreover, the codes that avoid the interference among users may not be completely orthogonal when receiving the signal, especially for uplink transmission. As a consequence, interference appears proportional to the number of served users. The solution to these issues is typically based on an exhaustive power control that involves an increase on the control traffic.

2.2.4 OFDMA

OFDM has been successfully applied to a wide variety of communication system

applications over the past years, and 5G is not an exception.The basis of OFDM is the conversion of a wideband channel of bandwidth B into N narrowband channels of bandwidth B/N, N being a large number, and the total achieved bit rate is the sum of the individual bit rates over the N subcarriers.
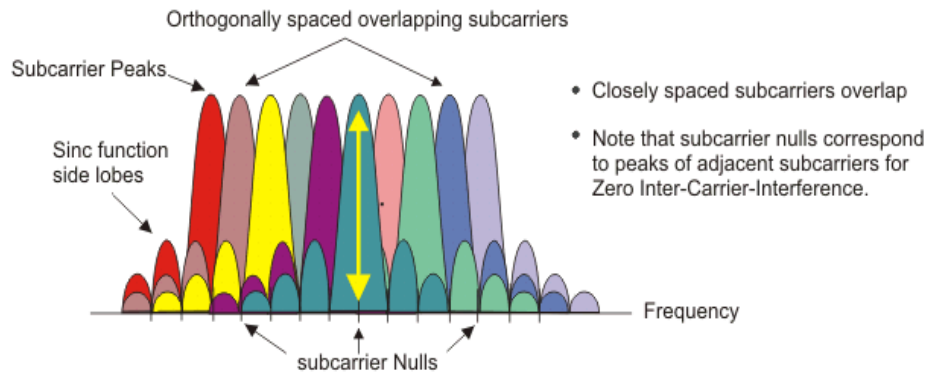

Fig.5 : OFDM signal frequency diagram

The key feature of this multicarrier technique is that the subcarriers must be "adequately" and equally spaced, meaning that the spectral separation among contiguous subcarriers is 1/Ts for them to be orthogonal for a symbol period Ts. OFDM allows individual modulation per subcarrier, though in practice this implies a complex process to determine the suitable modulation level for each subcarrier. While this article provides basic contents, a full treatment of OFDM can be found in OFDM-Based Multicarrier Transmission.

OFDMA is a MA technique that arises naturally from the OFDM modulation presented above when considering that the different symbols modulated on the subcarriers belong to different users. In this way, it is possible to accommodate several simultaneous transmissions corresponding to different information streams when traveling in different subcarriers, for the downlink of a general OFDM-based cellular system. At the user side, it is sufficient to retrieve the contents of the subcarriers assigned to that user to separate the information intended for this user from that of the rest. Note that it will be necessary to have the appropriate signaling mechanism to notify each user which subcarriers have been allocated to him/her.

2.3 WHY NOMA

The NOMA is a multiple access technique employed in 5G cellular wireless network. The main function of NOMA is to serve multiple UEs (User Equipments) using single 5G-NB (Node B or Base Station). It serves multiple users on same time/frequency resources.There are two main techniques employed in NOMA for multiple access.

• Power domain: Here NOMA achieves multiplexing based on different power levels.

• Code domain: Here NOMA achieves multiplexing based on different codes.

Following are the benefits or **advantages of NOMA**:

- It offers higher spectral efficiency due to use of multiple users on same frequency resource.

- It offers massive connectivity by serving more uses simultaneously at the same time. It offers lower latency due to simultaneous transmission all the time rather than dedicated scheduled time slot.

- It offers better QoS (Quality of Service) to all the users using flexible power control algorithms. It helps in increasing cell-edge throughput and better user experience at cell-edges.

- The NOMA along with MIMO delivers enhanced performance.

2.4 HOW NOMA IS BETTER THAN OMA

In downlink NOMA, the transmit signal from the BS and the received signal at both UE receivers is composed of a superposition of the transmit signals of both UEs.

Thus multi-user signal separation needs to be implemented at the UE side so that each UE can retrieve its signal and decode its own data. This can be achieved by non-linear receivers such as maximum likelihood detection or SIC (Successive Interference Cancellation).

For the case of SIC, the optimal order for decoding is in the order of the decreasing channel gain normalized by noise and ICI power. Based on this order, we can actually assume that any user can correctly decode the signals of other users whose decoding order comes before the corresponding user.

In a two-UE case, assuming that, UE-2 does not perform interference cancellation since it comes first in the decoding order. UE-1 first decode UE-2 signal, and subtracts its component from total received signal, and thus it gets its own signal component and decodes it, without interference from UE-2 signal

NOMA uses the power domain to separate signals from each other. NOMA gives a new dimension in which signals can be separated and given access to a base station. This technique that has not been used within 2G, 3G or 4G before.
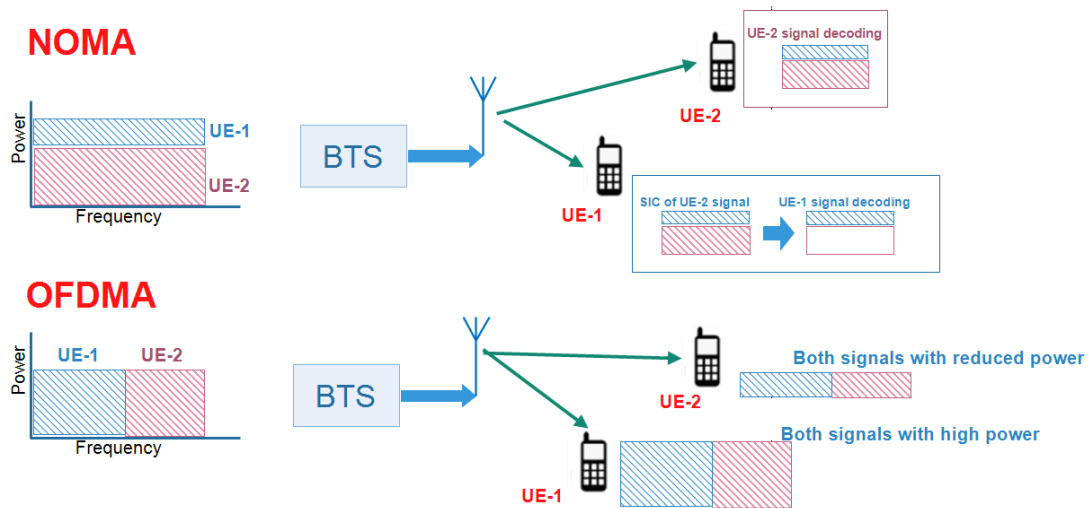
Fig. 6:Comparision of NOMA and OFDMA

In OFDMA, different UE signals are transmitter at different frequency resources, but in case of NOMA, different UE signals are transmitted at same frequency but at different power levels depending upon the position of UE in the cell. The performance gain of NOMA compared to that of OFDMA increases when the difference in channel gain the path loss between UEs is large. According to this simple two-UE case, NOMA provides a higher sum rate than OFDMA. In fact, the cell-center UE gains in terms of rate since this UE is bandwidth-limited and thus benefits more from being able to use double bandwidth, even if this comes at the price of much lower transmit power. Meanwhile, the cell-edge UE also gains in terms of rate since it is power-limited; its transmit power is only slightly reduced under NOMA but its transmit bandwidth can be doubled

2.5HOW NOMA WORKS

In NOMA, each user operates in the same band and at the same time where they are distinguished by their power levels. NOMA uses superposition coding at the transmitter such that the successive interference cancellation (SIC) receiver can separate the users both in the uplink and in the downlink channels.

2.5.1 SUPERPOSITION CODING

Superposition coding at the transmitter and successive interference cancellation (SIC) at the receiver makes it possible to utilize the same spectrum for all users. At the transmitter site, all the individual information signals are superimposed into a single waveform, while at the receiver, SIC decodes the signals one by one until it finds the desired signal.
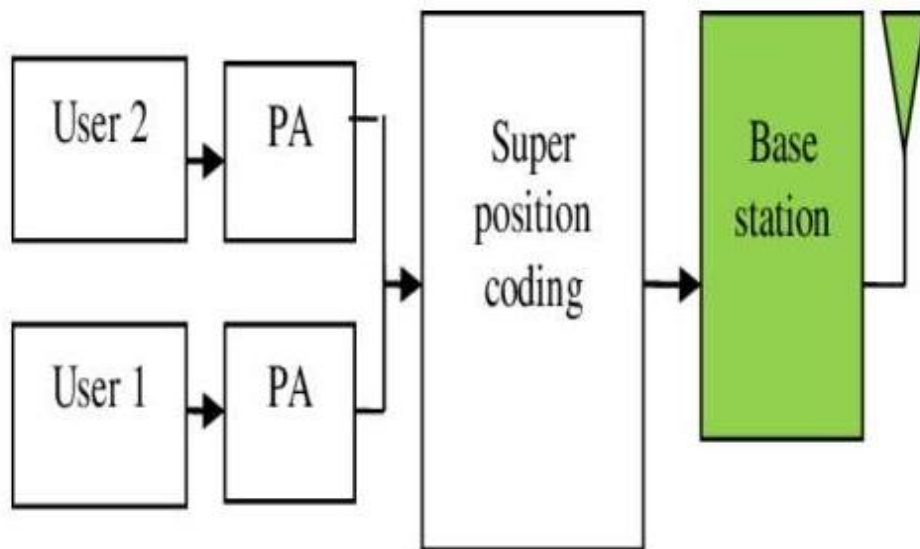
Fig.7.Block Diagram of NOMA in transmission section

At the transmitter side, each users signal is allocated with different power allocation coefficients and then it send the signals to the super position coding block to combine all the signals to a single signal and it is transmitted to base station.

At the receiver side, the signal is sorted according to SNR. Based on dominant power allocation coefficient among users,decoding takes place. The user with dominant power coefficient will decode first and then second dominant user decode next and so on till the last user.

