# Improving Performance of Wi-Fi by Compact MIMO Systems by using Gama Frequency-Selective Fading Channels

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## Abstract

***In this paper we propose a compact MIMO system in frequency-selective fading channels which improves the performance of Wireless Media. A MIMO beam forming system model with mutual coupling and matching network is proposed to cope with frequency-selective fading channels. The overall system proposed transfer matrix is derived using Z-parameter method. The system using the transform matrix which accepts the relay and the delay matrix for the computation. Then apply the diversity criteria by which we can make the code output pair which is distinct. So we can obtain two different pairs one is shows the below value in the MIMO System one is the Higher value. It is the only way to achieve orthogonally. One particular problem with this is that it has uneven power among the symbols it transmits. This means that the signal does not have a constant envelope and that the power each antenna must transmit has to vary, both of which are undesirable. We can take the middle value which overcomes this problem.***

## Keywords

***AE, Wi-Fi, MIMO, Z-parameter***

## 1. Introduction

A CDMA signals have a wide variety of bandwidth and transforming signals. Without coding or diversity, the performance of DS-CDMA degrades rapidly when number of users increase. Rake receiver is utilized to offer path diversity. However, it must continuously lock too many paths, which makes its implementation complicated. Another problem occurs at high data rate applications if symbol durations are less than the channel delay. A cellular distributed MIMO system with randomly located distributed antenna elements (AEs) and mobile users is considered. These are connected to the base station. In this Dissertation we propose a compact MIMO system in frequency-selective fading channels which improves the performance of Wireless Media. A MIMO beam forming system model with mutual coupling and matching network is proposed to cope with frequency-selective fading channels. The overall system proposed transfer matrix is derived using Z-parameter method. The system using the transform matrix which accepts the relay and the delay matrix for the computation. Then apply the diversity criteria by which we can make the code output pair which is distinct. So we can obtain two different pairs one is shows the below value in the MIMO System one is the Higher value. It is the only way to achieve orthogonally. One particular problem with this is that it has uneven power among the symbols it transmits. This means that the signal does not have a constant envelope and that the power each antenna must transmit has to vary, both of which are undesirable. We can take the middle value which overcomes this problem. Simulation results show that input impedance match gives good performance compared with the optimum impedance which maximizes the capacity. MIMO system performance can be improved by properly selecting the matching impedance. The detection of signals in a multipath environment leads to a Rake receiver, which is based on optimality theory tempered by some heuristic ideas. Rake receivers resolve the components of a received signal (arriving at different times) and combine them to provide diversity. Differential Global Satellite Navigation Systems (DGNSS) employ the principle that the main sources of error in satellite navigation are consistent over large geographical areas. These errors can be corrected by using reference stations at known locations to measure the pseudo range errors. They transmit corrections to users' receivers, which adjust their position measurements accordingly.

In this paper, we propose a complete MIMO system model with mutual coupling and matching network in correlated frequency-selective fading channels. This system is more suitable for practical MIMO systems modeling. This method is an efficient way to handle and improving the performance in a better way. Numerical results show that the MIMO system with properly selected matching impedances gives good performance in multipath frequency selective fading environment. It also solves the problem of high data rate applications and duration is less than the channel delay. There are lot of works are proposed in the recent years and it became the interesting and also the interesting area of research for several researchers because of the diversity field and lot of things to be happen in this area. We provide here an overview of different signals and methods. The rest of this paper is arranged as follows: Section 2 introduces Wi-Fi System; Section 3 describes about the MIMO; Section 4 shows the recent scenario; Section 5 describes the proposed method. Section 6 describes Conclusion and outlook.

