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Link Level Performance of Multiple input Multiple Output (MIMO) System

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Abstract

This paper addresses multiple input multiple output (MIMO) techniques within 3G WCDMA. It begins with an overview of MIMO theory and presents WCDMA physical layer and recent high speed downlink packet access (HSDPA) enhancement to the WCDMA standard. Furthermore, MIMO channel models used in WCDMA performance evaluation were also discussed. The distance between base stations is of little influence on capacity loss of TD-SCDMA uplinks, while the capacity loss of WCDMA uplinks will increase as the distance between base stations increases. The uplinks of WCDMA are of little interference to the downlinks of TD-SCDMA, which can even be ignored. The capacity loss of WCDMA uplinks will increase as the distance between base stations increases. To ensure that the capacity loss of WCDMA system is less than 5% at any offset distance, the ACIR should exceed 50dB. This paper presents methods for evaluating radio wave propagation, especially for cases where the base station antenna is below the rooftops, i.e. in the case of microcellular network environments. The developed microcellular propagation model has been developed for network planning purposes and it has been verified using numerous field propagation measurements, since there is often a gap between theory and practical implementation, prototyping is used to study the effects of real propagation channels, non-ideal RF equipment, and to understand complexity/speed/precision tradeoffs in algorithm implementation .

Keywords: *HSDPA, UMT, 3GPP, WCDMA, MIMO, ACIR*

1. Introduction

The main first generation standards are AMPS, TACS, and NMT. The digital systems currently in use, such as GSM, PDC, CDMA One (IS-95) and US-TDMA (IS-136) are second generation systems. These systems have enabled voice communications to go wireless in many of the leading markets, and customers are increasingly finding value also in other services such as text messaging and access to data networks, which are starting to grow rapidly. Third generation systems are designed for multimedia communication: with them person-to-person communication can be enhanced with high quality images and video, and access to information and services on public and private networks will be enhanced by the higher data rates and new flexible communication capabilities of third generation systems [1]. This, together with the continuing evolution of the second-generation systems, will create new business opportunities not only for manufacturers and operators, but also for the providers of content and applications using these networks.

The application of antenna array architectures to create multiple-input multiple-output (MIMO) configurations has attracted considerable interest within wireless communication system design. MIMO transceiver techniques promise tremendous performance benefits for wireless systems in terms of capacity increase and diversity gain, and MIMO extensions have been proposed to virtually every contemporary wireless communication system [2,4].

This paper addresses MIMO techniques within 3G WCDMA. It begins with an overview of MIMO theory and presents WCDMA physical layer and recent high speed downlink packet access (HSDPA) enhancement to the WCDMA standard. Furthermore, MIMO channel models used in WCDMA performance evaluation are discussed. The paper then turns to practical transceiver architectures that take into account the boundary conditions in WCDMA uplink and downlink. While the potential of MIMO systems is high, wireless popagation environment, existing system specification, and requirement for backward compatibility considerably limit the applicability of MIMO algorithms and projected gains.

2. MIMO technology

Multiple-input multiple-output, or MIMO, is an abstract mathematical model for multi-antenna communication systems. During the last few years, MIMO technology has attracted a lot of attention in the area of wireless communications, since significant increases in throughput and range are possible at the same bandwidth and same overall transmit power expenditure. In general, MIMO technology increases the spectral efficiency of a wireless communication system.Wireless MIMO communication exploits phenomena such as multipath propagation to increase data throughput and range, or reduce bit error rates, rather than attempting to eliminate effects of multipath propagation as traditional SISO (Single-Input Single-Output) communication systems seek to do.MIMO can also be used in conjunction with OFDM, and is part of the IEEE 802.16 standard and will also be part of the IEEE 802.11n High-Throughput standard, which is expected to be finalized in mid 2007. Standardization of MIMO to be used in 3G standards such as HSDPA is currently under way [7].

3. Design of the System

Radio signals from a transmitter traveling in space may reflect off multiple objects and arrive at the receiver through multiple paths. The receiver sees the vector combination of radio signals from these paths. Due to the phase delay difference over these paths, these signals sometimes add up in phase and, sometimes, when they are out of phase, they cancel each other out at the receiver. This causes the received signal strength to fluctuate constantly or fade and can significantly degrade the data throughput of the wireless system.In wireless systems, radio signals from different users are typically separated by frequency, time or code. With beam-forming technology, also referred as smart antenna technology, each user can also be distinguished by their physical location in space.