2.5.2 Successive Interference Cancellation
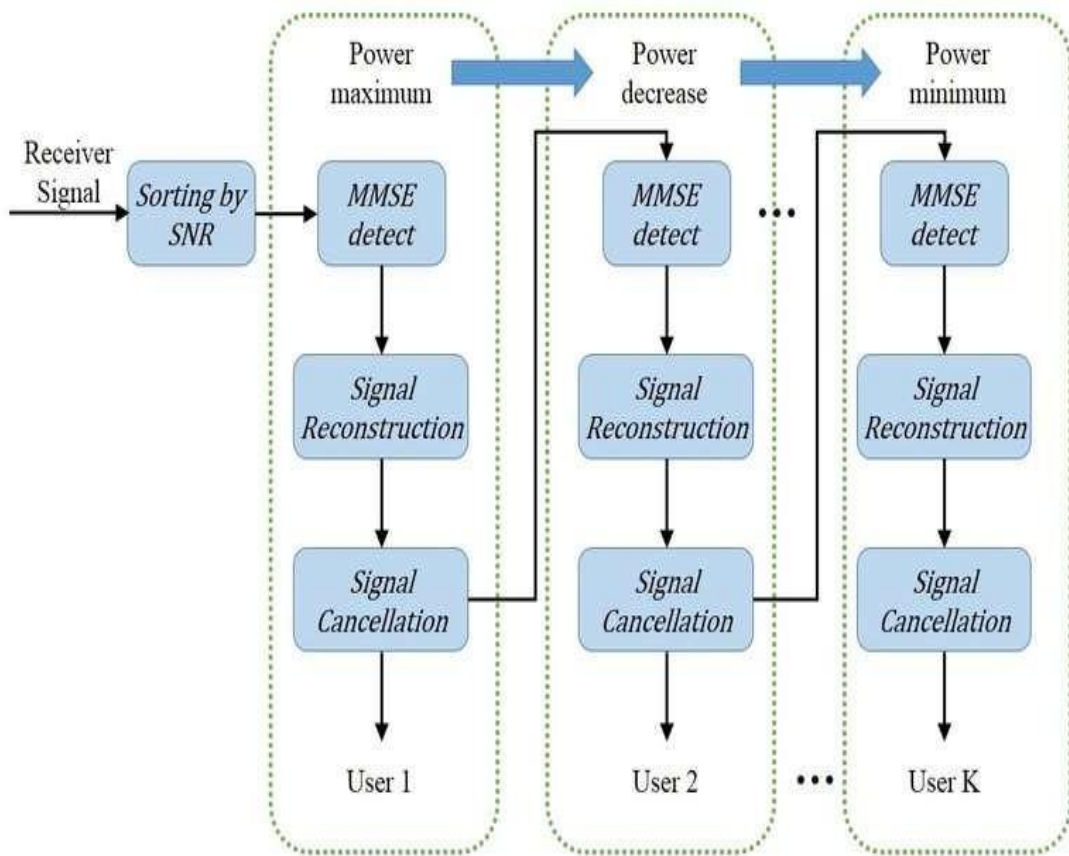
Fig.8: Decoding at receiver

In general, NOMA schemes can be classified into two types: power-domain multiplexingandcode-domainmultiplexing.Inpower-domainmultiplexing,differentusersare allocated different power coefficients according to their channel conditions in order toachieve ahighsystemperformance.Inparticular,multipleuser'sinformationsignalsaresuperimposed atthetransmitterside.Atthereceiversidesuccessiveinterferencecancellation(SIC)isapplied fordecodingthesignalsonebyoneuntilthedesireduser'ssignalisobtained,providingagood trade-off between the throughput of the system and the userfairness.

In code-domain multiplexing, different users are allocated different codes and multiplexed over the same time-frequency resources.

In addition to power-domain multiplexing and code-domain multiplexing, there are other NOMA schemes such as pattern division multiple access (PDMA) and bit division multiplexing (BDM). Although code-domain multiplexing has a potential to enhance spectral efficiency, it requires a high transmission bandwidth and is not easily applicable to thecurrent systems.Ontheotherhand,power-domainmultiplexinghasasimpleimplementationasconsiderable changes are not required on the existing networks. Also, it does not require additional bandwidth in order to improve spectral efficiency.

InNOMAthesamefrequencyresourceisassignedtomultiplemobileusers,withgood and bad channel conditions, at the same time. Hence, the resource assigned for the weak user is also used by the strong user, and the interference can be mitigated through SIC processes at user's receivers. Therefore, the probability of having improved spectral efficiency and a high throughput will be considerablyincreased.

NOMA can serve multiple users with different channel conditions simultaneously; therefore, it can provide improved user fairness, lower latency, and higher massive connectivity. And NOMA is also compatible with the current and future communication systems since it does not require significant modifications on the existing architecture.

2.6 MIMO

MIMO (multiple input, multiple output) is an antenna technology for wireless communications in which multiple antennas are used at both the source (transmitter) and the destination (receiver). The antennas at each end of the communications circuit are combined to minimize errors, optimize data speed and improve the capacity of radio transmissions by enabling data to travel over many signal paths at the same time.MIMO technologies have a significant capability of increasing capacity as well as improving error probability of wireless communication systems.
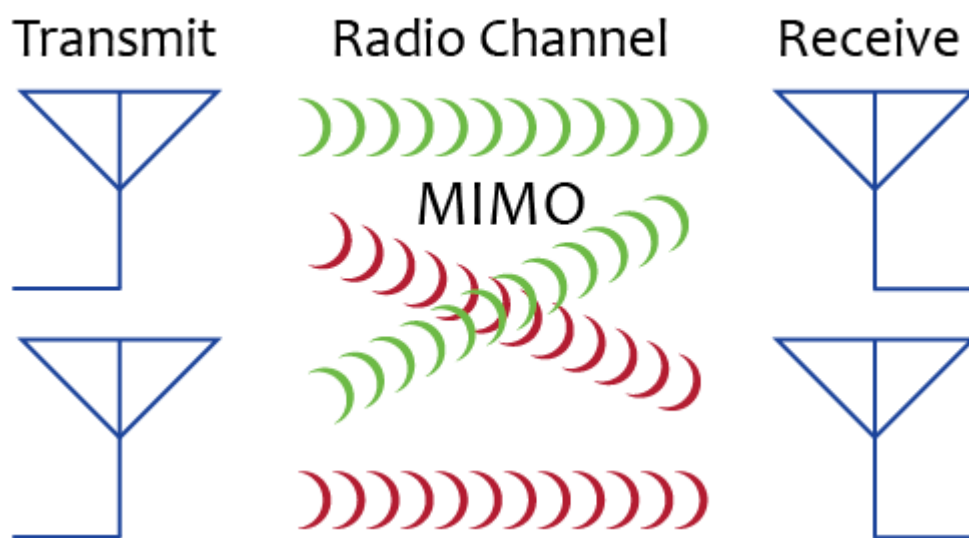

Fig 9: MIMO system with 2 transmitters and
2 recievers

Creating multiple versions of the same signal provides more opportunities for the data to reach the receiving antenna without being affected by fading, which increases the signal-to-noise ratio and error rate. By boosting the capacity of radio frequency (RF) systems, MIMO creates a more stable connection and less congestion

2.5.1 The Importance of MIMO for Users

The 3rd Generation Partnership Project (3GPP) added MIMO with Release 8 of the Mobile Broadband Standard. MIMO technology is used for Wi-Fi networks and cellular fourth-generation (4G) Long-Term Evolution (LTE) and fifth-generation (5G) technology in a wide range of markets, including law enforcement, broadcast TV production and government. It also can be used in wireless local area networks (WLANs) and is supported by all wireless products.

MIMO is often used for high-bandwidth communications where it's important to not have interference from microwave or RF systems. For example, it's frequently used by first responders who can't always rely on cell networks during a disaster or power outage or when a cell network is overloaded.

Before MIMO, there were other types of advanced antenna technology with different configurations -- most commonly, multiple input, single output (MISO) and single input, multiple output (SIMO). MIMO builds on these technologies.

2.5.2 Primary Advantages of MIMO

In its various configurations, MIMO has a number of advantages over MISO and SIMO advanced antenna technologies:

- MIMO enables stronger signals . It bounces and reflects signals so a user device doesn't need tobe in a clear line of sight

- Video and other large-scale content can travel over a network in large quantities. This content travels more quickly because MIMO supports greater throughput.

- Many data streams improve visual and auditory quality. They also decrease the chance of lost data packets.

2.5.3 MIMO-NOMA

The application of multiple-input multiple-output (MIMO) technologies to NOMA is important since the use of MIMO provides additional degrees of freedom for further performance improvement. The transceiver design for a special case of MIMO-NOMA downlink transmission, in which each user has a single antenna and the base station has multiple antennas. A multiple antenna base station used the NOMA approach to serve two multiple-antenna users simultaneously, where the problem of throughput maximization was formulated and two algorithms were proposed to solve the optimization problem. In many practical scenarios, it is preferable to serve as many users as possible in order to reduce user latency and improve user fairness.

Following this rationale users were grouped into small-size clusters, where NOMA was implemented for the users within one cluster and MIMO detection was used to cancel inter-cluster interference. This method does not need CSI at the base station; however, it avoids the use of random beamforming which can cause uncertainties for the quality of service (QoS) experienced by the users. However, precoding was not considered which has two disadvantages, as explained in the following. Firstly the number of antennas of each user has to be larger than the number of antennas at the base station. Secondly, there is a loss in diversity order since, without precoding, the spatial degrees of freedom at the base station cannot be exploited

In order to achieve a balance between the maximum number of mobile users and the optimal achievable sum rate in MIMO-NOMA systems, sum rate has been represented through two ways. The first approach targets the optimization of power partition among the user clusters. Another approach is to group the users in different clusters such that each cluster can be allocated with orthogonal spectrum resources according to the selected user grouping algorithms.

