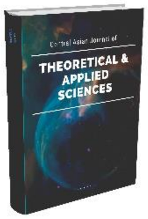

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Zero Forcing of Computer Based GSM Bandwidth Optimization

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Abstract: *The bandwidth optimization control protocol allows the mobile GSM system to send the information (request) and get the response using two different networks simultaneously. The communication could be provided to the mobile nodes not only by improving the transport layer channel capacity, but also by addressing the problems of the transmission channels and reducing their effects as well eliminating the interference in the Internet layer. This accomplished by using the control protocol technology (Zero Forcing) to improve the bandwidth, options and processes that ensure the correct delivery of request and response information. . In this paper, MBOCP Modified Bandwidth Optimization Control Protocol was introduced using hybrid zero forcing algorithm HZFA. The results of our simulation show that the mobile communication system gets higher and more accurate data rates and uses network resources efficiently compared to using a regular network.*

Keywords: *wireless networks, GSM, 4G, Bandwidth optimization control protocol, Digital Data.*

1. Introduction

There has been significant ongoing interest in remote Multiple-Input, Multiple-Output (MIMO) interchanges frameworks, because of their potential for emotional increases in channel limit. Until now, research has zeroed in on the single-client highlight point situation so that the sender as well beneficiary every has exhibits, also the existance of alternative co-channel clients isn't thought of. All the more as of late, consideration has moved to multi-client MIMO channels, where a few co-channel clients with exhibits endeavor to speak with one another or with some focal base station [1]-[7]. Examination here has zeroed in on two related enhancement issues that are specifically noteworthy: throughput boost (limit) and force control. To accomplish (aggregate) limit in a multi-client organization, one boosts the amount of the data rates for all clients subject to a total force limitation. Then again, the force control issue manages limiting the absolute sent force while accomplishing a pre-indicated least Quality-of-Service (QoS) level for every client in the organization. In one or the other case, an acceptable arrangement should adjust the longing for high throughput or great QoS at one hub in the organization with the subsequent expense in impedance created at different hubs.

Remote organizations, along with cell phones, have become key pieces of correspondence helping the appearance of various applications and administrations used in ventures and associations. The advantages of remote organizations are undeniable; accordingly, ceaseless turn of events and improvement of calculations and conventions are essential for effective administration of the organization limit and usefulness [1, 2]. Data transfer capacity accessibility is imperative for solid correspondence in remote organizations. Approaches and plans on transfer speed designation have been made in different remote correspondence organizations to accomplish the maximum capacity of the organization [2, 6]. Nonetheless, the developing quantities of cell phones and interactive media applications have established serious systems administration climate with the end goal that transmission capacity has become a scant asset [6]. Continuous clients (RTUs) produce more traffic having novel necessities, hence giving respectable Quality of Service (QoS) is a significant test in remote organizations [3].

This examination explores a Zero Forcing Algorithm (ZFA) method for extending a portion of the ideal data transfer capacity in remote organizations. ZFA is an excellent procedure and is one of the ways to improve the transmission channel capacity as it simulates the elimination method for its effects. The ZFA method provides an inverse function of transmitter channel equation, programming, representation and design of its operation. The benefit of this technology is to optimize a portion of the data traffic capacity, in this specific case, where the transmission capacity is allocated or assigned to clients in a remote organization. Transcription is used to determine the gallery check for QoS in relation to the accessible data transfer capacity and the amount of RTUs. With the call in transmission capacity, this check is a boost of effort to upgrade the transmission speed distribution that can be accessed in remote organizations [4].

Cell innovation advancement has been begun since 1950s, and the primary business frameworks came in the late 1970s. Where cell organizations can be arranged into various ages, specifically, First Generation, Second Age [GSM], Third Generation [3G] and Fourth Generation [4G]. In this paper we study the arranging stages to update the portable administrator organization, to assemble a third era in corresponding with the current sent second era organization. Numerous previous works have been directed with respect to the 3G radio organization arranging. For example [book3G], our examination is identified with the 3G arranging and execution for Nablus city, as one of the significant Palestinian urban areas. The arranging cycle have some primary credits and factors, for example, supporter profile gauging and the figuring of the administration traffic interest, notwithstanding the limit inclusion necessities. This paper winds up with a proposed for a pertinent 3G organization to be conveyed in the chose urban communities [5].

2. Literature Review

Headway in remote advancements has prompted the appearances of uses, conventions and situations that have contributed decidedly to the undertakings of human exercises [2]. Adaptable and solid correspondence networks are important to offer help to different parts of uses, administrations and transmissions. A portion of the new upgrades to help the effectiveness of correspondence and information conveyance across remote organizations incorporate sensor organizations, machine-to-machine correspondences, Internet of things, Millimeter-wave methods, different info numerous yield innovation, and a lot more [12]. The blended systems administration conditions are changing and more centered around client driven model which are dependent on Quality of Experience (QoE), that has been dictated by QoS gave by the organization [3].

The issues of transfer speed accessibility actually wait, along these lines numerous investigations are outfitting towards AI answers for oversee and designate parsimonious organization assets to give a worthy degree of QoS prerequisite for applications and administrations on correspondence networks [8]. In an offer to improve the assignment of this restricted data transmission, ordinary designation strategies are been selected Artificial Intelligence (AI)- based procedures to empower productive transfer speed distribution in correspondence organizations. Machine language-based calculations in [8] were proposed to give streamlining specialists to viable portion of assets to adjust intricacy, execution and to ease issue evacuation, which diminished issues with asset designation. In [9], Genetic calculation (GA) was utilized to improved organization execution and data transfer capacity designation during steering as it tackled issues identified with blunder rate and organization clog. In [4], differential development (DE), molecule swarm improvement (PSO) and GA methods were utilized to give ideal data transfer capacity distribution dependent on transfer speed reservation plan to give agreeable QoS in a remote organization however DE gave better outcomes. The exploration in [10] utilized PSO and gauss end in remote sensor organization (WSN) for dynamic transfer speed distribution to redress traffic imperatives and hubs' energy restriction. Changed WOA procedure in [11] was proposed for streamlining of hub inclusion in WSN, which brings about less cycle, higher inclusion, improved organization capacity to look for hubs and sped up. Flow examination into ideal data transmission assignment has excluded the WOA procedure.

The up and coming age of remote correspondence frameworks (e.g., 802.16m [1], LTE-Advanced [2]) consider multiuser MIMO (MU-MIMO) as one of the center advancements. An extensive exploration exertion has been devoted to the presentation assessment of MU-MIMO frameworks in sensible cell conditions [3]–[5]. In a solitary cell setting with ideal Channel State Information at the Transmitter (CSIT), the framework decreases to a vector Gaussian transmission channel whose limit area is totally portrayed [6]– [10]. In any case, in a multi-cell situation, we are within the sight of a vector Gaussian transmission and impedance channel, which isn't yet completely comprehended in a data hypothetical sense. A straightforward and functional methodology comprises of treating Inter-Cell Interference (ICI) as commotion. In this case, ICI may essentially restrict the framework limit. An assortment of between cell participation plans have been proposed to relieve ICI, going from a completely agreeable organization MIMO [11]–[14] to incompletely composed beamforming [15]–[17]. In this work, we center around the organization MIMO approach with restricted collaboration, where bunches of coordinating base stations (BSs) go about as a solitary conveyed MIMO transmitter also, impedance from different groups is treated as commotion. In a phone climate, the got signal force is a polynomially diminishing capacity of the distance among transmitter and recipient, with a unique reach regularly bigger than 30 dB [18]. Along these lines, clients near the cell (or bunch of composed cells) limit experience solid between cell obstruction, though the ideal sign is moderately powerless. These "edge" clients can't be simply disregarded by the framework. For instance, boosting the framework aggregate rate leads all in all to an uncalled for working point, where the framework assets are focused on clients close to the cell (or bunch) focus. Interestingly, decency booking has been proposed and generally concentrated to accomplish an attractive harmony between entirety rate and decency (see for instance [19]–[21] and references in that). Decency planning can be deliberately executed in the structure of stochastic organization enhancement [20]. Such decency planning calculations powerfully distribute the framework assets on an opening by-space premise, with the end goal that the long haul normal (or "ergodic") client rate point boosts some reasonable inward and component wise expanding network utility capacity [22]. While the insightful portrayal of the ideal ergodic rate point for a given organization utility capacity might be pitifully muddled in a reasonable situation, the framework execution has been assessed so far through computationally extremely serious Monte Carlo reenactment [3]–[5], [13], [14], [23]–[26], where the real planning calculation advances as expected and the ergodic rates are figured as time midpoints.

For the unique situation where the base station has a cluster however all clients utilize single radio wires, elective arrangements have been suggested in [19, 20, 21, 22]. The more broad issue discussed in this research, where every client could have various radio wires, has been drawn closer in two distinct manners. The first [23] utilizes an repetitive strategy for counterbalancing between client impedance, permitting numerous information sub-diverts per client as in traditional MIMO transmission strategies. The next method [24] sums up the single-reception apparatus calculations to incorporate beam-forming at the recipient, while as yet utilizing just a single information sub-channel per client. The repetitive idea of these calculations regularly brings about a high computational expense.