Wireless systems use smart antenna technology to reduce the effect of multipath fading and to improve radio link quality and coverage. Smart antenna technology uses adaptive antenna arrays that provide spatial diversity from the propagation channel and signal-processing algorithms in order to detect the direction of the client. A smart antenna is able to steer a transmitted beam by accurately controlling the phase of the signal over each element of the antenna array to the client. Another way to improve the range is to use maximum ratio combining on the receiver side. Here, two independent receivers are used to receive the same signal, and the two received signals are then combined using signal processing to get the desired signal. Antenna arrays are designed using traditional metrics from antenna theory. With beam-forming technology, a single data stream is transmitted over the communication link. Smart antenna technology can be used with existing 802.11a/b/g systems to improve performance. The data packet is compatible with the 802.11a/b/g standard that has the same spectral efficiency.

Real MIMO systems use multiple transmitter streams and multiple receivers. Each transmitter sends independent data [Tx1; Tx2; … Txn] from different transmit antennas simultaneously and using the same radio channel. At the receiver end, each antenna receives the composite signal from all transmitters represented by [Rx1; Rx2; … Rxm] where m and n represent the number of receivers and transmitters respectively. In a practical application, m and n are typically less than 4.

The different paths may be represented mathematically as:

Rx1 = h11Tx1 +h12Tx2+…. h1nTxn
Rx2 = h21Tx1 +h22Tx2+…. h2nTxn
:
Rxm = hm1Tx1 +hm2Tx2+…. hmnTxn……..(1)

or, in matrix form as

[Rx] = [H][Tx]……..(2).

The [H] in equation (2) represents the transfer matrix of a MIMO channel.

In a traditional radio system, multipath signals decrease throughput as they cause co-channel interference. On the other hand, a MIMO system relies on this interference suppression to implement multidatastream detection and then separate the individual transmitted streams. By carefully designing a MIMO packet and by using advanced digital signal processing (DSP) techniques in the MIMO decoder, we can recover the variously independent transmitted data streams.To recover the transmitted datastream [Tx] at the [Rx], the MIMO system decoder must first estimate the individual channel transfer coefficient hij to determine the channel transfer matrix [H] during the MIMO preamble of the packet. Once the estimated [H] has been produced, the transmitted datastream [Tx] can be reconstructed by multiplying the vector [Rx] with the inverse of transfer matrix [H]-1. This is represented by;

[Tx] = [H]-1[Rx]……...(3)

The process, in principle, is equivalent to solving a set of N unknowns with N linear equations. To ensure that the channel matrix is invertible, MIMO systems require an environment rich in multipath.

4. Link Level Performance of MIMO HSDPA

The capacity of a wireless link is generally measured in bits per second per Hertz (b/s/Hz). The methods available to increase this capacity in a traditional Single Input, Single Output (SISO) wireless system are fairly limited: increase the bandwidth, allowing a corresponding increase in the bits per second, or increase the transmit power, allowing a higher level modulation scheme to be utilized for a given bit error rate, effectively increasing the bits per second within the same bandwidth. The problem with both of these techniques is that any increase in power or bandwidth can negatively impact other communications systems operating in adjacent spectral channels or within a given geographic area. As such, bandwidth and power for a given communications system are generally well regulated, limiting the ability of the system to support any increase in capacity or performance.

MIMO technologies overcome the deficiencies of these traditional methods through the use of spatial diversity [3, 4]. Data in a MIMO system is transmitted over T transmit antennas through what is referred to as a "MIMO channel" to R receive antennas supported by the receiver terminal.If the antennas within the transmit array and the antennas within the receive array are spaced sufficiently far apart, the signals traveling between the various transmit and receive antennas through the MIMO channel will fluctuate or fade in an independent manner. The transmitted data can therefore be encoded, using a so-called space-time code, to make use of this spatial diversity and allow processing at the receiver to extract the underlying data.