Theapplicationofmultiple-inputmultiple-output(MIMO)technologiestoNOMAisimportant since the use of MIMO provides additional degrees of freedom for further performance improvement. MIMO can be used for either spatial multiplexing (increase achievable rate) or diversity gain (decrease BER).
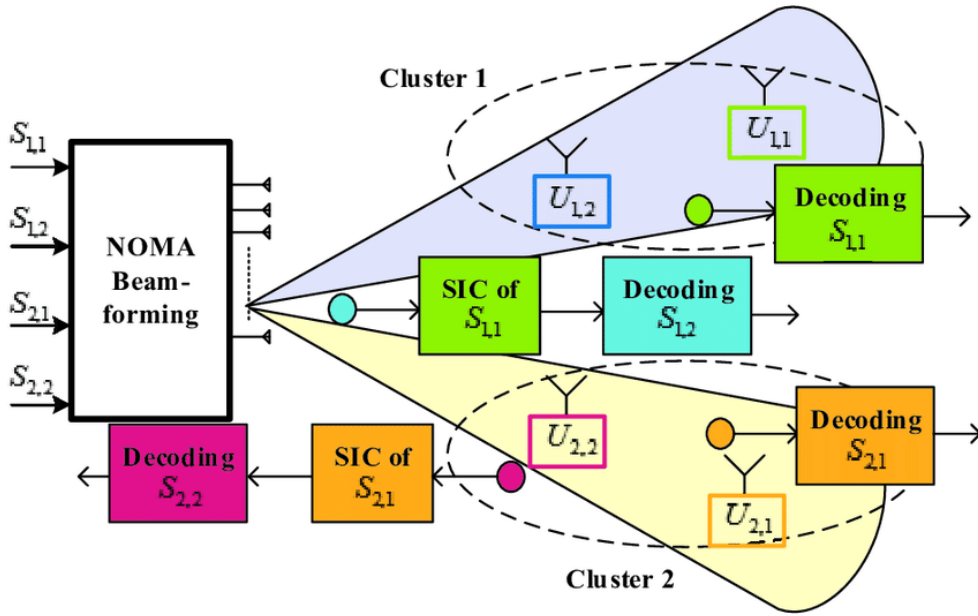
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Fig 10: A MIMO-NOMA system with 2 clusters

As multiple techniques can achieve multi-stream beamforming coding diversity, the use of MIMO techniques brings flexible dimension for performance improvements. There are two techniques in MIMO-NOMA Zero forcing and block diagonalization based on zero-forcing (ZF) technique, low complexity linear precoding scheme can reduce inter-interference when channel transmission occurs. Block diagonalization (BD) is typical linear precodingtechnique with implemented in the downlink of multiuser MIMOsystems.

The performance of downlink MIMO-NOMA network for a simple case of two users, that is, one cluster, is introduced. In this case, MIMO-NOMA provides a better performance than MIMO-OMA in terms of both the sum rate and ergodic sum rate. Also, it is shown that for a more practical case of multiple users, with two users allocated into a cluster and sharing the same transmit beamforming vector. MIMO-NOMA can achieve better outage performance than conventional MIMO-OMA, even for users that suffer strong co-channel interference.

CHAPTER-3

SYSTEM MODEL

CHAPTER-3

SYSTEM MODEL

3.1 SYSTEM MODEL OF NOMA

Consider a 3 x 1 downlink NOMA system with a base station in the middle of a single is assumed. We have assumed 3 distinct users for each NOMA pair. For each NOMA transmission let us order each user based on its distance to BS.
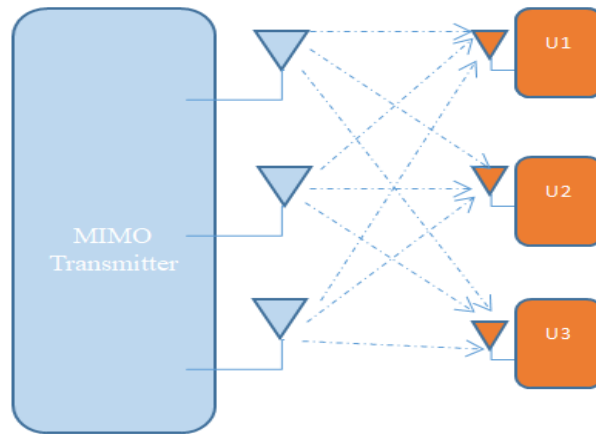
Fig.11 :3x1 downlink MIMO-NOMA
system model

Assume the closest one as U_1 ,

in the middle one as U_2 and the furthest one as U_3 Due to the mobility each user device can be U_1, U_2, U_3. Let d_1, d_2, d_3 denote their respective distances from the base station (BS) such that,$d_1 < d_2 < d_3$. Based on their distances, U_3 is the weakest/farthest user andU_1

Fig 12 Showing NOMA Downlink system model with one BS and three distinct users.

is the strongest/nearest user to the BS.

Let h_1, h_2, h_3 denote their corresponding Rayleigh fading coefficients such that, $|h_1|^2 >$

$|h_2|^2 > |h_3|^2$. (The channels are ordered this way because $h_i \propto \frac{1}{d_i}$). Let $\alpha_1, \alpha_2, \alpha_3$ denote theirrespective power allocation coefficients. According to the principles of NOMA, the weakest user must be a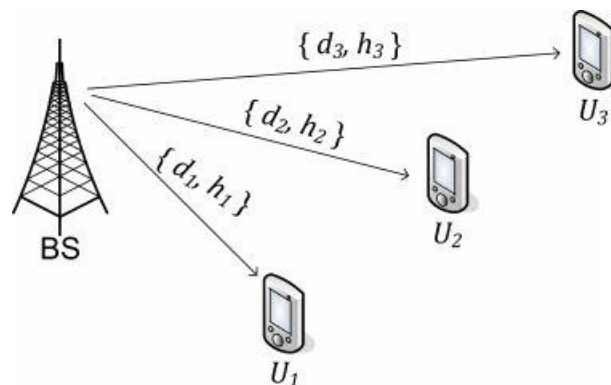llocated the most power and the strongest user must be allocated the least power. Therefore the power allocation coefficients must be ordered as $\alpha_1 < \alpha_2 < \alpha_3$. The choice of power allocation coefficients has a great significance on the performance of a NOMA network. In this project we make use of Dynamic Power Allocation to discuss how it improves the performance of a NOMA system.

Let x_1, x_2, x_3 denote the QPSK modulated messages that the BS needs to send to U_1, U_2, U_3 respectively . Then , the superposition coded signal transmitted by BS is given by,

$$x = \sqrt{P}\left(\sqrt{\alpha_1}x_1 + \sqrt{\alpha_2}x_2 + \sqrt{\alpha_3}x_3\right) \qquad (1)$$

Then, at the receiver end, SIC is performed. After that, respective user information decoding takesplace.InNOMA,thetransmitteratthetransmittersidetransmitsthetotalsignaltoallthe receivers simultaneously. The signal received by the users is givenby,

$$y_i = h_i x + n_i \qquad (2)$$

Where n_i denotes the AWGN at receiver of U_i

Successive Interference Cancellation (SIC):

NOMA adopts the principle of successive interference cancellation (SIC) algorithm at the receiver's side to segregate user's information.

Before decoding, let us take a look at SIC algorithm. SIC is an iterative algorithm where data is decoded in the order of decreasing power levels. That is, data corresponding to the user who is given the highest power is decoded first, then the data of the user who is given the next highest power is decoded. This process repeats till we have decoded all user's data.

Traditionally, only the strongest signal can be decoded, treating the other signal as interference. However, SIC facilitates recovery of even the weaker signal. For this, the bits of the stronger signal are decoded as before. The original (stronger) signal is then reconstructed from these bits, and subtracted (i.e., cancelled) from the combined signal. The bits of the weaker packet are then decoded from this residue. This can be an iterative process to recover multiple packets and hence it is termed successive interference cancellation.

3.2 SIC DECODING OF USERS:

- At user 3:

Since U_3 is allocated the highest power , he will perform direct decoding from y_1, treating the signals of U_2 and U_1 as interference. Thus , the achievable rate of U_3 is

$$R_3 = \log_2 \left(1 + \frac{\alpha_3 P |h_3|^2}{\alpha_2 P |h_3|^2 + \alpha_3 P |h_3|^2 + \sigma^2} \right) \qquad (3)$$

From this above equation , we make one important observation . Since $\alpha_2 + \alpha_3$ is present in the denominator now we want α_3 to satisfy $\alpha_3 > \alpha_1 + \alpha_2$. Only then user 3 's power will dominate the transmit signal , x and in the received signal y_3.

- At user 2:

Next lets write the rate equation for second user . Since $\alpha_2 < \alpha_3$ and $\alpha_2 > \alpha_1$, U_2 must perform Successive Interference Cancellation to remove U_3's data and treat U_1 as interference. After removing the U_1's data by SIC , the achievable rate for U_2 is ,

$$R_2 = \log_2 \left(1 + \frac{\alpha_2 P |h_2|^2}{\alpha_1 P |h_2|^2 + \sigma^2} \right)$$

Since α_1 is present in the interference term at the denominator , we want $\alpha_2 > \alpha_1$.

- At user 1:

Finally U_1 has to perform SIC two times to remove both U_2 and U_3 data from y_1. Since the α_3 term dominates the denominator in y_1, it must be removed first , after that , the α_2 term must be removed. So the achievable rate of user 1 can be ,

$$R_1 = \log_2 \left(1 + \frac{\alpha_1 P |h_1|^2}{\sigma^2} \right)$$

Moreover , The sum rate of U_1, U_2, U_3 can be formulated by

$$R_{sum}^{1,2,3} = R_1 + R_2 + R_3.$$

3.3 **DYNAMIC POWER ALLOCATION**

In present day scenario conserving energy is a great concern. The power in any form needs to be conserved by using it in an optimised manner. The conventional static power allocation consumes more power than required. In such cases its better to make use of other power allocating techniques such as Dynamic Power Allocation. Here DPA will allocate the power to the user based on certain parameters and constraints so that the power allocated to users will be based on their parameters. Hence no wastage of power can happen in this case. For Dynamic Power Allocation , there are certain constraints that followed by the allocated power coefficients there are 3 main constarints

1) Transmit Power Constraint
2) Outage Probability Constraint
3) SIC constraint

1st Constraint (Con1) Transmit Power Constraint:

Total power allocations sum must be less than or equal to unity.

$$\sum_{m=1}^{M} \alpha_m \leq 1$$

2nd Constraint (Con2) Outage Probability Constraint:

To avoid user m to be in outage the following constraint should be fulfilled

$$\alpha_m > \left(2^{\bar{R}_m} - 1\right) \sum_{i=1}^{m-1} \alpha_m$$

3rd Constraint (Con3) SIC constraint:

The following conditions must be met in order to accomplish successful SIC for m-th user with channel gain $|h_m|$

$$|h_m|^2 P_t \alpha_m \ - \ |h_m|^2 P_t \sum_{i=1}^{m-1} \alpha_i \ - 1 \geq \ \Phi_m$$

NOMA adopts the principle of successive interference cancellation (SIC) algorithm at the receiver's side to segregate user's information.

CHAPTER-4

PERFORMANCE ANALYSIS

CHAPTER-4

PERFORMANCE ANALYSIS

POWERALLOCATION

Wirelessdatanetworksareincreasinglybecominganimportantpartofnextgeneration network infrastructure. The objective of these networks is to provide with anytime, anywhere data access. The computing and storage capabilities of these devices cover a wide spectrum. Power consumption has become an important concern when it comes to the implementation phase of wireless devices. Therefore, power management is one of the challenging problems in wirelesscommunications.