In [10], three diverse non-iterative calculations for picking downlink communicate vectors have been presented in that issue in which the clients in the organization have different reception apparatuses. The main, Block Diagonalization, can be considered as a speculation of channel reversal for circumstances with numerous reception apparatuses per client. The square diagonalization calculation may be employed for any of the outcome expansion or force control issues, however is limited to channels where the sum of communicate radio wires (nT) is no more modest than the absolute sum of get receiving wires in the organization (nR). The subsequent strategy is a Successive Optimization calculation that tends to the force control issue each client in turn. It can outflank block-diagonalization at low SNR, yet it has similar restriction on channel measurements. At long last, we suggest a strategy for combined Transceiver handling, which loosens up the nT ¸ nR necessity by consolidating both of the past calculations along with the technique for [24]. This crossover approach obliges up to nT clients, paying little mind to their exhibit sizes. The essential bit of leeway of this and different strategies proposed in the paper are that they give effective, shut structure arrangements that yield a sensible compromise among execution and computational intricacy.

3. Methodology

The MIMO channel consisting of nT transmitters and nR recipients which is commonly displayed by a nR ×nT framework H. So, the resulting signal x will be:

$$x = H_s + n \quad (1)$$

where s is the sign vector, and n speaks to added substance commotion. In the level blurring case, every component of H is seen as the transmission coefficient connecting one of the send radio wires with one of the get reception apparatuses. In any case, this model can additionally be effectively stretched out to incorporate recurrence specific blurring by composing the general channel grid as a square framework whose segment blocks execute a convolution along the period-space drive reaction for a specific radio wire pair [12]. Along these lines, any enhancement calculation for a level blurring channel can without much of a stretch be reached out to incorporate recurrence particular channels. For straightforwardness, level blurring will be expected to be here. We center around MIMO transmission frameworks that incorporate straight pre-and post-handling implemented at the sender with beneficiary [25]:

$$\hat{d} = D(HMd + n) \quad (2)$$

where d is an information vector of irregular reach m, too the genuine sent waveform s = Md is created using a nT ×m balance network which comprises of each channel pre-coding executed at the transmitter. The obtained wave x has changed into a gauge of the underlying communicated data d by a m × nR demodulation network D. Respect a multi-client downlink channel with K clients with a solitary base station. The base has nT radio wires, and the jth beneficiary has nRj reception apparatuses. The general record of each reception apparatus at beneficiaries has characterized to be nR =Pn.Rj. Thus, We will use the documentation {nR1, . . . , nRK} × nT to demonstrate such a channel (instead of composing nR × nT as in a highlight point MIMO channel). For instance, a {2, 2} × 4 channel has a 4-recieving wire base with two 2-radio wire clients. The channel lattice from the base to the jth client is signified by Hj , and the related regulation grid byMj . The sign at the jth collector is in this way:

$$\mathbf{x}_j = \sum_{i=1}^{K} \mathbf{H}_j \mathbf{M}_i \mathbf{d}_i + \mathbf{n}_j \quad (3)$$

$$= \mathbf{H}_j \mathbf{M}_j \mathbf{d}_j + \mathbf{H}_j \tilde{\mathbf{M}}_j \tilde{\mathbf{d}}_j + \mathbf{n}_j \,, \quad (4)$$

where ˜M*j* and ˜d*j* are commonly determined as the modulation matrix as well send vector for all customer other than user *j* mixed:

$$\tilde{\mathrm{M}}_j = \begin{bmatrix} \mathrm{M}_1 & \dots & \mathrm{M}_{j-1} & \mathrm{M}_{j+1} & \dots & \mathrm{M}_K \end{bmatrix} \quad (5)$$

$$\tilde{\mathrm{d}}_j^T = \begin{bmatrix} \mathrm{d}_1^T & \dots & \mathrm{d}_{j-1}^T & \mathrm{d}_{j+1}^T & \dots & \mathrm{d}_K^T \end{bmatrix}. \quad (6)$$

The large limit ability of unique-client channels may be acknowledged by sending different data sub-diverts in equal. The ideal technique of applying such thing depends beginning with any data are existing to the transmitting end for the channel. If H is obscure, the ergodic limit can be accomplished for Gaussian channels by choosing M = α I [13]. The distinction in execution among these two methodologies has been demonstrated to be little at high SNR [26]. At less SNR, the water-filling arrangement yields a few improvement in execution, yet this should be adjusted against the expense of acquiring information on the channel at the transmitter. Then again, in a MIMO channel where a solitary base station is at the same time communicating to various free recipients and creating co-channel impedance, the circumstance turns out to be impressively unique. For similar issues, channel data at the transmitting end gives a significant preferred position, especially at high SNR, since it very well may be utilized for obstruction alleviation. The channel adjustment and demodulation frameworks can be seen as endeavoring to diagonalize the item DHM. Despite the fact that the ideal arrangement isn't really askew, it will commonly be close inclining by and large. The BLAST approach [14], which doesn't utilize any channel pre-coding, basically departs the assignment of diagonalization to the recipient. Then again, the water-filling arrangement separates the channel into its predominant subspaces, with the goal that ideal force stacking into the sub-channels may be obtained. Wonderful diagonalization is an option exclusively for nT ¸ K, as well as may be accomplished utilizing channel reversal; e.g., by picking that:

$$M = H_p, \quad (7)$$

where H_p is the pseudo-opposite of H [15, 27]. Then again, when every one of the K clients has different receiving wires, total diagonalization of the channel at the transmitter is problematic, since every client can arrange the handling of its own beneficiary yields. On the off chance that we characterize the organization channel and regulation networks H_s and M_s as:

$$\mathrm{H}_S = \begin{bmatrix} \mathrm{H}_1^T & \mathrm{H}_2^T & \dots & \mathrm{H}_K^T \end{bmatrix}^T$$

$$\mathrm{M}_S = \begin{bmatrix} \mathrm{M}_1 & \mathrm{M}_2 & \dots & \mathrm{M}_K \end{bmatrix}, \quad (8)$$

The ideal arrangement under the limitation that all between client obstruction be zero is one where $H_s M_s$ is block-slanting. Like channel reversal, a square inclining arrangement forces two conditions, one on the measurements and one on the autonomy of the component Hj lattices, in spite of the fact that it will be appeared in the following segment that the conditions are to some degree less exacting for a block-inclining arrangement. Be that as it may, there is as yet a constraint on the number of clients can be accommodated all the while. These conditions are not as prohibitive as they show up when seen with regards to a framework that utilizes SDMA related to other different access techniques (TDMA, FDMA, and so forth) Think about a base station with few radio wires and an enormous gathering of clients, where a SDMA-just arrangement is unreasonable. A more sensible execution would isolate the clients into subgroups (coordinated so the measurement prerequisites are fulfilled inside each gathering) whose individuals are multiplexed spatially, whereas, the subclasses by their own have allocated diverse period either recurrence spaces. The direct autonomy constraint may be met by brilliantly gathering the clients to try not to put two clients with profoundly associated directs in the equivalent subgroup.

Actually, there are many zero forcing algorithm types utilized for multichannel bandwidth optimization technique [10]. Two of the most utilized active algorithms known as the Block Diagonalization (BD) and the Successive Optimization (SO) Algorithms [10]. In fact, the choice of one of these two methods depends on several factors, the most important of which is the number of users and the number of overlapping channels. Knowledge of the type of transmission channel and prior knowledge of its nature are also considered an "important" and "important" role in choosing the appropriate algorithm for the system.

In this paper, a developed algorithm was nominated that combines the work of these two methods and works to combine the benefits obtained from them and exclude the limiting parameters of each of the two methods to obtain the best performance and to improve the efficiency of the transmission channel capacity of the used system. This algorithm is named the Hybrid Zero Effect Algorithm (HZF).

3.1 Hybrid Zero Forcing Algorithm

This technique, actually, is similar to the BD method, which accomplished by ignoring all multi-customer conflict, by forcing the conditions where H_j M_j = 0 for i ≠ j. Using an addition of energy restraint, the obtainable productivity for the concluding block-diagonal structure is:

$$\begin{aligned} C_{BD} &= \max_{\mathbf{M}_S,\, \mathbf{H}_i\mathbf{M}_j=\mathbf{0},\, i\neq j} \log_2 \left|\mathbf{I} + 1/\sigma_n^2 \mathbf{H}_S \mathbf{M}_S \mathbf{M}_S^* \mathbf{H}_S^*\right| \\ &= \max_{\mathbf{H}_i\mathbf{M}_j=\mathbf{0},\, i\neq j} \sum_{j=1}^{K} \log_2 \left|\mathbf{I} + 1/\sigma_n^2 \mathbf{H}_j \mathbf{M}_j \mathbf{M}_j^* \mathbf{H}_j^*\right| \leq C_S\,, \end{aligned} \tag{9}$$

where CS denotes the addition of the capacity of the scheme also * denotes the Hermitian transpose. If we express ˜Hj as:

$$\tilde{\mathbf{H}}_j = \left[\mathbf{H}_1^T \quad \ldots \quad \mathbf{H}_{j-1}^T \quad \mathbf{H}_{j+1}^T \quad \ldots \quad \mathbf{H}_K^T\right]^T , \tag{10}$$