The specific coding scheme utilized in the MIMO system is selected based on the target performance, the acceptable level of computational complexity in the receiver’s signal processing subsystem, and the level of a priori knowledge of the transmission channel. Some schemes, referred to as space-time diversity codes, optimize for "diversity order", which defines the performance gain that can be obtained through the number of decor related spatial branches that can be achieved through the MIMO channel.

Other schemes, referred to as Spatial Multiplexing, optimize for channel capacity. Both of these types of schemes are discussed with additional detail below. These schemes can be used in combination to obtain the benefits accrued by both. Ultimately, the space-time coding scheme operating in conjunction with the MIMO channel allows the MIMO based system to support a significant increase in both performance and capacity over an equivalent SISO system while maintaining the same bandwidth and power.N- space-time diversity coding, each modulated symbol is encoded and transmitted from each of the transmit antennas.

This maximizes the total available spatial diversity from the MIMO channel, on a per symbol basis, offering a significant increase in bit error rate performance over an equivalent SISO channel operating at the same transmit power. Space-time diversity coding works with any number of transmit or receive antennas, with the total diversity order equal to T*R. Various space-time coding schemes have been developed for use in space-time diversity coding. In one of the earlier schemes, referred to as Delay Diversity, each symbol sent on one antenna is delayed by a symbol period and then sent on another antenna. This scheme is a simple example of a space-time trellis code (STTC), and is typically decoded through the use of a fairly complex maximum likelihood sequence estimator in the front-end of the receiver. One of the more popular schemes for space-time diversity coding is the Alamouti scheme [9]. This scheme utilizes a simple space-time block code (STBC) that encodes two modulated symbols into a matrix that is two rows by two columns in size.

During each symbol period, the contents of a row are transmitted via the corresponding antennas. Decoding of a space-time blocking code can also be done using a maximum likelihood detector, but other techniques can also be employed.Space-time diversity codes support a symbol rate of at most one symbol per symbol period [7]. However, the improvement in signal to noise ratio at the receiver using space-time diversity coding can be quite high, with one paper reporting up to 16dB improvement for a two transmit and two receive antenna system.This improvement allows an increase in the number of bits transmitted per symbol period while maintaining the same bandwidth, transmit power and bit error ratio, thus improving the capacity of the wireless link. It can also be used to extend distance over which a symbol can be transmitted, again while maintaining bandwidth, transmit power and bit error rate performance. This can improve the transmitter to receiver ratios, lowering site count and associated periodic costs.

5. Spatial Multiplexing

Spatial multiplexing maximizes the link capacity that is sent over a given bandwidth by transmitting a different symbol on each antenna during each symbol period. Thus the number of symbols transmitted per symbol period is equal to the number of transmit antennas. For spatial multiplexing to work, the number of receive antennas must be greater than or equal to the number of transmit antennas. The space-time code in a spatial multiplexing scheme is inherent in the multiplexing function.The predominant encoding schemes associated with spatial multiplexing break into two types: horizontal encoding and vertical encoding. In horizontal encoding, the bit stream to be transmitted is demultiplexed into T separate data streams. Each of these data streams is then temporally encoded, interleaved and converted to transmission symbols, with different modulation schemes allowed on each transmit channel. In contrast, in vertical encoding, the bit stream to be transmitted is encoded using a space-time block code and then converted into transmission symbols. The transmission symbols are then demultiplexed into T bit streams and transmitted [13].

Vertical encoding offers improved diversity gain over horizontal encoding because each data bit can be spread across all of the transmit antennas. However horizontal encoding accrues an advantage in receiver complexity in that the individual data streams are decoded separately, typically using a relatively simple linear receiver, such as the Zero Forcing receiver or Minimum Mean Squared Error receiver . Vertical encoding, on the other hand requires joint decoding at the receiver, which significantly increases receiver complexity [14].

6. Back propagation Algorithm

There are many variations of the back propagation algorithm, several of which we discuss in this paper. The simplest implementation of back propagation learning updates the network weights and biases in the direction in which the performance function decreases most rapidly - the negative of the gradient. There are two different ways in which this gradient descent algorithm can be implemented:

incremental mode and batch mode. In the incremental mode, the gradient is computed and the weights are updated after each input is applied to the network. In the batch mode all of the inputs are applied to the network before the weights are updated.