In wireless networks, power allocation is an effective technique for prolonging the lifetimeofnetworkterminals.Generallyoptimumpowerallocationimprovestheefficiencyof wireless systems. When power allocation is properly done, source information can reach the destination efficiently. The problem of power allocation in relay assisted wireless system is investigatedherewithMaximalRatioCombining(MRC)atthedestinationterminal.Basedon the SNR and BER, power is allocated to the network terminals using Dynamic power allocation scheme. Also based on the users channel capacity optimized power allocation is done. Hence the channel serves good enough in transmittingthe source information to thedestination.

The outage probability is the ratio of the number of samples of the signal below the threshold to the total number of samples. If we increase the threshold power , the outage probability is increased , that is the better detection of signal is decreased.In Information theory outage probability of a communication channel is the probability that a given information rate is not supported, because of variable channel capacity.

The amount of power that is allocated to the user data to transmit the respective signal from the transmitter to the receiver is called power allocation. By implementing the optimum power allocation process, the efficiency of the wireless communications system has been improved. To transmit the signal from the transmitter antenna to the receiver antenna, power allocationcoefficientsarerequired,asNOMAisbasedonapowerdomaintechnique.Theuser which is distant from the transmitter antenna is allocated with high power and the user which is close to the transmitter is allocated with less power coefficient. The summation of allpower

allocationcoefficientsmustbe1.IntheMIMOsystem,NOMAisincludedtoachieveeffective   sum rates which come up with greater performance. Here we use both fixed powerallocation coefficientsas well as Dynamic power allocationsanddeterminedtheachievablesumratesforthe threeusers.Theachievableratesfor respective users are calculated. The performance of conventional NOMA and MIMO-NOMA in both Static and Dynamic Power allocations is observed.
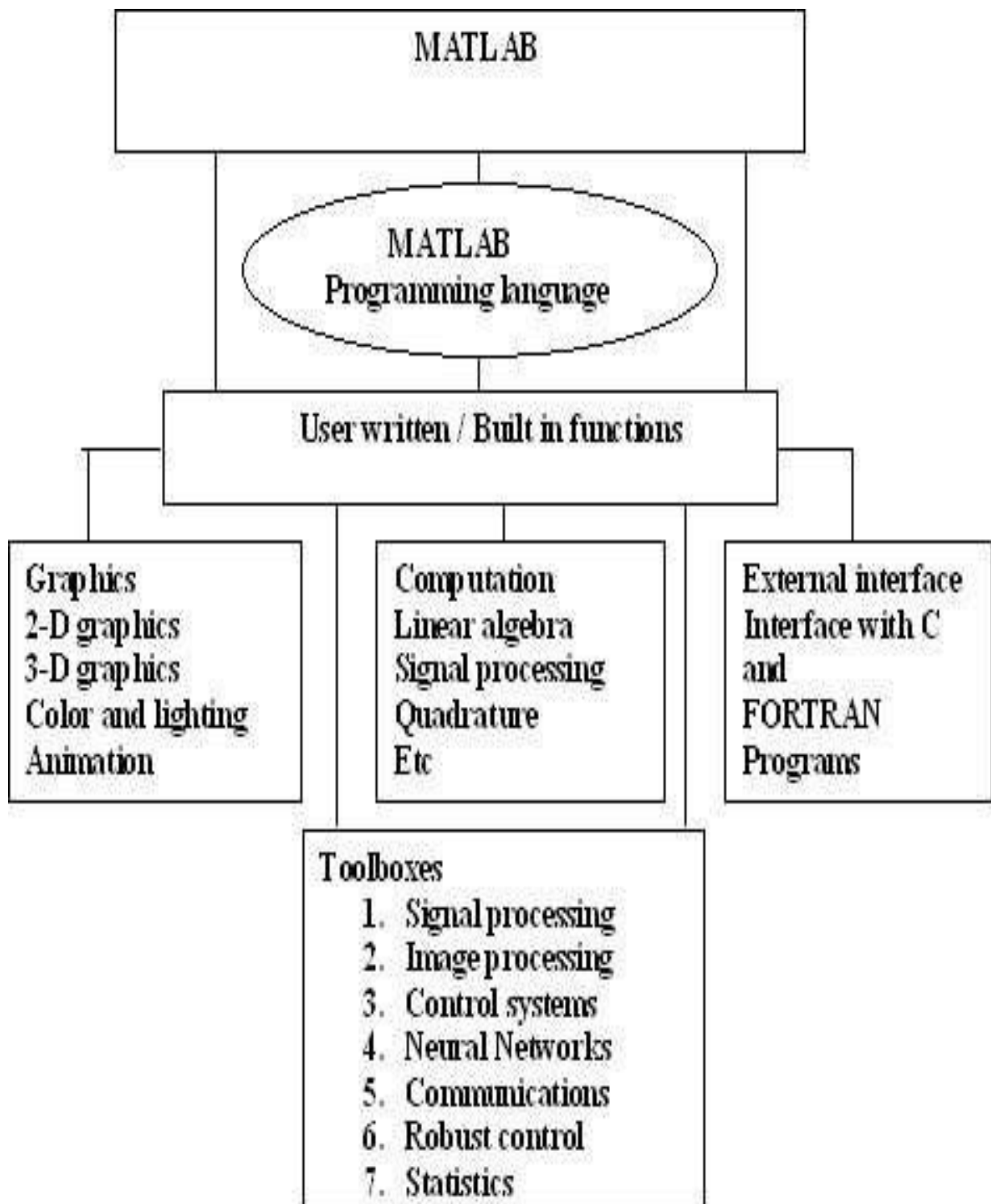
CHAPTER-5

MATLAB

CHAPTER-5

MATLAB

5.1 MATLABINTRODUCTION

MATLAB is a high performance language for technical computing. It integrates computation visualization and programming in an easy to use environment. MATLAB stands for matrix laboratory. It was written originally to provide easy access to matrix software developed by LINPACK (linear system package) and EISPACK (Eigen system package) projects.MATLABisthereforebuiltonafoundationofsophisticatedmatrixsoftwareinwhich the basic element is matrix that does not require pre dimensioning. Typical uses ofMATLAB

1. Math andcomputation

2. Algorithmdevelopment

3. Dataacquisition

4. Data analysis, exploration andvisualization

5. Scientific and engineering graphics

The main features ofMATLAB

1. Advanced algorithm for high performance numerical computation, especially in the Field matrixalgebra

2. A large collection of predefined mathematical functions and the ability to define one's own functions.

3. Two-and three dimensional graphics for plotting and displayingdata

4. A complete online helpsystem

5. Powerful matrix or vector oriented high level programming language for individual applications.

6. Toolboxes available for solving advanced problems in several applicationareas.

MATLAB

MATLAB
Programming language

User written / Built in functions

Graphics
2-D graphics
3-D graphics
Color and lighting
Animation

Computation
Linear algebra
Signal processing
Quadrature
Etc

External interface
Interface with C
and
FORTRAN
Programs

Toolboxes
1. Signal processing
2. Image processing
3. Control systems
4. Neural Networks
5. Communications
6. Robust control
7. Statistics

Fig. 5.1 Features and capabilities of MATLAB

5.2 MATLABINSTALLATION

Installation Procedure for MATLAB Software

Redundant clients-Windows XP-SP2/Vista/Windows 7/Windows 8

Download:

> • win32.rar or win64.rar (for 64 bitsystem)

> • PLP

> • "license.dat" *from http://mirror.iitd.ernet.in/matlab* into Your DesiredFolder.

STEPS: Installation of MATLAB Software for window XP/VISTA / Windows 7/8

Get administrator privileges for the system on which you plan to install MATLAB. Use WinRAR to extract RAR file

**Step1: Start the installer**

For Windows, double-clicking on setup.exe

Step 2: Choose to Install Without Using the Internet

When it starts, the installer displays the following dialog box. Select the Install without using the Internet option and Click OK to proceed with installation.

Step 3: Review the License Agreement

Review the software licensing agreement and, if you agree to its terms, click Yes.

Click Next.   Select Yes.
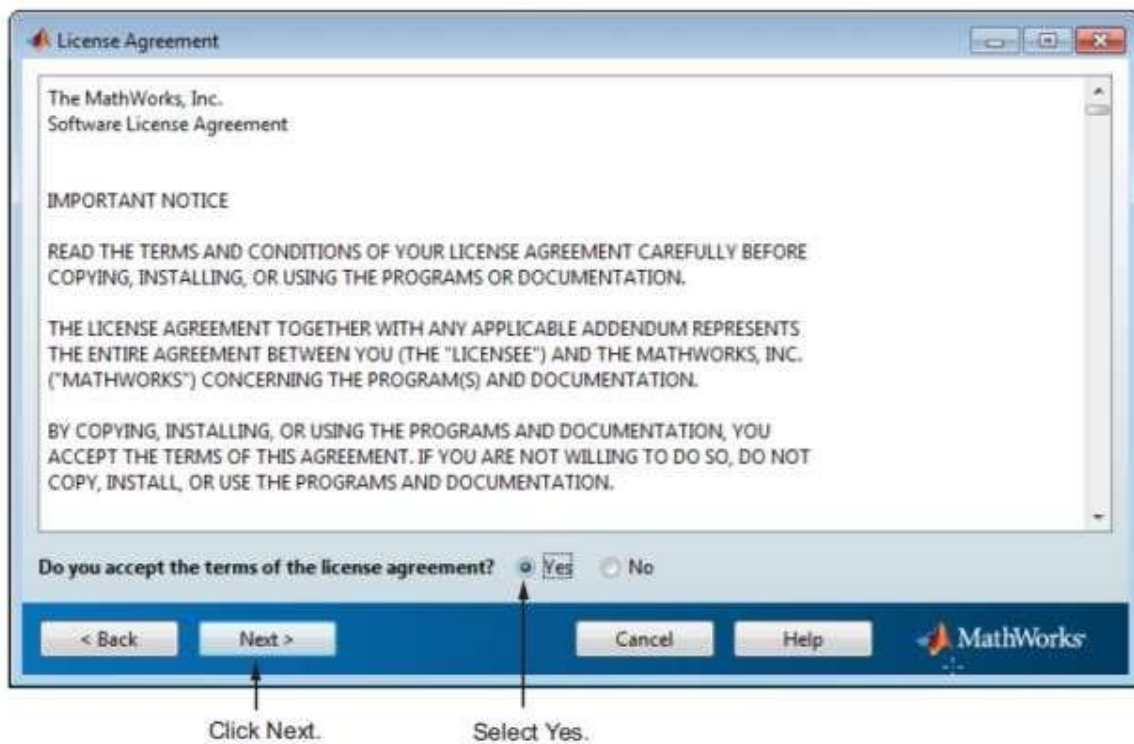
Step 4: Enter the File Installation Key

 Enter your File Installation Key and Click OK.