the zero-impedance imperative strength Mj to place in the invalid field of ˜Hj. Such explination permits us to characterize the measurement constraint important to ensure that everything clients may be contained below the zero-impedance imperative. Information can be communicated to client j if the invalid domain of ˜Hj has a measurement more prominent than 0. This is fulfilled when rank(˜Hj) < nT . Expecting to be the measurement condition is fulfilled for all clients, let ˜Lj = rank(˜Hj) · nR − nRj , and characterize the SVD:

$$\tilde{\mathbf{H}}_j = \tilde{\mathbf{U}}_j \tilde{\mathbf{\Sigma}}_j \begin{bmatrix} \tilde{\mathbf{V}}_j^{(1)} & \tilde{\mathbf{V}}_j^{(0)} \end{bmatrix}^* , \quad (11)$$

where ˜V(1) j holds the primary ˜Lj right particular vectors, and ˜V(0) j the last (nT − ˜Lj) right solitary vectors. Consequently, ˜V(0) j structures a symmetrical reason for the invalid space of ˜Hj , and its segments are in this manner contender for the adjustment matrixMj of client j. Let ¯Lj speak to the position of the item Hj˜V (0) j . With the end goal for transmission to client j to occur under the zero interference limitation, ¯Lj ¸ 1 is vital. Hence, ¯Lj is limited by Lj + ˜Lj − nT · ¯Lj · min{Lj ,˜Lj} [28]. A adequate constraint for ¯Lj ¸ 1 is that in any event one column of Hj is straightly free of the lines of ˜Hj . To fulfill this constraint, we must consider to evade spatially multiplexing clients with exceptionally associated channel frameworks. Note that both the measurement and autonomy situations permit specific issues which cannot be dealt with by channel reversal. The channel reversal technique would necessitate that all lines of Hj be directly autonomous of ˜Hj . While this isn't vital for block diagonalization, it would even now be useful, bringing about a higher estimation of $\bar{L}_{j,1}$ and in this manner more noteworthy levels of opportunity for the last arrangement. Expecting that the autonomy condition is fulfilled for all clients, we currently characterize the network:

$$\mathbf{H}'_S = \begin{bmatrix} \mathbf{H}_1 \tilde{\mathbf{V}}_1^{(0)} & & \mathbf{0} \\ & \ddots & \\ \mathbf{0} & & \mathbf{H}_K \tilde{\mathbf{V}}_K^{(0)} \end{bmatrix} \quad (12)$$

Thus, the scheme capacity subjected to the zero-interference restraint may instantly has expressed as:

$$C_{BD} = \max_{\mathbf{M}'_S} \log_2 |\mathbf{I} + 1/\sigma_n^2 \mathbf{H}'_S \mathbf{M}'_S \mathbf{M}'^*_S \mathbf{H}'^*_S| \quad (13)$$

The issue is presently to discover a matrix M_S' that amplifies the determinant. This is currently equal to the single-client MIMO limit issue, and the arrangement is to let M'_S be the correct particular vectors of H_S', weighted by water-filling on the relating solitary qualities [12]. In this manner, an answer for M_S' dependent on a SVD and water-filling is the arrangement that amplifies whole limit with regards to the framework under the zero-impedance imperative. The square structure of H_S' permits the SVD to be resolved independently for every client, instead of registering a solitary enormous SVD. Characterize the SVD:

$$\mathbf{H}_j \tilde{\mathbf{V}}_j^{(0)} = \mathbf{U}_j \begin{bmatrix} \mathbf{\Sigma}_j & \mathbf{0} \\ \mathbf{0} & \mathbf{0} \end{bmatrix} \begin{bmatrix} \mathbf{V}_j^{(1)} & \mathbf{V}_j^{(0)} \end{bmatrix}^* , \quad (14)$$

where Σj is ¯Lj × ¯Lj , and V(1) j speaks to the primary ¯Lj particular vectors. The result of ˜V (0) j and V(1) j presently delivers an symmetrical premise of measurement ¯Lj , and speaks to the transportation vectors that boost the data rate for client j substance to creating zero obstruction. Accordingly, we characterize the balance grid as:

$$\mathbf{M}_S = \left[\tilde{\mathbf{V}}_1^{(0)}\mathbf{V}_1^{(1)} \quad \tilde{\mathbf{V}}_2^{(0)}\mathbf{V}_2^{(1)} \quad \ldots \quad \tilde{\mathbf{V}}_K^{(0)}\mathbf{V}_K^{(1)}\right]\mathbf{\Lambda}^{1/2}, \qquad (15)$$

where ʌ is a diagonal matrix with items¸ λ_i mount the energy sent into every of the columns of M_S. With M_S selected as in (15), the capacity of the BD technique in (9) will be:

$$C_{BD} = \max_{\mathbf{\Lambda}} \log_2 \left|\mathbf{I} + \mathbf{\Sigma}^2\mathbf{\Lambda}/\sigma_n^2\right|,$$

$$\mathbf{\Sigma} = \begin{bmatrix} \mathbf{\Sigma}_1 & & \\ & \ddots & \\ & & \mathbf{\Sigma}_K \end{bmatrix}. \qquad (16)$$

The ideal force stacking parameters in ʌ are then discovered utilizing "water filling" on the slanting components of Σ, expecting to be an absolute force limitation *P*. A synopsis of the BD calculation is given underneath.

Overall Capacity using Block Diagonalization

1. For $j = 1, \cdots, K$:

(i) Compute $\tilde{V}^{(0)}_j$, the right null space of $\tilde{H}_j$.

(ii) Calculate the SVD:

$$\mathbf{H}_j\tilde{\mathbf{V}}_j^{(0)} = \mathbf{U}_j \begin{bmatrix} \mathbf{\Sigma}_j & \mathbf{0} \\ \mathbf{0} & \mathbf{0} \end{bmatrix} \begin{bmatrix} \mathbf{V}_j^{(1)} & \mathbf{V}_j^{(0)} \end{bmatrix}^* . \qquad (17)$$

2. Utilize "water filling" along the diagonal items of Σ to complete the best energy charging matrix ʌ within energy restraint *P*.

3. Setting M_S to be as follows:

$$\mathbf{M}_S = \left[\tilde{\mathbf{V}}_1^{(0)}\mathbf{V}_1^{(1)} \quad \tilde{\mathbf{V}}_2^{(0)}\mathbf{V}_2^{(1)} \quad \ldots \quad \tilde{\mathbf{V}}_K^{(0)}\mathbf{V}_K^{(1)}\right]\mathbf{\Lambda}^{1/2}. \qquad (18)$$

Now, and by considering the SO method that utilizing The values of $\Lambda_{H,j}$, the noise energy, as well the overall energy restraint to evaluate the energy charging harmonics $\Lambda_{Z,j}$ utilizing the "water-filling" result, also the modulation matrix for customer *j* then will be [10]:

$$\mathbf{M}_j = \tilde{\mathbf{V}}_j^{(0)} \mathbf{W}_j \mathbf{\Lambda}_{Z,j}^{1/2}, \quad (19)$$

In which the "water-filling" parameters in $\Lambda_{Z,j}$ have selected so that the rate need R_j is contented, and $\mathbf{W_j}^* = H_j \tilde{} V^{(0)}$. The overall sent energy specified to every customer will be the addition of the items of all $\Lambda_{Z,j}$.

Finally, the hybrid Zero Forcing algorithm (HZF) will be derived by substituting (19) into (9) and thus the capacity will be in the form of:

$$C_{HZF} = \max_{\mathbf{M}'_S} \log_2 |\mathbf{I} + 1/\sigma_n^2 \mathbf{H}'_S \mathbf{M}'_S \mathbf{M}'^*_S \mathbf{H}'^*_S| \quad (21)$$

3.2 Coordinated Transmit-Receive Processing

The BD thus calculations examined hitherto depend relying on the prerequisite that nT ¸ nR. By and large, the transmission end can send n_T impedance free information streams, paying little heed to the quantity of clients. In this segment, we suggest a system for expanding the pertinence of the BD thus calculations to up to n_T clients, paying little heed to the clients' exhibit sizes, by planning the preparing between the transmitters and collectors. Our methodology depends on crafted by [24] for the force control issue. In [24], it was expected that all clients utilize MMSE beneficiaries. Whenever the transmitting unit definitely have information of the channels what's more, the signs to be communicated, it can anticipate what the MMSE parameters for every collector will be. One information sub-channel is communicated to every client (hence permitting n_T clients), an underlying arrangement of beneficiary vectors are expected, and the ideal sender and collector vectors are on the other hand recalculated up to the arrangement merges to one with least force. There is an approach to evade the evaluation expense of an iterative methodology, also to take into consideration more than one information stream for every client (of such non repetitive plan has still been suggested). To do this, we suggest a quick elective technique that utilizes a sensible introductory recipient gauge followed by use of either the BD or SO calculations. Notwithstanding lessening calculation, this permits a block-wise advancement of the communicate vectors for situations where various information sub-channels may be utilized.