In batch mode the weights and biases of the network are updated only after the entire training set has been applied to the network. The gradients calculated at each training example are added together to determine the change in the weights and biases Batch Gradient Descent (traingd). The batch steepest descent training function is traingd. The weights and biases are updated in the direction of the negative gradient of the performance function. If we want to train a network using batch steepest descent, we should set the network train Fcn to train gd, and then call the function train. There is only one training function associated with a given network.

There are seven training parameters associated with trained: epochs, show, goal, time, min_grad, max_fail, and lr. The learning rate lr is multiplied times the negative of the gradient to determine the changes to the weights and biases. The larger the learning rate, the bigger the step. If the learning rate is made too large, the algorithm becomes unstable. If the learning rate is set too small, the algorithm takes a long time to converge. The training status is displayed for every show iteration of the algorithm. (If show is set to NaN, then the training status never displays.) The other parameters determine when the training stops. The training stops if the number of iterations exceeds epochs, if the performance function drops below goal, if the magnitude of the gradient is less than mingrad, or if the training time is longer than time seconds. Max_fail, which is associated with the early stopping technique, in the section on improving generalization.

The following code creates a training set of inputs p and targets t. For batch training, all of the input vectors are placed in one matrix. p = [-1 -1 2 2;0 5 0 5];

```
t = [-1 -1 1 1];
```

Next, we create the feedforward network. Here we use the function minmax to determine the range of the inputs to be used in creating the network. Net=newff (minmax (p), [3, 1], {'tansig','purelin'},'traingd');

At this point, we might want to modify some of the default training parameters. net.trainParam.show = 50;

```
net.trainParam.lr = 0.05;
net.trainParam.epochs = 300;
net.trainParam.goal = 1e-5;
```

If we want to use the default training parameters, the above commands are not necessary.

Now we are ready to train the network. [net,tr]=train(net,p,t);

```
  TRAINGD, Epoch 0/300, MSE 1.59423/1e-05, Gradient
2.76799/1e-10
  TRAINGD, Epoch 50/300, MSE 0.00236382/1e-05, Gradient
0.0495292/1e-10
  TRAINGD, Epoch 100/300, MSE 0.000435947/1e-05, Gradient
0.0161202/1e-10
  TRAINGD, Epoch 150/300, MSE 8.68462e-05/1e-05, Gradient
0.00769588/1e-10
  TRAINGD, Epoch 200/300, MSE 1.45042e-05/1e-05, Gradient
0.00325667/1e-10
  TRAINGD, Epoch 211/300, MSE 9.64816e-06/1e-05, Gradient
0.00266775/1e-10
  TRAINGD, Performance goal met.
```

The training record tr contains information about the progress of training. An example of its use is given in the Sample Training Session. Now the trained network can be simulated to obtain its response to the inputs in the training set. a = sim(net,p)

```
a = -1.0010   -0.9989    1.0018    0.9985
```

Batch Gradient Descent with Momentum (traingdm). In addition to traingd, there is another batch algorithm for feed forward networks that often provides faster convergence - traingdm, steepest descent with momentum. Momentum allows a network to respond not only to the local gradient, but also to recent trends in the error surface. Acting like a low-pass filter, momentum allows the network to ignore small features in the error surface. Without momentum a network may get stuck in a shallow local minimum. With momentum a network can slide through such a minimum. Momentum can be added to back propagation learning by making weight changes equal to the sum of a fraction of the last weight change and the new change suggested by the back propagation rule. The magnitude of the effect that the last weight change is allowed to have is mediated by a momentum constant, mc, which can be any number between 0 and 1. When the momentum constant is 0, a weight change is based solely on the gradient. When the momentum constant is 1, the new weight change is set to equal the last weight change and the gradient is simply ignored.

The gradient is computed by summing the gradients calculated at each training example, and the weights and biases are only updated after all training examples have been presented. If the new performance function on a given iteration exceeds the performance function on a previous iteration by more than a predefined ratio max_perf_inc (typically 1.04), the new weights and biases are discarded, and the momentum coefficient mc is set to zero.