10706-16682-10020-38749-58852-13152-57659-27128-07009-39738-29125-60143

Enter File Installation Key here.

Select this option to gather the information needed to get a File Installation Key.

Click Next.

Step 5: Choose the Installation Type

In the Installation Type dialog box, specify whether you want to perform a Custom installation and click Next.

Select Typical or Custom.

Click Next.

**Step 6: Specify the Installation Folder**

Specify the name of the folder where you want to install MathWorks products. Accept the default installation folder or click Browse to select a different one. If the folder doesn't exist, the installer creates it.

Step 7: Specify Products to Install (Custom Only)

Leave it by default and continue.

Step 8: Specify the Location of the License File

 Enter the full path of your License File in the text box (or drag and drop the file) and click Next.

Specify License File processed
during license manager installation
on your server.
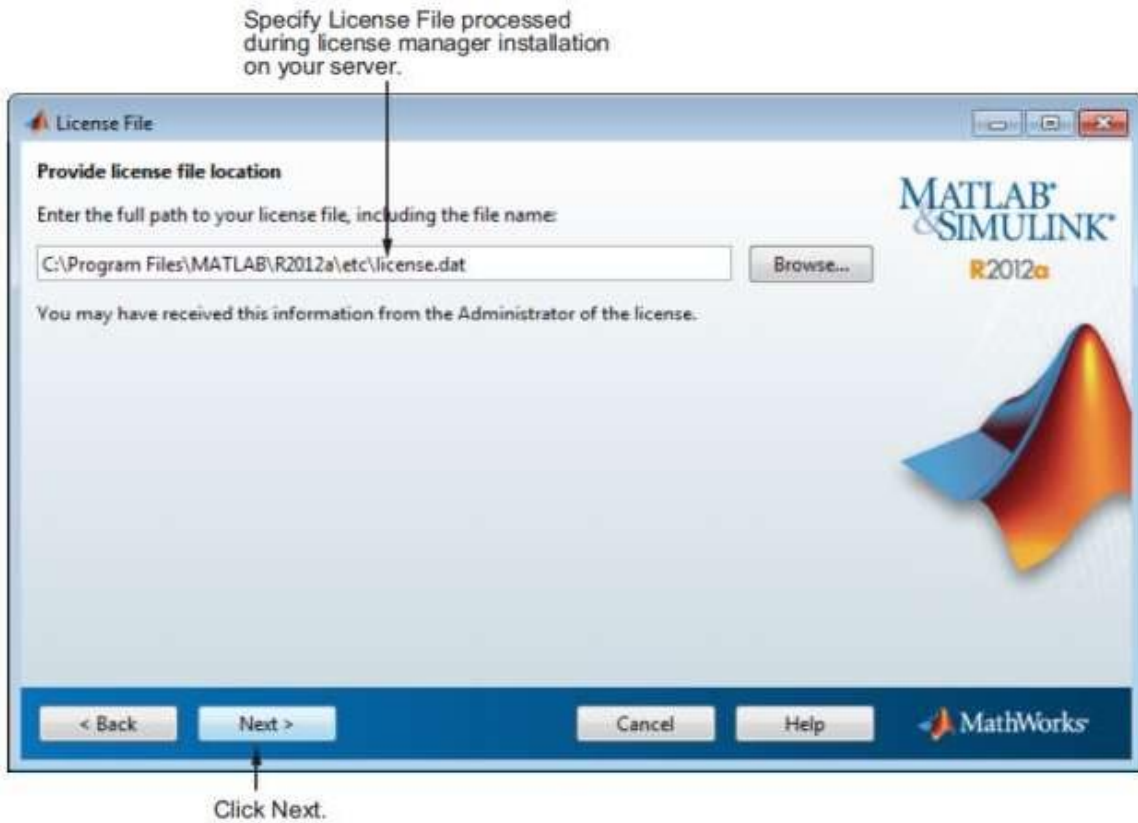
Click Next.

Step 9: Specify Installation Options (Custom Only)

After selecting installation options, click Next to proceed with the installation.

Step 10: Confirm Your Choices and Begin Copying Files Before it begins copying files to your hard disk, the installer displays a summary of your installation choices. To change a setting, click Back. To proceed with the installation, click Install. As it copies files to your hard drive, the installer displays a status dialog box to show the progress of the installation.
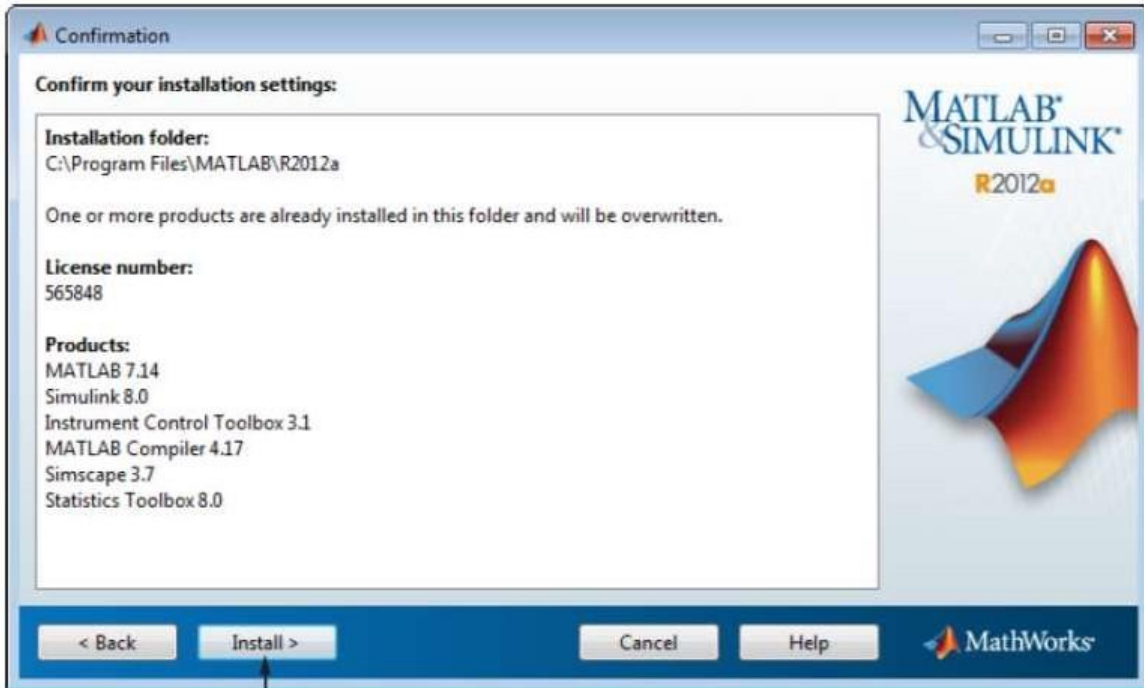
Click Install.

Step 11: Complete the Installation

Step 11: Complete the Installation
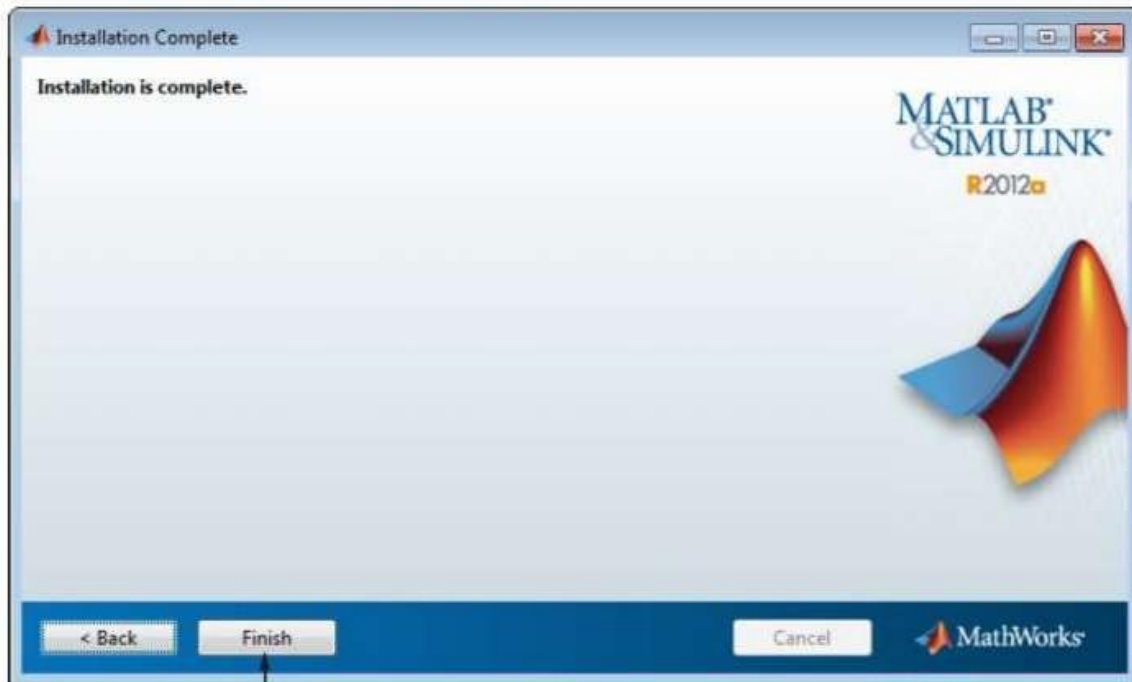
Click Finish.

Step 12: Set Environment Variables

Click right Button on My Computer

Select Properties……..>Advanced System settings …….>Environment

Variables…>New

The environment variable that should be added is as follows:

Variable_ name: MLM_LICENSE_FILE

Variable_value:27000@licmngr1.iitd.ernet.in, 27000@licmngr2.iitd.ernet.in, 27000@
licmanager.cse.iitd.ernet.in.

5.3 The MATLABSYSTEM

The MATLAB System consists of five mainparts

- DevelopmentEnvironment:

This is the set of tools and facilities that help you use MATLAB functions and files. Many of these tools are graphical user interfaces. It includes the MATLAB desktop and Command Window, command history an editor and debugger, and browsers for viewing help the workspace, files, and the search path.