## 2. Wi-Fi System

Wi-Fi is a trademark of the Wi-Fi Alliance. A Wi-Fi enabled device such as a personal computer, video game console, smart phone, and digital audio player can connect to the Internet when within range of a wireless network connected to the Internet. The coverage of one or more (interconnected) access points called hotspots when offering public access generally comprises an area the size of a few rooms but may be expanded to cover many square miles, depending on the number of access points with overlapping coverage. The technical term "IEEE 802.11" has been used interchangeably with Wi-Fi, but over the past few years Wi-Fi has become a superset of IEEE 802.11. Wi-Fi is used by over 700 million people, there are over 4 million hotspots (places with Wi-Fi Internet connectivity) around the world, and about 800 million new Wi-Fi devices every year. Wi-Fi products that complete the Wi-Fi Alliance interoperability certification testing successfully can use the Wi-Fi CERTIFIED designation and trademark. Not every Wi-Fi device is submitted for certification to the Wi-Fi Alliance. The lack of Wi-Fi certification does not necessarily imply a device is incompatible with Wi-Fi devices/protocols. If it is compliant or partly compatible, the Wi-Fi Alliance may not object to its description as a Wi-Fi device though technically only the CERTIFIED designation carries their approval.Wi-Fi certified and compliant devices are installed in many personal computers, video game consoles, MP3 players, smart phones, printers, digital cameras, and laptop computers. However, the use of Wi-Fi via virtual Router is also possible in a number of ways. Wi-Fi allows the deployment of local area networks (LANs) without wires for client devices, typically reducing the costs of network deployment and expansion. Spaces where cables cannot be run, such as outdoor areas and historical buildings, can host wireless LANs. As of 2010 manufacturers are building wireless network adapters into most laptops. The price of chipsets for Wi-Fi continues to drop, making it an economical networking option included in even more devices. Wi-Fi has become widespread in corporate infrastructures.

Different competitive brands of access points and client network-interfaces can inter-operate at a basic level of service. Products designated as "Wi-Fi Certified" by the Wi-Fi Alliance are backwards compatible. "Wi-Fi" designates a globally operative set of standards: unlike mobile phones, any standard Wi-Fi device will work anywhere in the world.

Wi-Fi operates in more than 220,000 public hotspots and in tens of millions of homes and corporate and university campuses worldwide. The current version of Wi-Fi Protected Access encryption (WPA2) as of 2010 is considered secure, provided users employ a strong passphrase. New protocols for quality-of-service (WMM) make Wi-Fi more suitable for latency-sensitive applications (such as voice and video); and power saving mechanisms (WMM Power Save) improve battery operation.

A Wi-Fi signal occupies five channels in the 2.4 GHz band; any two channels whose channel numbers differ by five or more, such as 2 and 7, do not overlap. The oft-repeated adage that channels 1, 6, and 11 are the only non-overlapping channels is, therefore, not accurate; channels 1, 6, and 11 do, however, comprise the only group of three non-overlapping channels in the U.S.

The Internet protocol performs poorly in the face of noise when run with WiFi as the physical layer.TCP has been tuned for a wired network in which packets lost due to noise is very rare and packets are lost almost exclusively due to congestion. On a wireless network, noise is common. This difference causes TCP to greatly slow or breaks transmission when noise is significant, even when most packets are still arriving correctly.

## 3. MIMO

In radio, multiple-input and multiple-output, or MIMO, is the use of multiple antennas at both the transmitter and receiver to improve communication performance. It is one of several forms of smart antenna technology. Note that the terms input and output refer to the radio channel carrying the signal, not to the devices having antennas. MIMO technology has attracted attention in wireless communications, because it offers significant increases in data throughput and link range without additional bandwidth or transmit power. It achieves this by higher spectral efficiency (more bits per second per hertz of bandwidth) and link reliability or diversity (reduced fading). Because of these properties, MIMO is an important part of modern wireless communication standards such as IEEE 802.11n (Wifi), 4G, 3GPP Long Term Evolution, WiMAX and HSPA+.

MIMO technology is also starting to gain adoption in non-wireless communications systems. One example is the new home networking standard ITU-T G.9963, which defines a power line communications system that uses MIMO techniques to transmit multiple signals over multiple AC wires (phase, neutral and ground). MIMO can be sub-divided into three main categories, precoding, spatial multiplexing or SM, and diversity coding. Precoding is multi-stream beam forming, in the narrowest definition. In more general terms, it is considered to be all spatial processing that occurs at the transmitter. In (single-layer) beam forming, the same signal is emitted from each of the transmit antennas with appropriate phase (and sometimes gain) weighting such that the signal power is maximized at the receiver input. The benefits of beam forming are to increase the received signal gain, by making signals emitted from different antennas add up constructively, and to reduce the multipath fading effect. In the absence of scattering, beam forming results in a well defined directional pattern, but in typical cellular conventional beams are not a good analogy. When the receiver has multiple antennas, the transmit beam forming cannot simultaneously maximize the signal level at all of the receive antennas, and precoding with multiple streams is used. Note that precoding requires knowledge of channel state information (CSI) at the transmitter. Spatial multiplexing requires MIMO antenna configuration. In spatial multiplexing, a high rate signal is split into multiple lower rate streams and each stream is transmitted from a different transmit antenna in the same frequency channel. If these signals arrive at the receiver antenna array with sufficiently different spatial signatures, the receiver can separate these streams into (almost) parallel channels. Spatial multiplexing is a very powerful technique for increasing channel capacity at higher signal-to-noise ratios (SNR). The maximum number of spatial streams is limited by the lesser in the number of antennas at the transmitter or receiver. Spatial multiplexing can be used with or without transmit channel knowledge. Spatial multiplexing can also be used for simultaneous transmission to multiple receivers, known as space-division multiple access. By scheduling receivers with different spatial signatures, good separability can be assured. Diversity techniques are used when there is no channel knowledge at the transmitter. In diversity methods, a single stream (unlike multiple streams in spatial multiplexing) is transmitted, but the signal is coded using techniques called space-time coding. The signal is emitted from each of the transmit antennas with full or near orthogonal coding. Diversity coding exploits the independent fading in the multiple antenna links to enhance signal diversity. Because there is no channel knowledge, there is no beam forming or array gain from diversity coding. Spatial multiplexing can also be combined with precoding when the channel is known at the transmitter or combined with diversity coding when decoding reliability is in trade-off. Narrow band flat fading MIMO system is modeled as