The batch form of gradient descent with momentum is invoked using the training function traingdm. The traingdm function is invoked using the same steps shown above for the traingd function, except that the mc, lr and max_perf_inc learning parameters can all be set. In the following code we recreate our previous network and retrain it using gradient descent with momentum. The training parameters for traingdm are the same as those for traingd, with the addition of the momentum factor mc and the maximum performance increase max_perf_inc. (The training parameters are reset to the default values whenever net.trainFcn is set to traingdm.) p = [-1 -1 2 2;0 5 0 5];

```
t = [-1 -1 1 1];
net=newff(minmax(p),[3,1],{'tansig','purelin'},'traingdm');
net.trainParam.show = 50;
net.trainParam.lr = 0.05;
net.trainParam.mc = 0.9;
net.trainParam.epochs = 300;
net.trainParam.goal = 1e-5;
[net,tr]=train(net,p,t);

TRAINGDM, Epoch 0/300, MSE 3.6913/1e-05, Gradient
4.54729/1e-10
  TRAINGDM, Epoch 50/300, MSE 0.00532188/1e-05, Gradient
0.213222/1e-10
  TRAINGDM, Epoch 100/300, MSE 6.34868e-05/1e-05, Gradient
0.0409749/1e-10
  TRAINGDM, Epoch 114/300, MSE 9.06235e-06/1e-05, Gradient
0.00908756/1e-10
  TRAINGDM, Performance goal met.
a = sim(net,p)
a =   -1.0026   -1.0044    0.9969    0.9992
```

Since we reinitialized the weights and biases before training (by calling newff again), we obtain a different mean square error than we did using traingd. If we were to reinitialize and train again using traingdm, we would get yet a different mean square error. The random choice of initial weights and biases will affect the performance of the algorithm. If we want to compare the performance of different algorithms, we should test each using several different sets of initial weights and biases.We may want to use net=init(net) to reinitialize the weights, rather than recreating the entire network with newff.

6. Analysis Methodologies

In accordance with 3GPP TR25.942, there are mainly two ways to analyze the interference: certainty calculation and MonteCarlo simulation.

Certainty Calculation

When the TD-SCDMA base station sends out a signal and the WCDMA base station in the neighboring cell is receiving in the adjacent frequency, there will be interference between the base stations. The best way to avoid such interference is to make good network planning and provide sufficient coupling loss between base stations.

MCL = Interference Power – ACA – ACIPL

ACA: Adjacent Channel Attenuation

ACIPL: Adjacent Channel Interference Power Level

Interference power is the emission power of interference source;

ACIPL refers to the Interference Power Level within the receiving frequency band;

ACA refers to ACIR.

Such method is best for theoretical evaluation and analysis. The conclusion based upon such method is not so much in compliance with the real scenario. But it is efficient and easy for calculation.

MonteCarlo Simulation

The emission power of base stations and mobile stations, and the load of base stations can be simulated to get the best knowledge of interference in the real world. This method is widely used and recognized as one of the most effective way. But as the system gets complex, the operand and the demand for system resources will increase dramatically. The certainty calculation is to study the worst-case scenario of the interference between base stations of two different systems. Additional means for isolation can be obtained based on this method. Therefore, it is recommended that MonteCarlo simulation be adopted to calculate the interference between base stations, between terminals, and between base stations and terminals.

7. Simulation Results

The simulation conclusions are obtained based upon the simulation method and process as well as the simulation model based upon macro-cell, which are recommended in 3GPP TR25.942. The relationship between the capacity loss and ACIR of the interfered system is measured when the base stations of the two systems are in different offset locations. Figure 1, 2, 3 &4 shows SNR vs. Channel capacity, Probability Distribution function Of Landas Matrix , BER vs. SNR(2 Transmitter &1Reciver), BER vs. SNR(2 Transmitter &2 Receiver) respectively.

(1) Capacity and Base Station Intervals

TD-SCDMA Uplink Communications

The distance between base stations is of little influence on capacity loss of TD-SCDMA uplinks, while the capacity loss of WCDMA uplinks will increase as the distance between base stations increases. When ACIR reaches 25dB, the capacity loss of WCDMA system is less than 5% at any offset distance.