Make m_j become the value for spatial dimensions utilized to send to customer j, as well to make W_j become an $m_j \times nR_j$ matrix having the m_j beam-formers customer j that will apply in incoming info from the base. Another definition of modern "block matrix" H_S:

$$\overline{\mathbf{H}}_S = \begin{bmatrix} \overline{\mathbf{H}}_1 \\ \vdots \\ \overline{\mathbf{H}}_K \end{bmatrix} = \begin{bmatrix} \mathbf{W}_1^* \mathbf{H}_1 \\ \vdots \\ \mathbf{W}_K^* \mathbf{H}_K \end{bmatrix}. \quad (20)$$

The matrix H_S has measurements viable along any of the BD or SO calculations when $\Sigma\ m_j \leq n_T$. Utilizing $H\tilde{}_S$ set up of H_S in either calculation permits some between client impedance to be communicated, yet this obstruction is killed at the yield of the collector beam-formers since it is controlled into the nulls of the W_j beam-patterns. The difficult at that point be any of picking m_j and the beam-formers W_j for every client. The quantity of sub-channels mj dispensed to every client should clearly be 1 when $K = n_T$, expecting that all clients are to be obliged. The inquiry is to some degree more troublesome when $K < n_T$. In such a case, the extra levels of opportunity accessible to the transmitting unit may either be utilized to at present send just a single information stream to every client, except with an expanded pick up, or to allot extra sub-channels to a few or all clients. On the off chance that nT isn't adequate to allot an auxiliary sub-channel to all clients, the subject for whose customer(s) must have obtained extra sub-channels will probably rely upon the enhancement to be employed. In the event that framework throughput is the essential concern, the ideal arrangement may almost certainly be to give additional channels to more grounded clients. In the event that force control is the objective, it very well might be more useful to give the clients with more fragile channels the extra sub-channels. Space doesn't allow an itemized conversation of the asset assignment issue here, however this is a subject of huge current interest. At the point when the estimations of m_j have been resolved, it is then important to decide the W_j lattices. The methodology in [24] is to expect an underlying set of W_j frameworks, and afterward iteratively register MS and W_j given the realized beneficiary structure. To maintain a strategic distance from the computational cost of an iterative arrangement, we propose the utilization of a keen beginning an incentive for the set of W_j lattices, trailed by calculation of the BD answer for the subsequent HS. As appeared in the reenactments, such technique may bring about a close ideal arrangement. A conspicuous possibility for W_j , as well the approach we suggest underneath, is to utilize the mj prevailing left solitary vectors of H_j. A blueprint of how planned communicate get preparing can be utilized in combination with block-diagonalization is given in the accompanying calculation portrayal: Composed T_x-R_x Block-Diagonalization Algorithm:

1. For $j = 1, \cdots, K$:

Calculate the SVD $Hj = Uj\, \Sigma j . V^*_j$.

2. Obtain m_j , the value of sub-channels for every customer.

3. For $j = 1, \cdots, K$:

(i) Let W_j be the first m_j columns of U_j .

(ii) Compute $H_j = W^*_j \,.\, H_j$.

4. Implement the square diagonalization calculation utilizing $H^{\sim}_S$ instead of H_S.

Noting that whenever the shaft formers W_j speak to just a theory by the transmitter at the ideal recipient structure, they don't really relate to what the collector will really utilize. The ideal beneficiary will be the result of the first mj segments of U_j from the BD calculation and W_j . This planned preparing can be utilized related to the SO calculation also, by utilizing SO in the spot of the BD calculation in sync 4. We mention the accompanying objective facts. To start with, for channels with $m_j > 1$, the ideal collector is no longer W_j , except for a blend of W_j and the left particular vectors from the second SVD in the BD calculation. Likewise, when $mj = 1$ for all clients, the square diagonalization disentangles to a weighted pseudo-backwards of HS. The planned Tx-Rx calculations streamline to the standard BD thus calculations, when measurements grant, by instating them with $W_j = I$. In the reproduction results that follow, we utilize composed preparing with block diagonalization to analyze the exhibition of a $\{4, 4\} \times 4$ channel for various quantities of sub-channels per client.

4. Simulation Results

The project has been designed and simulated using MatLab17b Simulink Tool-Box as shown in Figure (1).

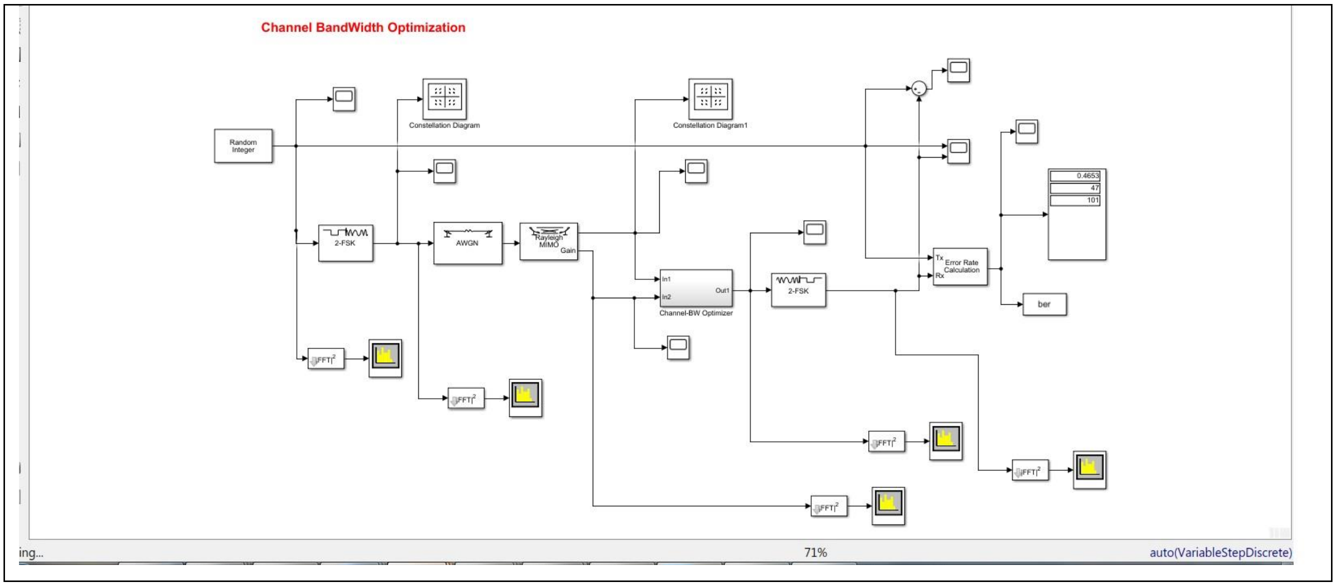

Figure1. GSM Channel Bandwidth Optimization System diagram.

In this simulation system, the following design details have been utilized :

1) Digital data source.
2) FSK digital modulation technique.
3) Rayleigh communication channel.
4) Zero Forcing Simulation Model.

The simulation model has been designed, tested, and implemented without the existence of the ZFA and with its existence under the design specifications under the existence of AWGN and for various values of SNR. The results of the Bit Error Rate BER, and the channel bandwidth capacity has been successfully extracted as well illustrated in the following figures.

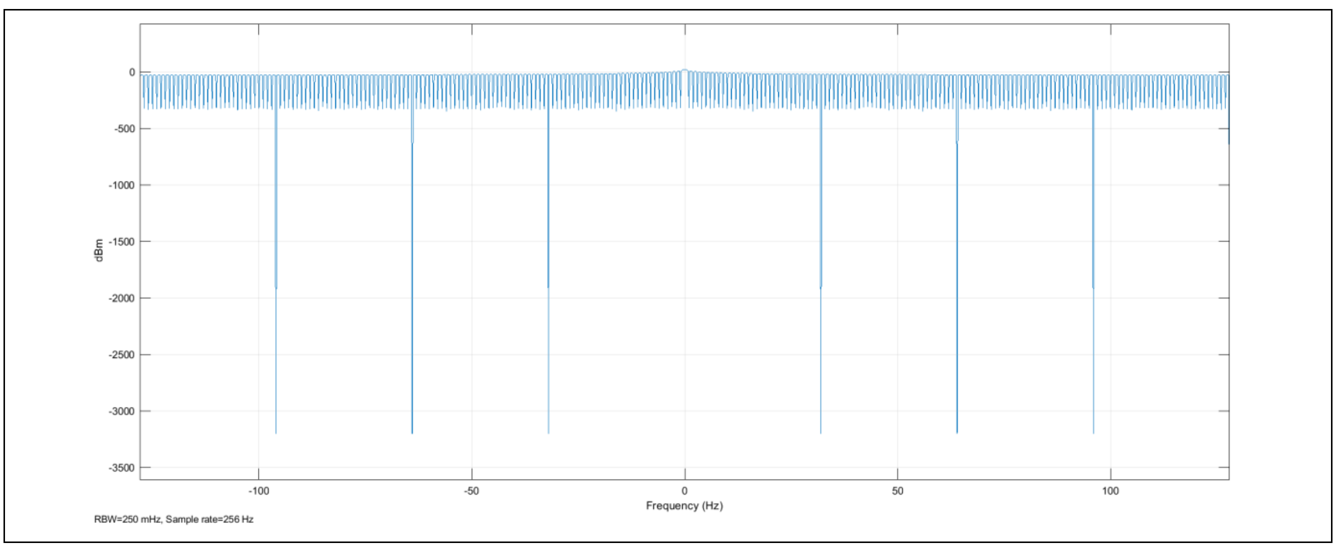

Figure 2. Input Signal Spectrum.