$Y=Hx + n$

where y and x are the receive and transmit vectors, respectively, and H and n are the channel matrix and the noise vector, respectively. MIMO Channel is shown in Fig 1.

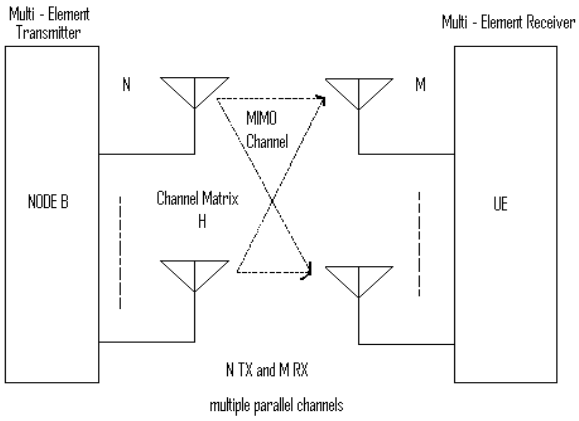


**Fig 1 MIMO Channel**

## 4. Recent Scenario

In 2007, Patrick Amihood et al. [1] derive the asymptotic distribution of the multiple-antenna interference when the processing gain is sufficiently large. The probability of error is derived for the conventional RAKE receiver, and its performance is compared for various system configurations. We consider system tradeoffs for both fixed rate and fixed diversity. For a fixed total data rate, we demonstrate the advantage of decreasing the number of transmit antennas while increasing the number of codes, and for a fixed total diversity order, they demonstrate the advantage of decreasing the number of RAKE taps while increasing the number of receive antennas. In 2009, Antonis Phasouliotis et al. [2] they analyze and compare the error rate performance of downlink coded multiple-input multiple-output multi-carrier code division multiple access (MIMO MC-CDMA) and coded MIMO orthogonal frequency division multiple access (MIMO OFDMA) systems under frequency selective fading channel conditions. In particular, the pairwise error probabilities (PEP) for both systems are derived. Simulation results illustrate that when the number of users, hence the system load is low; MIMO MC-CDMA outperforms MIMO OFDMA. In 2009, Chengshan Xiao et al. [3] consider the transmit linear precoding problem for MIMO systems with discrete-constellation inputs. We assume that the receiver has perfect channel state information (CSI) and the transmitter only has partial CSI, namely, the channel covariance information. We first consider MIMO systems over frequency-flat fading channels. They design the optimal linear precoder based on direct maximization of mutual information over the MIMO channels with discrete constellation inputs. In 2009, Qiang Guo et al. [4] proposed a complete MIMO beam forming system model with mutual coupling and matching. The overall system transfer matrix is derived using Z-parameter method. The transmit and receive weight vectors are iteratively determined using a MIMO beam forming scheme. Performance of the MIMO system with various antenna matching methods is studied in numerical experiment. Simulation results show that input impedance match gives good performance compared with the optimum impedance which maximizes the capacity. MIMO system performance can be improved by properly selecting the matching impedance. In 2009, Juinn-Horng Deng et al. [5] propose a new differential MIMO single-carrier system with frequency-domain equalization (SCFDE) aided by the insertion of cyclic prefix. This block transmission system not only inherits all the merits of the SISO SC-FDE system, but is also equipped with a differential space time block coding (DSTBC) such as to combat the fast-changing frequency selective fading channels without the needs to estimate and then compensate the carrier frequency offset and channel effects. Hence, for practical applications, it has the additional merits of decoding simplicity and robustness against difficult transmission environments. Computer simulation shows that with two transmit antennas, the proposed system can provide diversity benefit as the non-differential system does, while greatly reducing the receiver complexity. In 2010, Rongtao Xu et al. [6] analyzed performance of spatial multiplexing-based multiple-input multiple output (MIMO) systems using zero forcing (ZF) detectors in frequency selective fading channels is analyzed in this paper. The approximation of a linear combination of Wishart matrices is used to derive the probability density function (p.d.f.) of output signal-to-noise ratio (SNR) expression. Analytical error rate expressions for the system are obtained with the assumption that inter-path interference is omitted. Simulations are carried out to evaluate the analytical results. They relate the diversity order of frequency selective fading channels with the multipath power delay profile. In 2010, Ozgur Oyman et al. [7] investigate the performance of distortion-aware MIMO link adaptation in realistic link-level simulation (LLS) and system-level simulation (SLS) environments based on orthogonal frequency division multiplexing (OFDM) under broadband frequency-selective fading with special focus on multicast broadcast services (MBS), and demonstrate their advantages over good put-maximizing