TD-SCDMA Downlink Communications

The uplinks of WCDMA are of little interference to the downlinks of TD-SCDMA, which can even be ignored. The capacity loss of WCDMA uplinks will increase as the distance between base stations increases. To ensure that the capacity loss of WCDMA system is less than 5% at any offset distance, the ACIR should exceed 50dB.

(2) Capacity and ACIR

TD-SCDMA Uplink Communications

The uplinks of WCDMA are of little interference to the downlinks of TD-SCDMA, which can even be ignored. The capacity loss of WCDMA uplinks will increase as the distance between base stations increases. To ensure that the capacity loss of WCDMA system is less than 5% at any offset distance, the ACIP should exceed 50dB.

TD-SCDMA Downlink Communications

The downlink capacity of TD-SCDMA is almost immune from the interference of the mobile stations of TD-SCDMA (ACIR>40dB). As ACIR increases, the interference of TD-SCDMA base stations to WCDMA base stations will decrease and the WCDMA uplink capacity loss will decrease correspondingly.

(3) Capacity and Cell Radius

TD-SCDMA Uplink Communications

As the radius of the cell increases, the capacity loss of TD-SCDMA uplinks will increase. When ACIR reaches 20 dB, the capacity loss is lower than 5%.

The capacity loss of WCDMA uplinks will also increase with the increase of the radius of the cell. When ACIR reaches 32 dB, the capacity loss of WCDMA base stations is lower than 5% regardless of the radius of the cell.

TD-SCDMA Downlink Communications

The downlink capacity of TD-SCDMA is almost immune from the interference of the mobile stations of TD-SCDMA, which can even be ignored. The capacity loss of WCDMA uplinks will increase with the increase of the radius of the cell. To ensure that the capacity loss of WCDMA system is less than 5% at any offset distance, the ACIR should be larger than 65dB.

(4) Interference Conclusions

The key factor determining the co-existence of TD-SCDMA and WCDMA systems is the interference of TD-SCDMA base stations to WCDMA base stations, which can only be reduced rather than eliminated.The capacity loss of the TD-SCDMA uplinks can be controlled so long as the ACIR between base stations and UE is lower than 40 dB. According to the specifications of 3GPP, ACIR of the first adjacent channel shall exceed 40dB and ACIR of the second adjacent channel shall exceed 45dB. The existing RF indicators can meet that requirement.

The capacity loss of the TD-SCDMA downlinks can be controlled so long as the ACIR between base stations and UE is lower than 40 dB. Feasibility Studies on the Co-Existence of WCDMA and TD-SCDMA Base Stations .To make WCDMA and TD-SCDMA systems co-exist, ways must be found to reduce the above interference between the TD-SCDMA base stations and WCDMA base stations.

The following solutions are recommended.

1. Increasing the Coupling Loss between Antennas

Increasing the coupling loss between antennas is the most economical and effective way. The MCL between antennas can be increased from 30dB to50~60dB through proper arrangement without sacrificing the flexibility of BS locations.