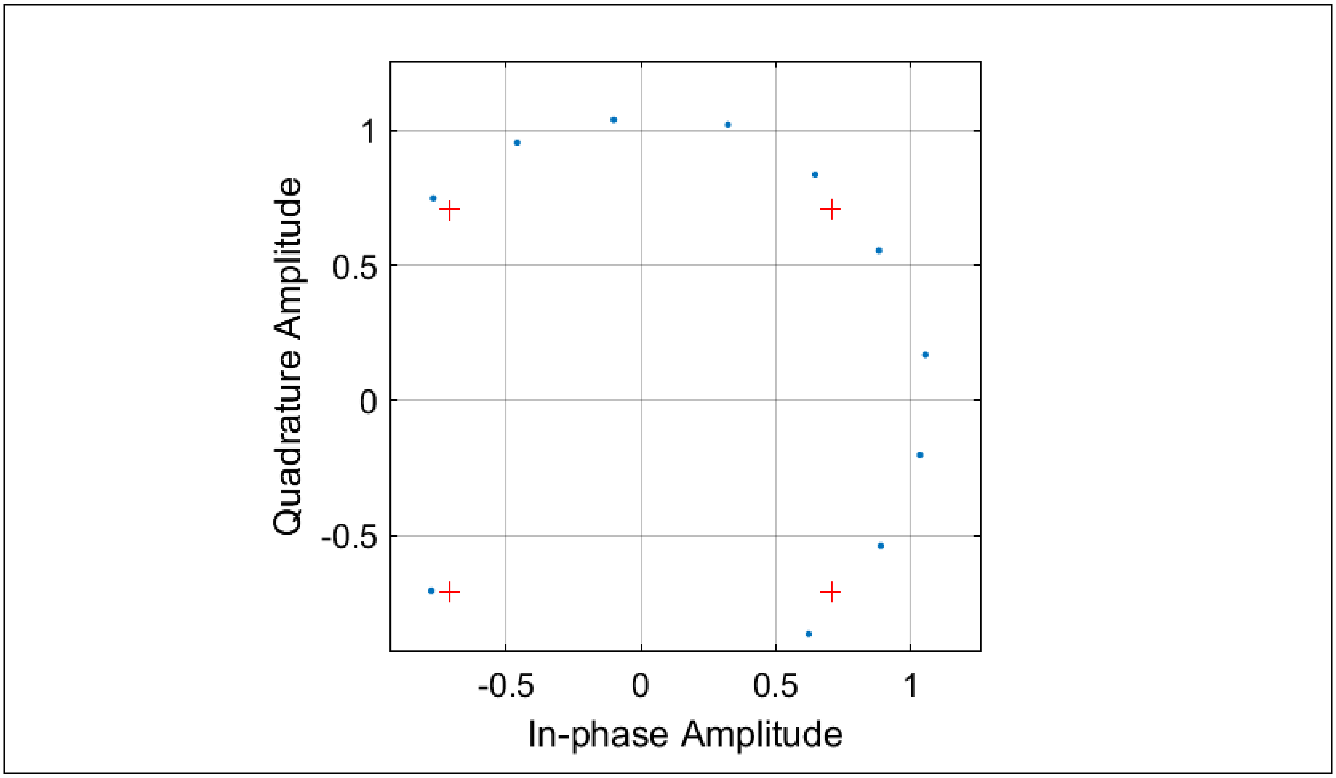

Figure 3. 2 FSK Modulator Polar diagram.

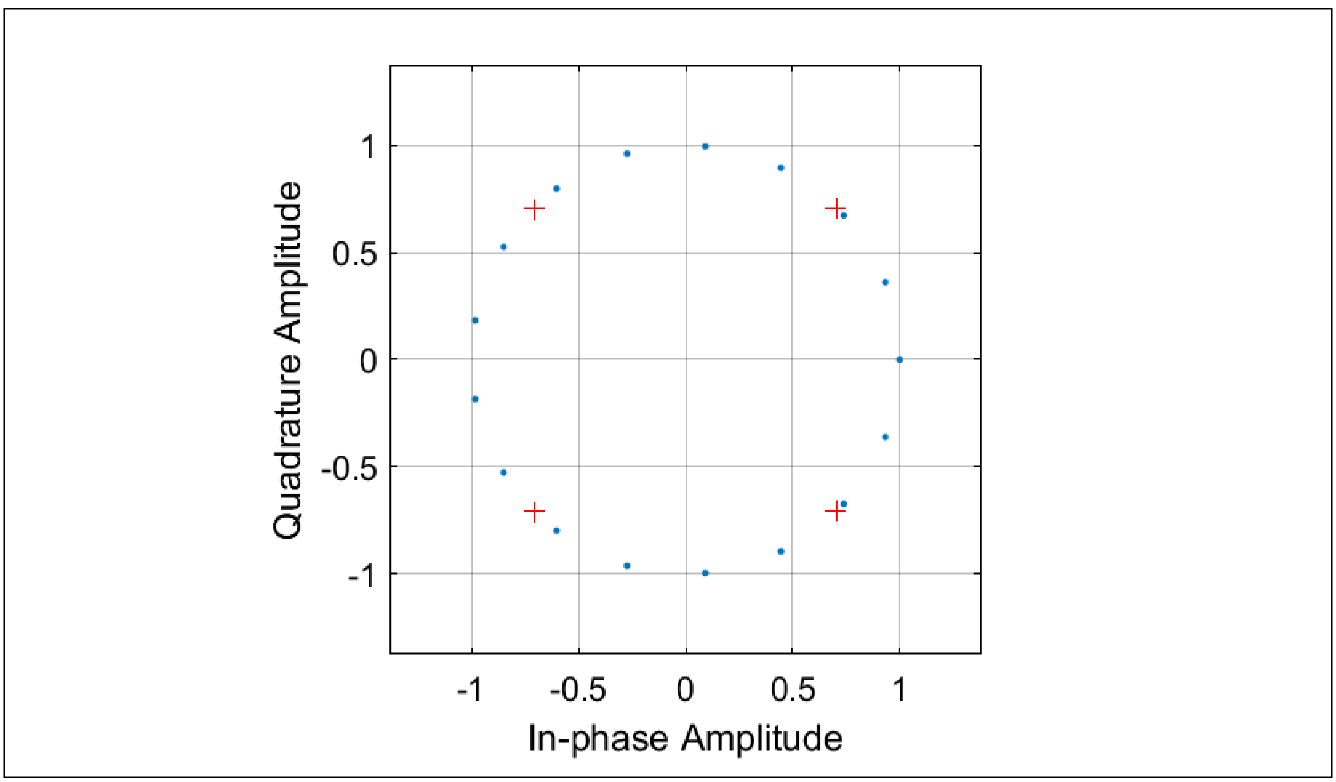

Figure 4. 2 FSK Demodulator Polar diagram.

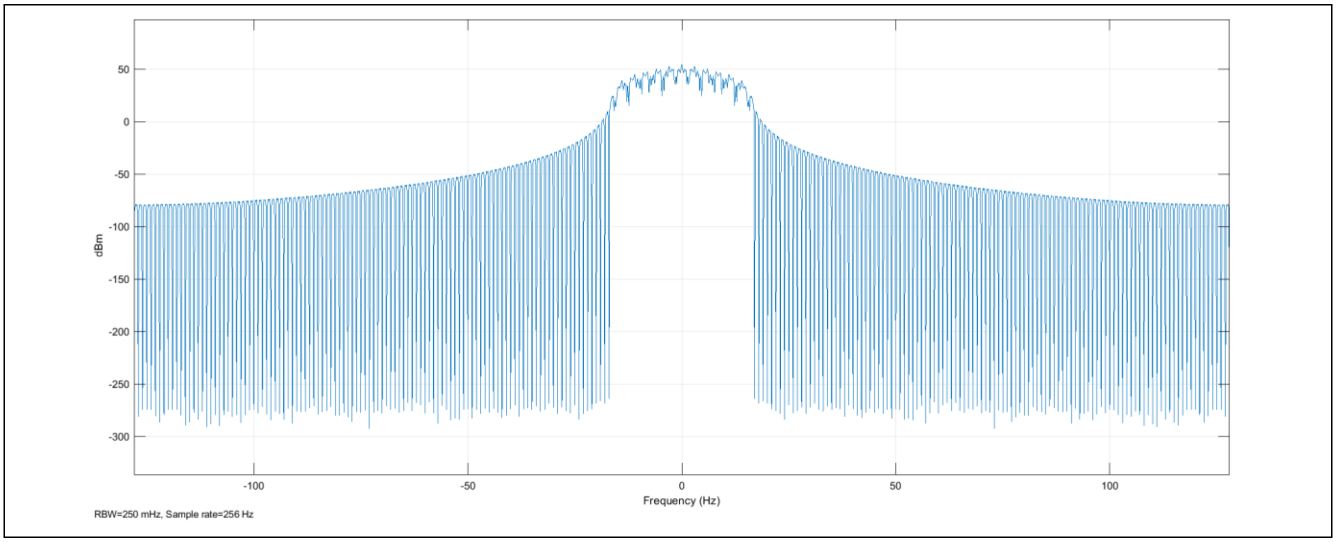

Figure 5. 2 FSK Modulator Signal Spectrum.