MIMO link adaptation techniques in terms of reduced end-to-end distortion and higher peak signal-to-noise ratio (PSNR). In 2010, Yahong Rosa Zheng et al. [8] proposed about the flat fading waveforms with temporal correlation or Doppler spectrums are generated using a sum-of-sinusoid method. The intertype correlation matrix associated with multipath delay spread is computed according to the channel power delay profile and transmit/receive filters. The spatial correlations matrices are predefined inputs associated with transmit and receive antenna arrangements. In 2010, Yen-Chih et al. [9]C proposed two analytic correlated multiple-input multiple-output (MIMO) block fading channel models and their time-variant extensions that encompass the popular Kronecker model and the more general Weichselberger model as special cases. Both static and time-variant models offer compact representations of spatial- and/or time-correlated channels. When the transmit antenna array is such that the associated MIMO channel has a small angle spread (AS), which occurs quite often in a cellular downlink, our models admit reduced-rank channel representations. They also provide compact channel state information (CSI) descriptions which are needed in feedback systems and in many post channel estimation applications. The latter has the important implication of reduced feedback channel bandwidth requirement and lower post-processing complexity. In 2010, Dongya Shen et al. [10] first investigate the channel capacity of the MIMO channels over the Rayleigh-Lognormal fading channel. The paper derives the analytic expression of channel capacity n of the MIMO Rayleigh-Lognormal fading channel in integral form, gives the Eigenvalue Probability Density Function (PDF) of the MIMO Rayleigh-Lognormal fading channel.

## 5. Proposed Method

In this section, we describe the proposed method. We study and after observation we see the performance in terms of symbol and Bit error probability (SEBP) of multiple-input-multiple-output (MIMO) systems with high spectral efficiency. We also consider the coherent detection of M array phase shift keying signals in a flat Rayleigh-fading environment, which is focused on constellation scheme. We also bright our scope on spectrally efficient Compact multiple input and output system. In this system, after serial-to-parallel conversion, several sub streams of symbols are simultaneously transmitted by using an antenna array, thereby increasing the spectral efficiency. The received signal is based on linear minimum mean-square-error combining, eventually followed by successive interference cancellation. Exact and approximate expressions are derived for an arbitrary number of transmitting and receiving antenna elements. Simulation results confirm the validity of our analytical methodology.

We also used PSD (power spectrum density) or energy spectral density (ESD), which is a positive real function of a frequency variable associated with a stationary stochastic process, or a deterministic function of time, which has dimensions of power per hertz (Hz), or energy per hertz. It is very useful for finding channel estimation. We also taken the example for understand the phenomena. Typically 10 data time series have been computer generated from a known theoretical spectral density. The spectral estimate according to the recipe discussed here has been estimated for each of the 10 data series and results are reported to show both the agreement with the theoretical PSD and the scatter around the mean estimate. In this Dissertation we propose a compact MIMO system in frequency-selective fading channels which improves the performance of Wireless Media. A MIMO beam forming system model with mutual coupling and matching network is proposed to cope with frequency-selective fading channels. The overall system proposed transfer matrix is derived using Z-parameter method. The system using the transform matrix which accepts the relay and the delay matrix for the computation. Then apply the diversity criteria by which we can make the code output pair which is distinct. So we can obtain two different pairs one is shows the below value in the MIMO System one is the Higher value. It is the only way to achieve orthogonally. One particular problem with this is that it has uneven power among the symbols it transmits. This means that the signal does not have a constant envelope and that the power each antenna must transmit has to vary, both of which are undesirable. We can take the middle value which overcomes this problem.