• The MATLAB Mathematical FunctionLibrary:

This is a vast collection of computational algorithms ranging from elementary functions, like sum sine, cosine, and complex arithmetic, to more sophisticated functions like matrix inverse, matrix Eigen values, Bessel functions, and fast Fourier transforms.

• The MATLABLanguage:

This is a high-level matrix/array language with control flow statements, functions, data structures, input/output, and object-oriented programming features. It allows both programming in the small to rapidly create quickly programs, and "programming in the large" to create large and complex application programs.

• Graphics:

MATLAB has extensive facilities for displaying vectors and matrices as graphs, as well as annotating and printing these graphs. It includes high-level functions for two-dimensional and three dimensional data visualization, video processing, animation, and presentation graphics. Italsoincludeslow-levelfunctionsthatallowyoutofullycustomizetheappearanceofgraphics   as well as to build complete graphical user interfaces on your MATLABapplications

• The MATLAB Application Program Interface(API):

This is a library that allows you to write C and Fortran programs that interact with MATLAB. It includes facilities for calling routines from MATLAB (dynamic linking), calling MATLAB as a computational engine, and for reading and writing MAT-files .

5.4 Starting MATLAB

On Windows platforms, start MATLAB by double-clicking the MATLAB shortcut icon on your Windows desktop. On UNIX platforms, start MATLAB by typing mat lab at the operatingsystemprompt.YoucancustomizeMATLABstart-up.Forexample,youcanchange   the directory in which MATLAB starts or automatically execute MATLAB statements in a script file namedstart-ups.

5.5 MATLABDesktop

When you start MATLAB, the MATLAB desktop appears, containing tools(graphical userinterfaces)formanagingfiles,variables,andapplicationsassociatedwithMATLAB.The following illustration shows the default desktop. You can customize the arrangement of tools and documents to suit yourneeds.

5.6 MATLAB Working Environment

• MATLABDesktop:

MATLAB Desktop is the main MATLAB application window. The desktop contains fivesubwindowsthecommandwindow,theworkspacebrowserthecurrentdirectorywindow,

the command history window, and one or more figure windows, which are shown only when the user displays a graphic. The command window is where the user types MATLAB commands and expressions at the prompt(>>) and where the output of those commands is displayed. MATLAB defines as the workspace as the set of variables that the user creates in a worksession.Theworkspacebrowsershowsthesevariablesandsomeinformationaboutthem.

Double clicking on a variable in the workspace browser launches the Array Editor, which can be used to obtain information and income instances edit certain properties of the variable. The current Directory tab above the workspace tab shows the contents of the current directory, whose path is shown in the current directory window. For example, in the windows operating system the path might be as follows: C-MATLAB Work, indicating that directory "work" is a subdirectoryofthemaindirectoryMATLABWHICHISINSTALLEDINDRIVEC.clicking on the arrow in the current directory window shows a list of recently used paths. Clicking on thebuttontotherightofthewindowallowstheusertochangethecurrentdirectory.MATLAB uses a search path to find M-files and other MATLAB related files, which are organize in directories in the computer file system. Any file run in MATLAB must reside in the current directory or in a directory that is on search path. By default, the files supplied with MATLAB and math works toolboxes are included in the search path. The easiest way to see which directories is on the search path. The easiest way to see which directories are soon the search paths, or to add or modify a search path, is to select set path from the File menu the desktop, and then use the set path dialog box. It is good practice to add any commonly used directories to the search path to avoid repeatedly having the change the current directory. The Command History Window contains a record of the command window, including both current and previousMATLABsessions.PreviouslyenteredMATLABcommandscanbeselectedandre-executed from the command History window by right clicking on a command or sequence of commands. This action launches a menu from which to select various options in addition to executing the commands. This is a use to select various options in addition to executing the commands. This is useful feature when experimenting with various commands in a work session.

• Using the MATLAB Editor to createM-Files:

TheMATLABeditorisbothatexteditorspecializedforcreatingM-filesandgraphical MATLABdebugger.Theeditorcanappearinawindowbyitself,oritcanbeasubwindowin

the desktop, M-files are denoted by the extension m The MATLAB editor window has numerous pull-down menus for tasks such as saving viewing, and debugging files. Because it performs some simple checks and also uses colour to differentiate between various elements of code, this text editor is recommended as the tool of choice for writing and editing M functions. To open the editor, type edit at the prompt opens the M-file filenames in an editor window ready for editing. As noted earlier the file must be in the current directory, or in a directory in the search path.

• GettingHelp:

The principle way to get help online is lo use the MATLAB help browser, opened as a separate window either by clicking on the question mark symbol (?) on the desktop toolbar,or by typing help browser at the prompt in the command window. The help Browser is a web browser integrated into the MATLAB desktop that displays a Hypertext Markup Language (HTML)documents.TheHelpBrowserconsistsoftwopanes,thehelpnavigatorpane,usedto   find information, and the display pane, used to view the information. Self explanatory tabs other navigator pane are used to perform a scratch. For example, help on a specific function is obtained by selecting the search tab, selecting Function Name as the Search Type, and then typinginthefunctionnameintheSearchforfield.ItisgoodpracticetoopentheHelpBrowser atthebeginningofaMATLABsessiontohavehelpreadilyavailableduringcodedevelopment   or other MATLABtask.
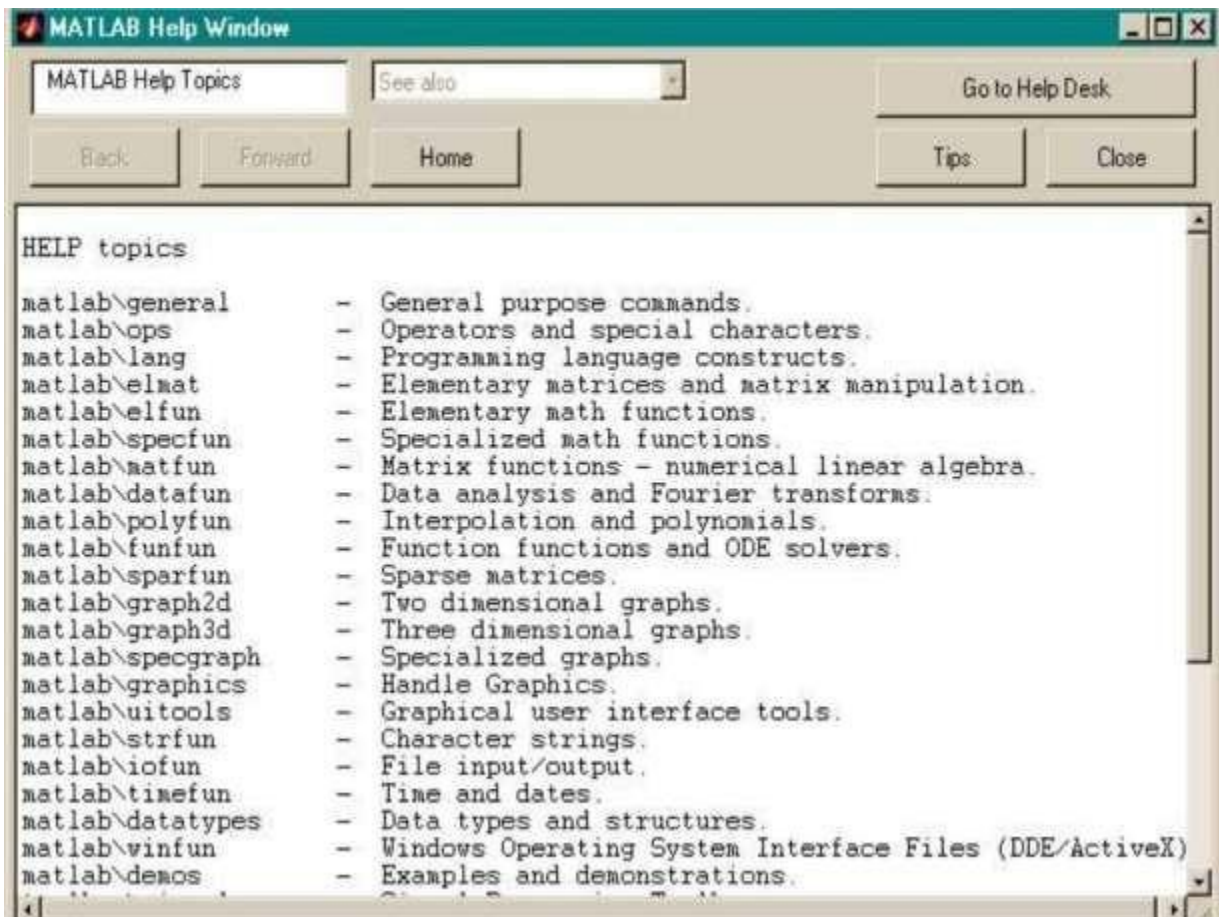
Anotherwaytoobtainforaspecificfunctionisbytypingdocfollowedbythefunctionname at the command prompt. For example, typing doc format displays documentation for the function called format in the display pane of the Help Browser. This command opens the browser if it is not alreadyopen.

M-functions have two types of information that can be displayed by the user The first is called the HI line, which contains the function name and alone line description the second is a block of explanation called the Help text block. Typing help at the prompt followed by a function name displays both the HI line and the Help text for that function in there command window.