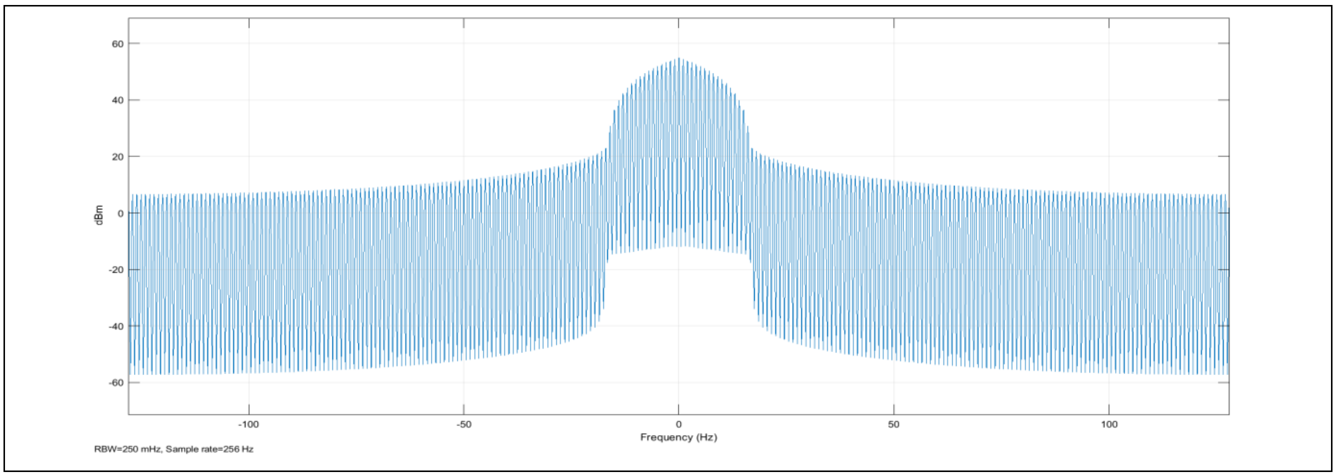

Figure 6. AWGN Channel Modulated Signal Spectrum.

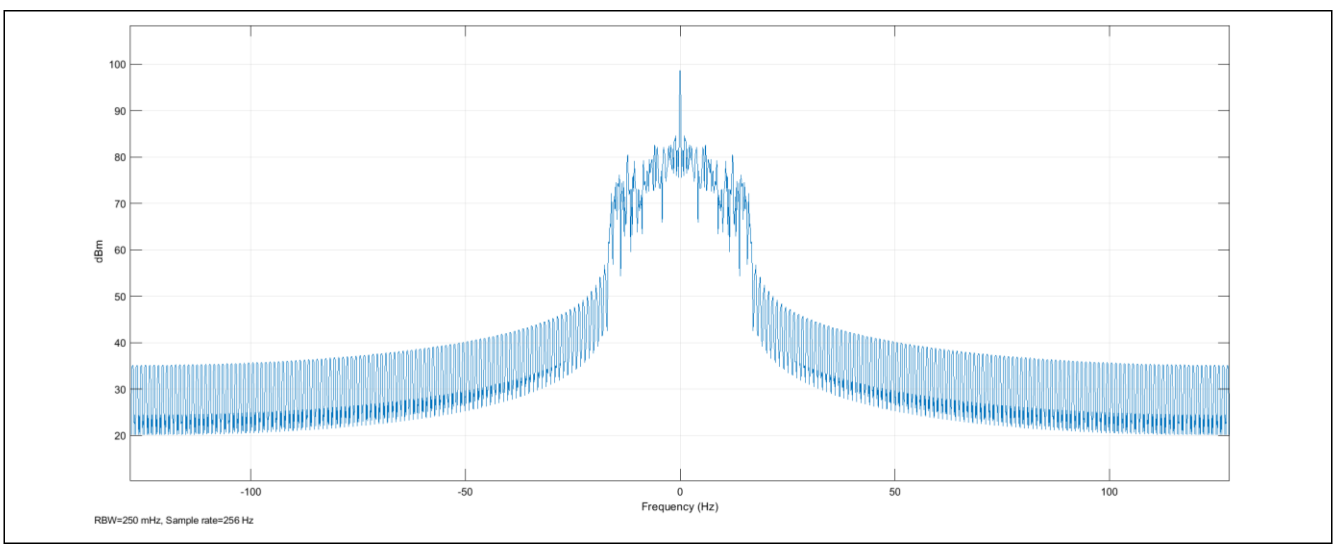

Figure 7. Modulated Signal Spectrum after HZFA.

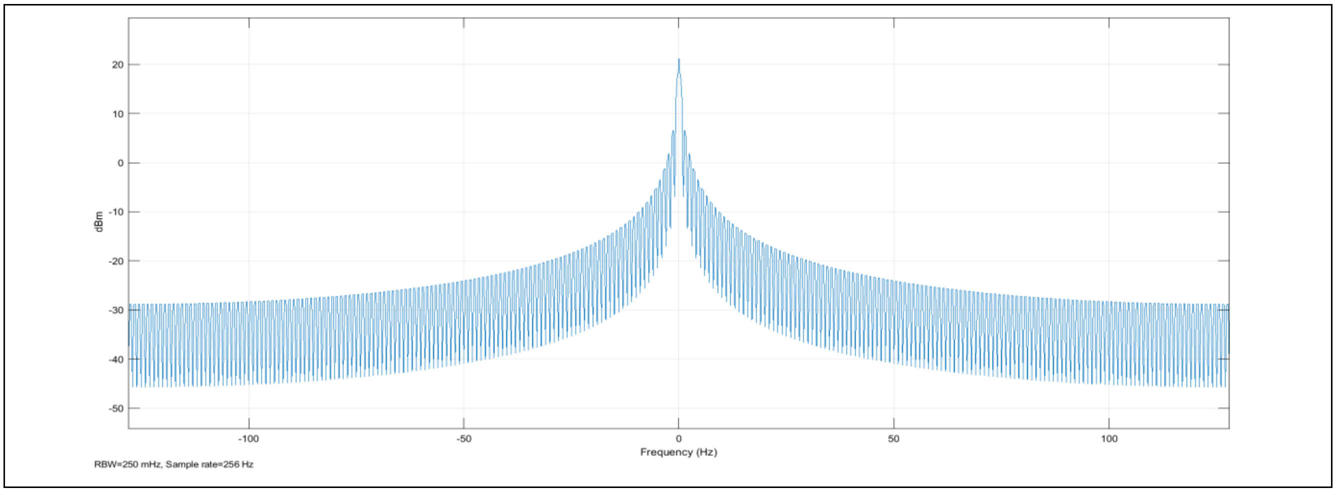

Figure 8. Demodulated Signal Spectrum using HZFA.

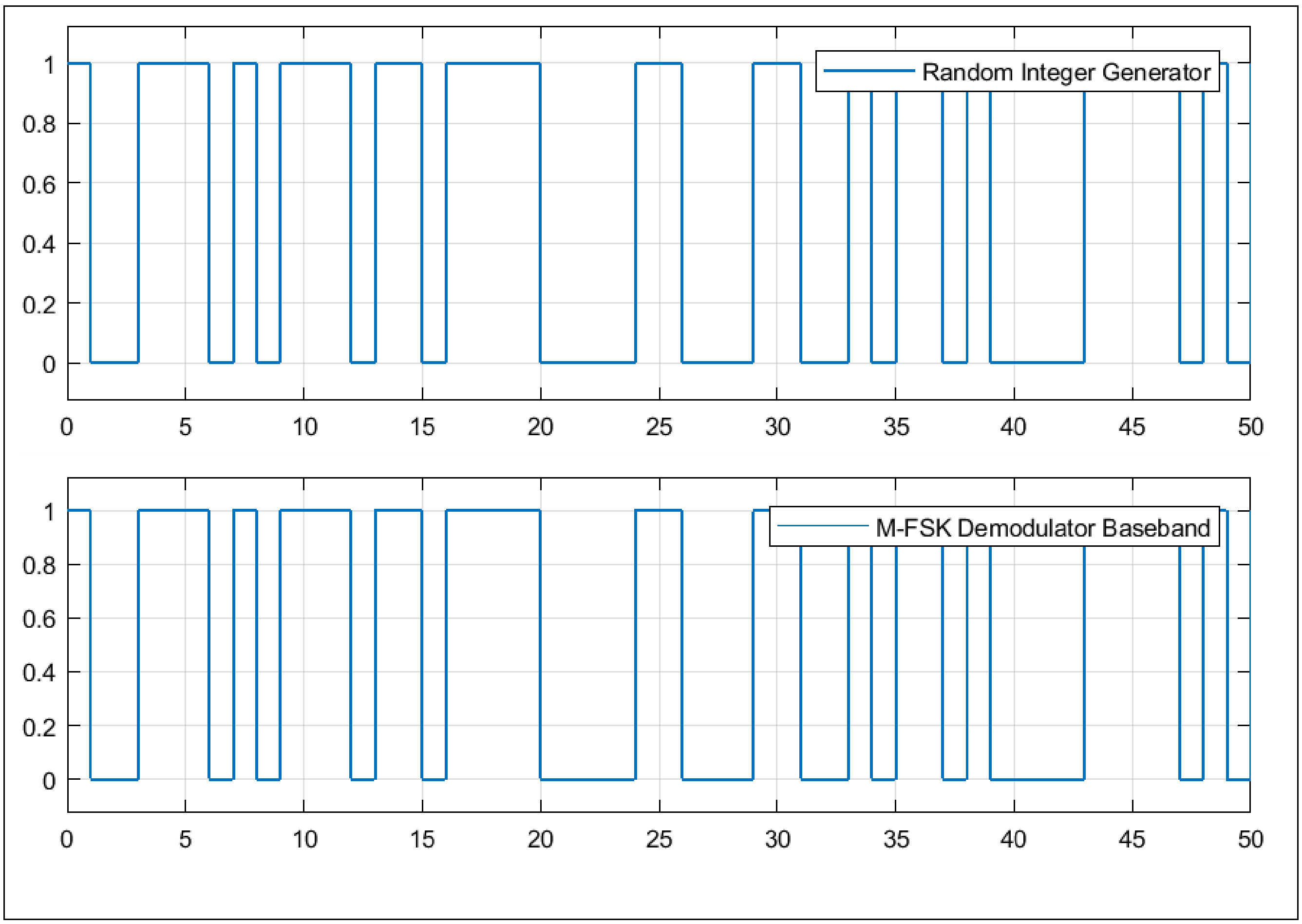

Figure 9. Data Signal at the transmitter & at the receiver using HZFA.