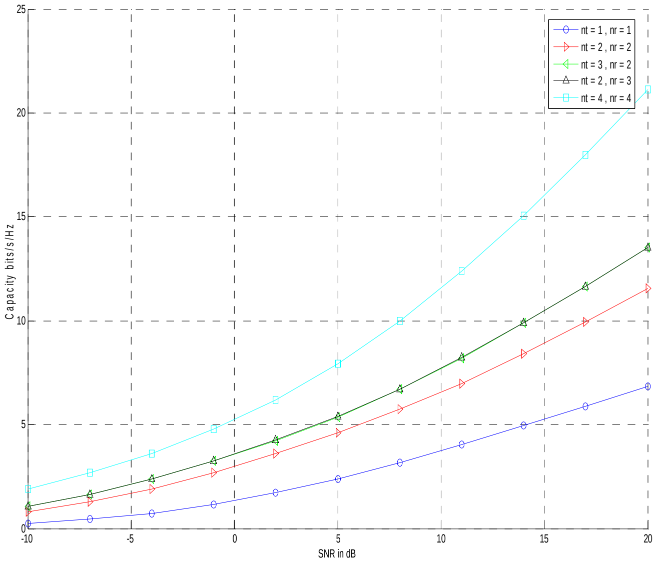


Figure 1. SNR & Channel Capacity

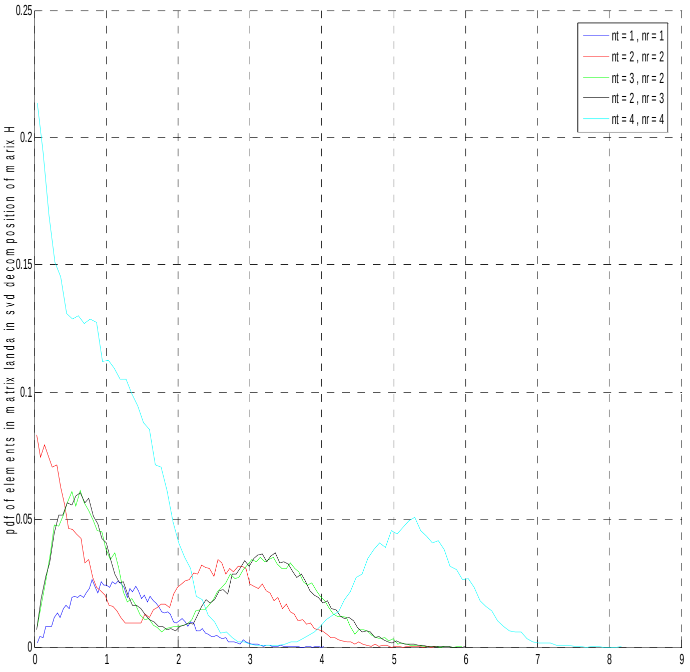
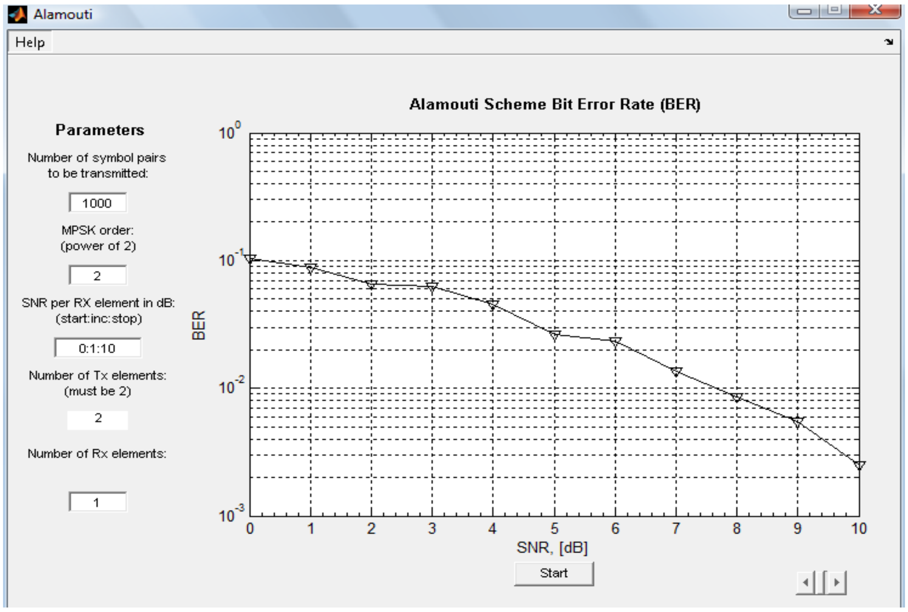