Typically look for followed by a keyword displays all the HI lines that contain that keyword.Thisfunctionisusefulwhenlookingforaparticulartopicwithoutknowingthenames of applicable functions. For example, typing look for edge at the prompt displays the HI lines containingthatkeyword.BecausetheHIlinecontainsthefunctionname,itthenbecomes

possible to look at specific functions using the other help methods. Typing look for edge-allat the prompt displays the HI line of all functions that contain the word edge in cither the HIline or the Help text block. Words that contain the characters edge also are detected. For example, the HI line of a function containing the word poly edge in the H1 line or Help text would also bedisplayed.
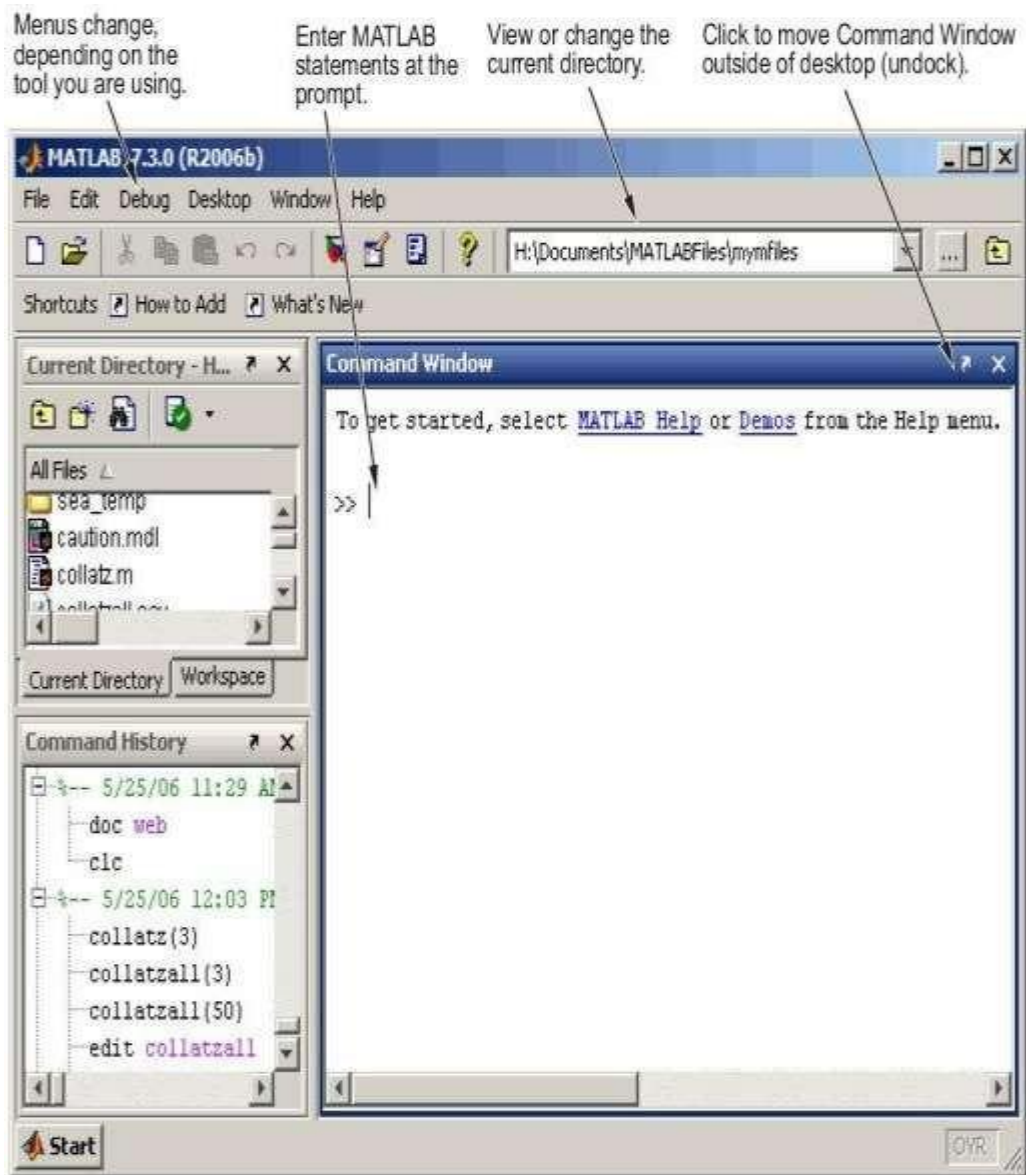
5.7 Saving and Retrieving a WorkSession

There are several ways to save and load an entire work session or selected workspace variables in MATLAB. The simplest is as follows.

Tosavetheentireworkspace,simplyright-clickonanyblankspaceintheworkspace Browser window and select Save Workspace as from the menu that appears. This opens a directory window that allows naming the file and selecting any folder in the system in which to save it. Then simply click Save. To save a selected variable from the workspace, select the variablewithaleftclickandthenright-clickonthehighlightedarea.ThenselectSaveSelection Asfromthemenuthatappears.Thisagainopensawindowfromwhichafoldercanbeselected to save thevariable.

To select multiple variables, use shift click or control click in the familiar manner, andthenusetheprocedurejustdescribedforasinglevariable.Allfilesaresavedinthedouble-precision,binaryformatwiththeextensionmat.Thesesavedfilescommonlyarereferredtoas MAT-files.Forexample,asessionnamed,saysmywork_2012-02-10,andwouldappearasthe MAT-file mywork_2012_02_10.mat when saved. Similarly, a saved video called final video will appear when saved as final_video.mat.

To load saved workspaces and/or variables, left-click on the folder icon on the toolbar of the workspace Browser window. This causes a window to open from which a folder containing MAT-file or selecting open causes the contents of the file to be restored in the workspace Browser window. It is possible to achieve the same results described in the preceding paragraphs by typing save and load at the prompt with the appropriate file names and path information. This approach is not as convenient, but it is used when formats other than those available in the menu method are required.

Menus change, depending on the tool you are using.

Enter MATLAB statements at the prompt.

View or change the current directory.

Click to move Command Window outside of desktop (undock).

• GraphComponents:

MATLAB displays graphs in a special window known as a figure. To create a graph, you need to define a coordinate system. Therefore every graph is placed within Axes, which are contained by the figure. The actual visual representation of the data is achieved with

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graphics objects like lines and surfaces. These objects are drawn within the coordinate system defined by the axes, which MATLAB automatically creates specifically to accommodate the range of the data. The actual data is stored as properties of the graphics objects.
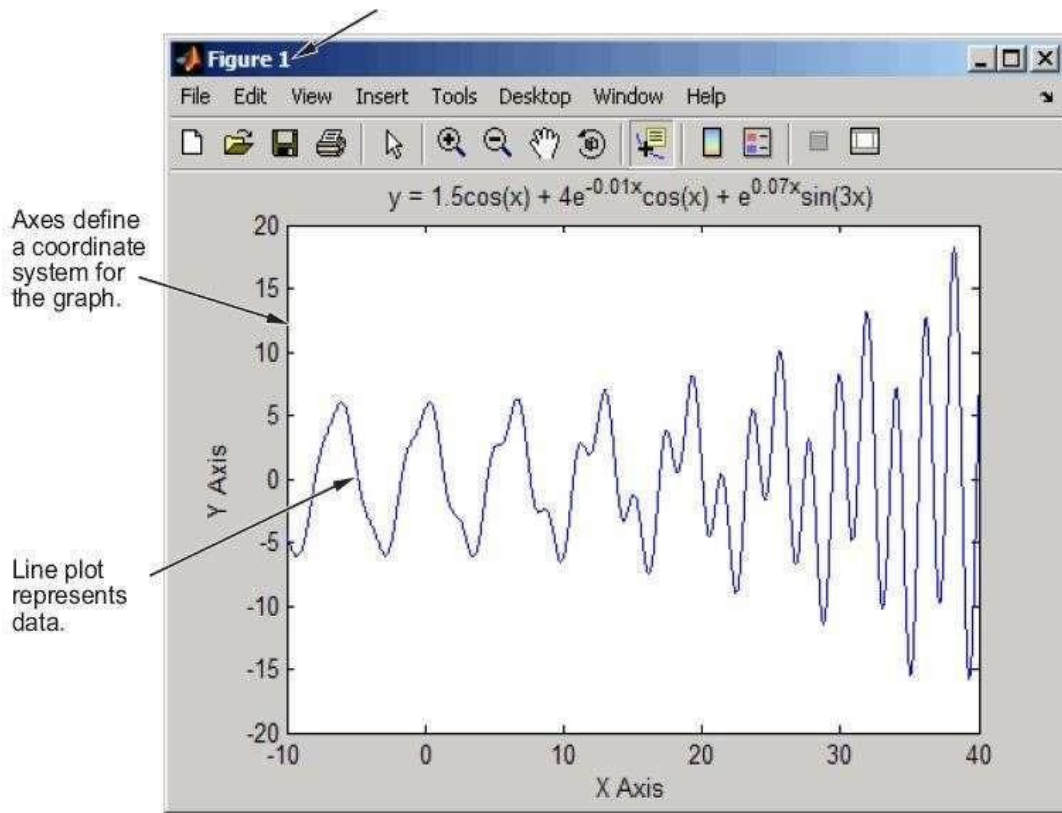
• Plotting Tools

   Plotting tools are attached to figures and create an environment for creating Graphs.

These tools enable you to do the following:

 • Select from a wide variety of graphtypes

• Change the type of graph that represents avariable

• See and set the properties of graphicsobjects

• Annotate graphs with text, arrows,etc.

• Drag and drop data intographs

 Display the plotting tools from the View menu or by clicking the plotting tools icon in the figure toolbar, as shown in the following picture.

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Enable plotting tools from the View menu or toolbar

• Editor/Debugger

Use the Editor/Debugger to create and debug M-files, which are programs you write to run MATLAB functions. The Editor/Debugger provides a graphical user interface for text editing, as well as for M-file debugging. To create or edit an M-file use File > New or File > Open, or use the edit function.
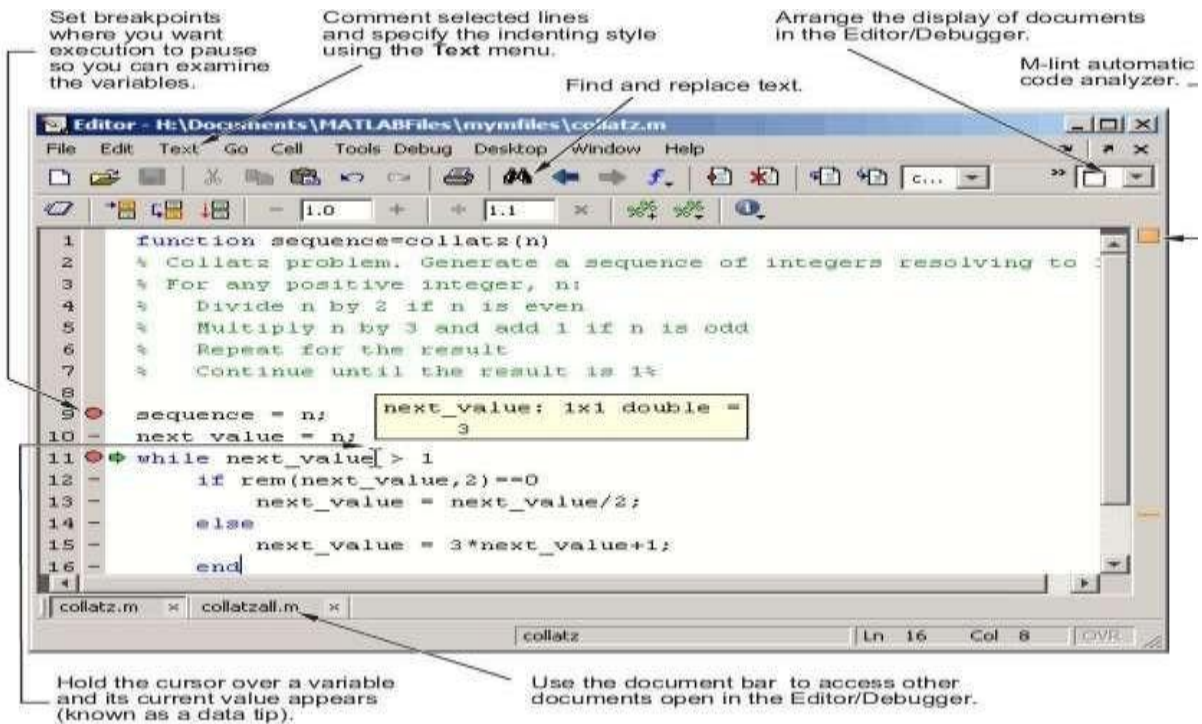
CHAPTER-6

SIMULATION RESULTS

CHAPTER-6

SIMULATION RESULTS

This project focuses on how MIMO-NOMA system performs when power is allocated dynamically rather than the conventional static methods. The Simulation results shows a comparison of each static and dynamic method. For the analysis of Power allocation, Channel capacity,user data ,MATLAB2015a is used with the followingspecifications.