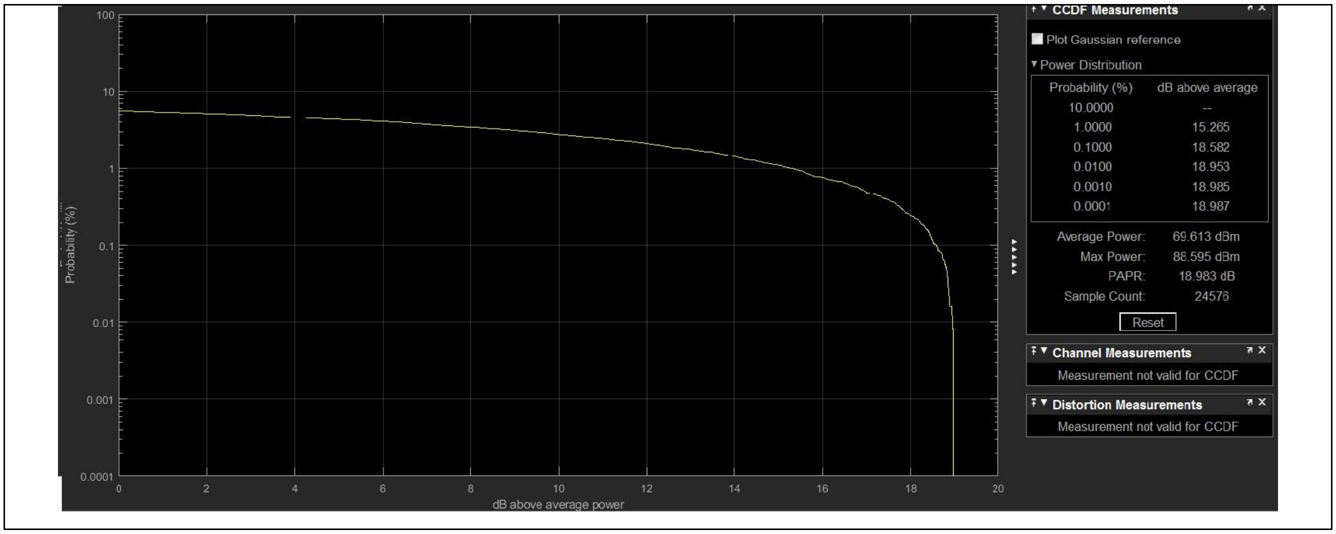

Figure 10. 2FSK Signal BER diagram at the Modulator output.

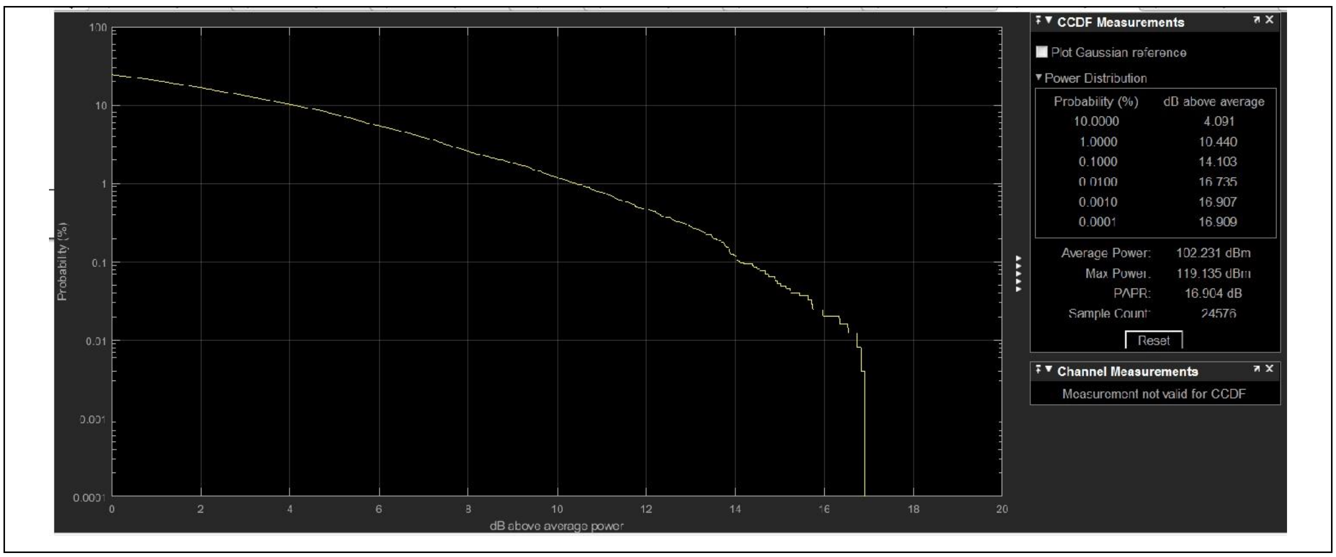

Figure 11. 2FSK Signal BER diagram at the HZFA output.

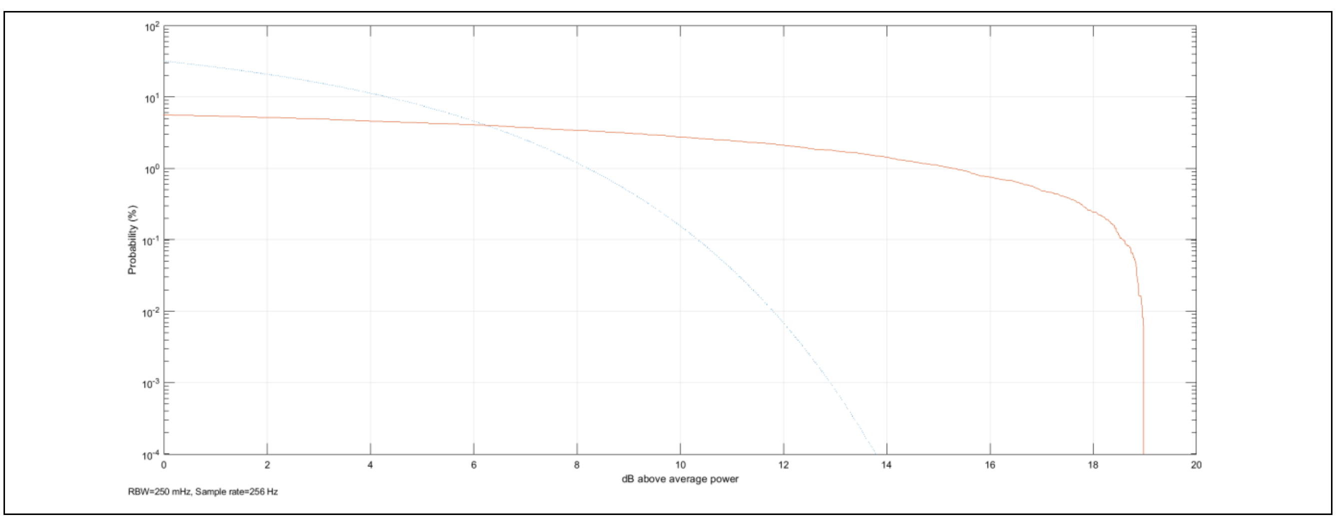

Figure 12. Error Probability of the 2FSK Signal at the 2FSK Modulator output.