Figure 2. Probability Distribution function Of Landas Matrix



Parameters

Number of symbol pairs to be transmitted: 1000

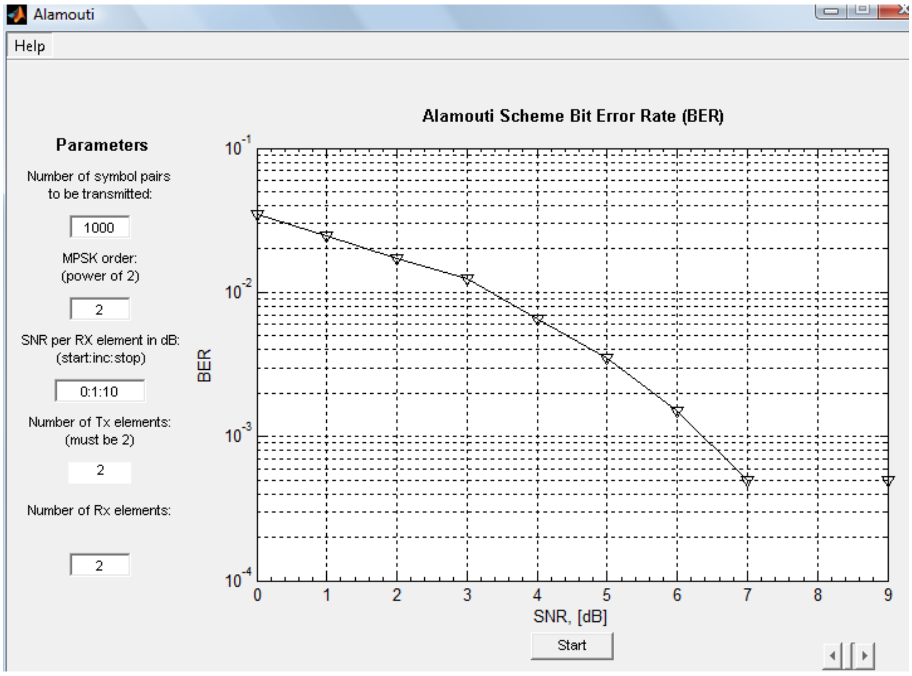
MPSK order: (power of 2) 2

SNR per RX element in dB: (start:inc:stop) 0:1:10

Number of Tx elements: (must be 2) 2

Number of Rx elements: 1

Figure 3. BER vs SNR(2 Transmitter &1Reciver)



Parameters

Number of symbol pairs to be transmitted: 1000

MPSK order: (power of 2) 2

SNR per RX element in dB: (start:inc:stop) 0:1:10

Number of Tx elements: (must be 2) 2

Number of Rx elements: 2

Figure 4. BER Vs SNR(2 Transmitter &2Reciver)

2. Coexistence Filter

Using coexistence filter is another effective method. Using filters at acceptable price can provide satisfactory interference suppression. The filter can be used on the emission/receiving antennas of TD-SCDMA or in the WCDMA systems to improve ACS in the WCDMA system.

3. Frequency Guard Band (FCB)

FCB can also be used to reduce interference. Due to the difference of signal bandwidth between TD-SCDMA and WCDMA, FCB is not quite effective in reducing the WCDMA out-of-band interference (due to limited ACS). For instance, 5MHz Frequency Guard Band can only reduce the WCDMA out-of-band interference by 5dB. In fact, although FCB cannot reduce the interference caused by TD-SCDMA to WCDMA, it can help TD-SCDMA meet the requirements more easily.

8. Conclusion

As from all the tests we have done to check the code performance, channel performance, and changes effect on WCDMA system. We come to this conclusion that, if we want to have constant output with respect to input we are providing, we need to use both (Rayleigh & AWGN) channels. Where as if we want to go towards low power consumption, we should go for single channel mode, but in this mode output is very distracted and fluctuating.On the basic of BER (Bit Error Rate) and SER (Symbol Error Rate), we have find out that SER is less when only one channel mode is applied to the system, Where as BER is less when system works on both the channels simultaneously. The capacity loss of WCDMA uplinks will increase as the distance between base stations increases. To ensure that the capacity loss of WCDMA system is less than 5% at any offset distance, the ACIR should exceed 50dB. This paper presents methods for evaluating radio wave propagation, especially for cases where the base station antenna is below the rooftops, i.e. in the case of microcellular network environments. The developed microcellular propagation model has been developed for network planning purposes and it has been verified using numerous field propagation measurements, since there is often a gap between theory and practical implementation, prototyping is used to study the effects of real propagation channels, non-ideal RF equipment, and to understand complexity/speed/precision tradeoffs in algorithm implementation. Thus we get to the conclusion that for maximum performance in WCDMA we need to go with both the channels simultaneously in algorithm implementation.

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