TABLE:

6.1 The following table shows the parameters that have been used for simulation.

Parameters	Specifications
Techniques used	MIMO-NOMA,NOMA,
N	10^5
N0	$-174 + 10 * \log_{10}(BW)$
BW	10^6
eta	4
Channel type	Rayleigh fading channel
Modulation type	BPSK
Transmit power range	0:40 (dB)

The Simulation results shows a comparison of each static and dynamic method. For the analysis of Power allocation, Channel capacity,user data ,MATLAB2015a is used with the followingspecifications.

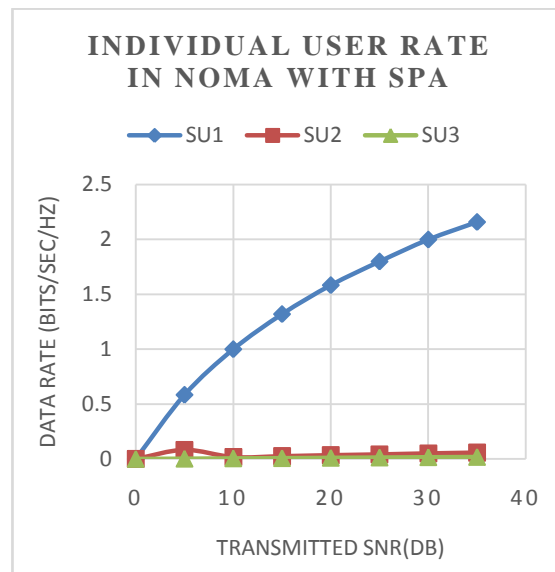6.2 Data rate of Individual users of NOMA when static power allocation is employed

Fig. 13:Individual User Rate in NOMA with
SPA

The maximum average data rate for user 1 who is nearer to the base station when SPA is employed is 2.25 bits/sec/Hz. Transmitted SNR is in the range of 0-40 dB. The other two static users are even having much lower data rates. This is because we take in the fact that users keeps on moving from one place to other so their channel conditions changes and so does their data rates.

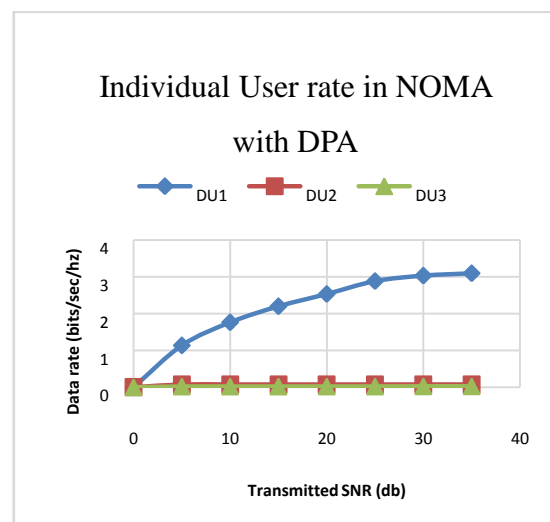6.3 : Avg Data rate for individual users of NOMA when Dynamic Power is Allocated.

Fig. 14: Individual User rate in NOMA with
DPA

The maximum average data rate when dynamic power allocated is almost over 3.2 bits/sec/Hz for the user 1 who is nearer to the base station. Thus from above graph its obvious that the performance of NOMA increases when DPA is employed rather than the conventional SPA.

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6.4 : The comparision of average sum rate of DPA vs SPA performace for conventional NOMA .
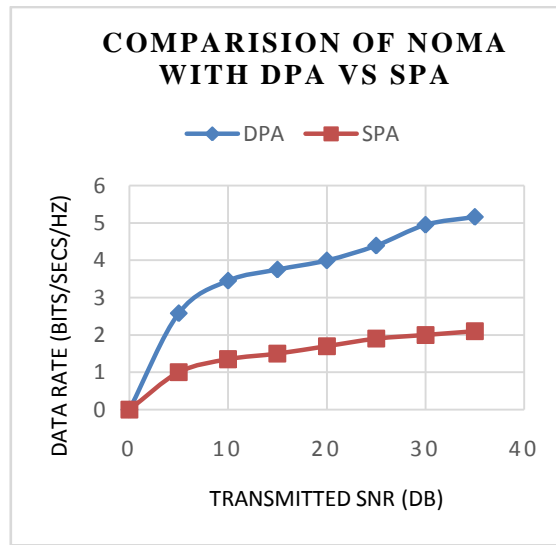

Fig. 15: ComparisionOf NOMA with DPA
vs SPA

This figure illustrates that NOMA has a average sum rate of over 5 bits/sec/Hz when power is allocated dynamically and NOMA has a average sum rate of just over 2 bits/sec/Hz when power is allocated statically .

Now that we know that DPA provides better edge to the performance of conventional NOMA, The results of MIMO-NOMA when DPA is used are shown below.

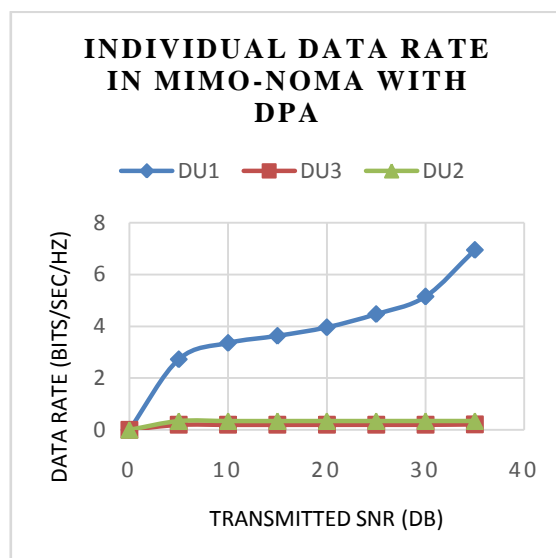6.5 : Data rates of Individual users in MIMO-NOMA using Dynamic Power Allocation

Fig. 16: individual data rate in MIMO-
NOMA with DPA

From the above figure it is obtained that , NOMA when integrated with MIMO technology and also when power allocated dynamically , gives way better results / performance when compared to conventional NOMA. The user1 who is nearer to base station has a average sum rate of 7bits/sec/Hz , where in case of conventional NOMA it's about 5bits/sec/Hz.

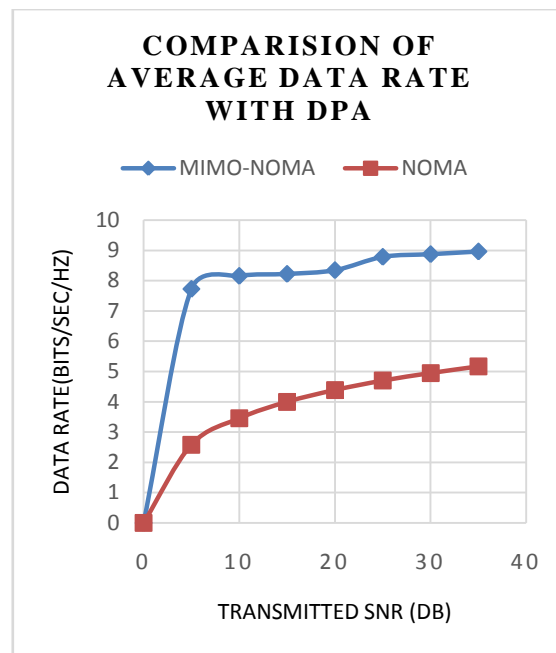6.6 performance of NOMA vs MIMO-NOMA when DPA is deployed.

Fig. 17:Comparision of average data rate
with DPA

The average data rate of conventional NOMA is 5bits/sec/Hz where as the average data rate of NOMA with MIMO is about 9bits/sec/Hz. MIMO-NOMA has a better performace than conventional NOMA.

Conclusion

CONCLUSION

In OMA, Orthogonal multiple access techniques are used, because of that it can strict to limited users and it cannot satisfy the number of subscribers day by day, and also it cannot satisfy the low latency, massive connectivity and spectral efficiency. To satisfy the number of increasing subscribers NOMA technique is introduced. The performance of NOMA is better than OMA in latency, spectral efficiency, and massive connectivity because it uses the same resource blocks for different user's data transmission. But Bit error rate and SNR are not upto themark.AMIMOsystemisincorporatedwiththeNOMAtechniquetoachievelessBERand good SNR. A DPA for NOMA with MIMO and user mobility is proposed in this paper . The effects of user mobility and pi on channel conditions are studied. Because channel conditions change, SPA may fail to meet the outage probability and SIC restrictions. The suggested DPA determines a set of power allocations that results in the highest total rate, taking into account the power budget to simulation results. The results of combining MIMO with traditional NOMA were equally impressive.

The Simulation results and performance of each technique areanalysed.

Future Scope

In this paper we have used Dynamic Power Allocation with a small sample size of 3 users, so in future this paper can be extended by taking more number of users can be considered.This can be further studied by taking positions of the users based on variable heights and distances.

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