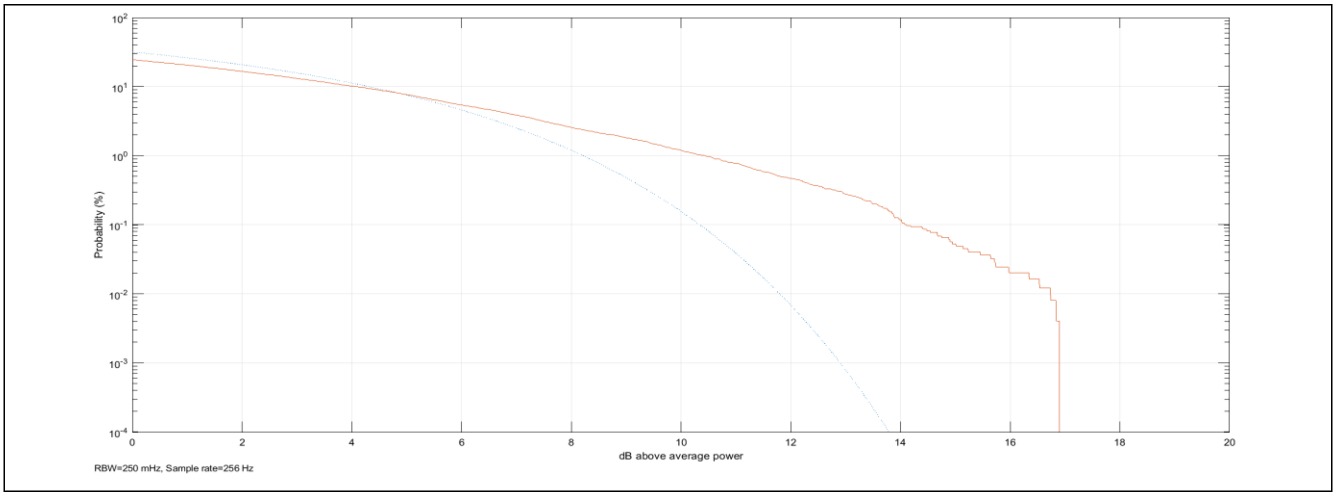

Figure 13. Error Probability of the 2FSK Signal at the HZFA output.

Table 1. Comparison between Power Saving before & after HZF Algorithm

Before HZFA		After HZFA	
▼ Power Distribution		▼ Power Distribution	
Probability (%)	dB above average	Probability (%)	dB above average
10.0000	--	10.0000	4.091
1.0000	15.265	1.0000	10.440
0.1000	18.582	0.1000	14.103
0.0100	18.953	0.0100	16.735
0.0010	18.985	0.0010	16.907
0.0001	18.987	0.0001	16.909
Average Power:	69.613 dBm	Average Power:	102.231 dBm
Max Power:	88.595 dBm	Max Power:	119.135 dBm
PAPR:	18.983 dB	PAPR:	16.904 dB
Sample Count:	24576	Sample Count:	24576

5. Conclusions

In this paper, the topic of transmission channel optimization for GSM systems is covered, in which a new developed method for improving the transmission of information in the multi-user transmission channel is presented. This technique combines the benefits of two known methods, the BD diagonal block algorithm and the SO sequential optimization algorithm, both of which are below required level. In terms of they do not fully arrived the total channel capacitance, but the diagonal block algorithm approximates the capacitance at a high SNR. While the cascading optimization algorithm is more suitable for this problem to reduce the resulting output power supplied to a stable group of modulation speeds rather than the issue for enlarging the outcomes for constant strength. The mathematical equations for the developed method called HZFA Hybrid Zero Effect Algorithm were derived and simulated using Matlab17b program for simulation using a digital signal source and include a 2FSK digital frequency with a realistic transmission channel effect with AWGN type random noise with -10 dB SNR. The results showed a "significant" improvement in the capacity of the transmitter channel through the use of the developed technology.

Since most of the added noise to the transmitted signal that have -10 dB SNR strength have been successfully eliminated. This will result in a saving of the transmitter channel capacity by 90% which will much enhancing the receiving signal after decoding. The new technique show a good operation as well permanently eliminating transmitter channel noise. Furthermore, the proposed technique has produced a good enhancement to the overall average and maximum power by 30dBm as well as the bit error rate BER has been enhanced by 10%.

References

1. S. Ahmad, R. M. Nadeem, B. Ehsan, M. Ullah and A. B. Siddique, “Wireless networks throughput enhancement using artificial intelligence,” Indian Journal of Science and Technology, vol. 10, no. 26, pp. 1 – 5, 2017.
2. S. Orike and T. J. Alalibo, “Comparative analysis of computer network protocols in wireless communication technology,” International Journal of Electronics Communication and Computer Engineering, vol. 10, no. 3, pp. 76 – 85, 2019.
3. F. Farid, S. Shahrestani, and C. Ruan, “Quality of service concerns in wireless and cellular networks,” Communications of the IBIMA, vol. 2013, pp. 1 – 15, 2013
4. Z. Afzal, P. A. Shah, K. M. Awan, and Zahoor-ur-Rehman, “Optimum bandwidth allocation in wireless networks using differential evolution,” Journal of Ambient Intelligence and Humanized Computing, vol. 10, no. 4, pp. 1401 – 1412, 2019.
5. J. Chang and H. Chen, "Dynamic-grouping bandwidth reservation scheme for multimedia wireless networks," IEEE Journal on Selected Areas in Communications, vol. 21, no. 10, pp. 1566-1574, 2003
6. B.I. Bakare and T.J. Alalibo, “Gigabit Fidelity (GI-FI) as future wireless technology in Nigeria,” International Journal of Engineering Science Invention, vol. 7, no. 12, ver.3, pp. 1-6, 2018.
7. S. Mirjalili and A. Lewis, "The Whale Optimization Algorithm," Advances in Engineering Software, vol. 95, pp. 51-67, 2016.
8. Y. Shen, Y. Shi, J. Zhang, and K. B. Letaief. (2018) “LORA: Learning to Optimize for Resource Allocation in wireless networks with few training samples,” [online] arXiv preprint arXiv: 1812.07998. Available: https://arxiv.org/abs/1812.07998
9. P. Akilandeswari, P. Gopikannan, and C. Balasubramanian, “A bandwidth allocation using genetic algorithm to providing solution for optimization problem in wireless mesh network,” International Journal of Innovation and Scientific Research, vol. 25, no. 2, pp. 445 – 456, 2016.
10. M. L. Umashankar, and M. V. Ramakrishna, “Optimization techniques in wireless sensor networks: A survey,” International Journal of Scientific Research Engineering & Technology, vol 6, no. 7, pp. 704 – 708, 2017.
11. L. Wang, W. Wu, J. Qi, and Z. Jia, “Wireless sensor network coverage optimization based on whale group algorithm,” Computer Science and Information Systems, vol. 15, no. 3, pp. 569-583, 2018
12. C. Jiang, H. Zhang, Y. Ren, Z. Han, K. C. Chen, and L. Hanzo, “Machine learning paradigms for next-generation wireless networks,” IEEE Wireless Communications, vol. 24, no. 2, pp. 98- 105, 2017.
13. G. J. Foschini and M. J. Gans, “On Limits of Wireless Personal Communications in a Fading Environment when Using Multiple Antennas,” Wireless Personal Communications, vol. 6, pp. 311–335, March 1998.

14. P.Wolniansky, G. Foschini, G. Golden, and R. Valenzuela, "V-BLAST: An architecture for Realizing Very High Data Rates Over the Rich Scattering Wireless Channel," in Proceedings of ISSSE-98, IEEE, September 1998.
15. G. Caire and S. Shamai, "On the Achievable Throughput of a Multi-Antenna Gaussian Broadcast Channel." Submitted to IEEE Transactions on Information Theory, July 2001.
16. P. Viswanath and D. Tse, "Sum Capacity of the Multiple Antenna Gaussian Broadcast Channel and Uplink-Downlink Duality." Submitted to IEEE Transactions on Information Theory, July 2002.
17. W. Yu and J. Cioffi, "Sum Capacity of Gaussian Vector Broadcast Channels." Submitted to IEEE Transactions on Information Theory, November 2001.
18. M. Costa, "Writing on Dirty Paper," IEEE Transactions on Information Theory, vol. 29, pp. 439–441, May 1983.
19. M. Schubert and H. Boche, "An Efficient Algorithm for Optimum Joint Beamforming and Power Control," in Proceedings of the IEEE Vehicular Technology Conference, vol. 4, pp. 1911–1915, IEEE, Spring 2002.
20. H. Boche and M. Schubert, "Optimum SIR Balancing Using Extended 1-Norm Beamforming Optimization," in Proceedings of the IEEE International Conference on Acoustics, Speech, and Signal Processing, vol. 3, pp. 2945– 2948, IEEE, 2002.
21. M. Bengtsson and B. Ottersten, "Optimal and Suboptimal Beamforming," in Handbook of Antennas in Wireless Communications (L. C. Godara, ed.), CRC Press, August 2001.
22. M. Bengtsson, "A Pragmatic Approach to Multi-User Spatial Multiplexing," in Proceedings of IEEE Sensor Array and Multichannel Signal Processing Workshop, IEEE, August 2002.
23. K.-K. Wong, R. D. Murch, R. S.-K. Cheng, and K. B. Letaief, "Optimizing the Spectral Efficiency of Multiuser MIMO Smart Antenna Systems," in Proceedings of theWireless Communications and Networking Conference, vol. 1, pp. 426–430, IEEE, 2000.
24. J.-H. Chang, L. Tassiulas, and F. Rashid-Farrokhi, "Joint Transmitter Receiver Diversity for Efficient Space Division Multiaccess," IEEE Transactions on Wireless Communications, vol. 1, pp. 16–27, January 2002.
25. W. Qiu, H. Tr¨oger, and M. Meurer, "Joint Transmission (JT) in Multi-user MIMO Transmission Systems," in COST 273 TD(02)008, EURO-COST, January 2002.