The proposed method works in the below manner

[1] For a generic multi-port network definition, it is assumed that each of the ports is allocated an integer n ranging from 1 to N, where N is the total number of ports. For port n, the associated Z-parameter definition is in terms of input and output. By taking parameter between 1 to N, we apply Z-Transformation so that we could be able to analyze the aspects that which channels from the input receiver is probable and most common use. Then we apply the matrix relation among those parameter and according to that relation we can profound the capacity of that particular channel and receiver.

[2] Then we can transmit the values for taking the fading input and output in the corresponding MIMO channels. We taken a generic multi-port network definition example, it is assumed that each of the ports is allocated an integer n ranging from 1 to N, where N is the total number of ports. For port n, the associated Z-parameter definition is in terms of input currents and output. We can take the codes achieve rate-1/2 and rate-3/4 respectively. The two matrices give examples of why codes for more than two antennas must sacrifice rate, it is the only way to achieve orthogonality. This means that the signal does not have a constant envelope and that the power each antenna must transmit has to vary, both of which are undesirable. Modified versions of this code that overcome this problem have since been designed.

[3] Finally we apply gama selective fading on those input which provide us two values one value is the lower value and other is the higher value based on those criteria we can apply diversity criteria and calculate the comparison on both of the method. One is the traditional method other is the approach.

[4] Finally our simulation results show that our approach is better than the previous one. Fig 2, 3 and 4 shows the comparison on different parameter.

Fig 2 PSD estimate as for the data but for a spectrum with a steeper rise at low frequency. Notice the anomaly due to a leakage of the spectral window that brings us to recommend discarding the data below150Hz. First, in order to investigate the dependence of power delay profile on the bit error probabilities, we consider model in computing the bit error probabilities as shown in Fig 3.The reason for choosing for the pre- modulation filter is that it is known to achieve the best BER performance. It is seen that there is little difference between the Gaussian and the one-sided exponential profile.

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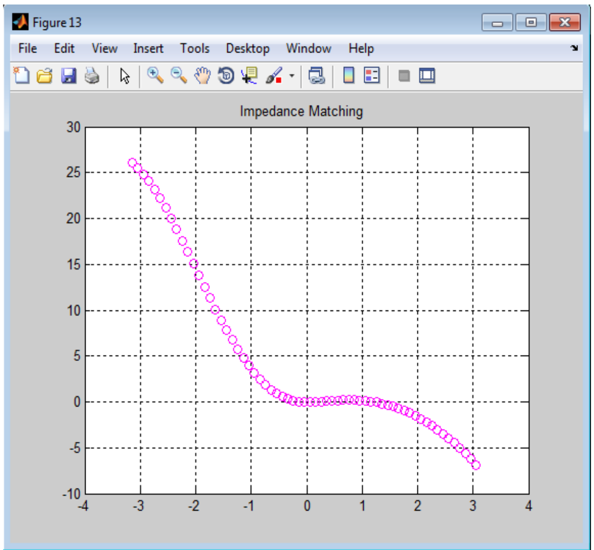


**Fig 2 Comparison 1**

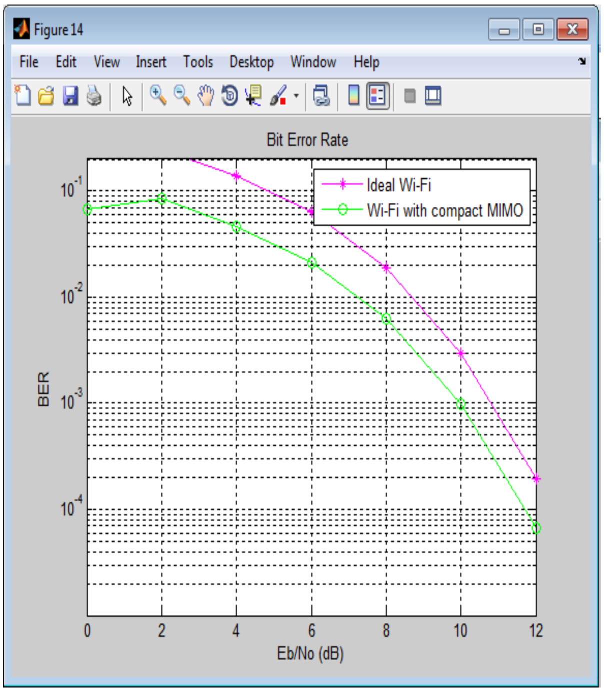


**Fig 3 Comparison 2**

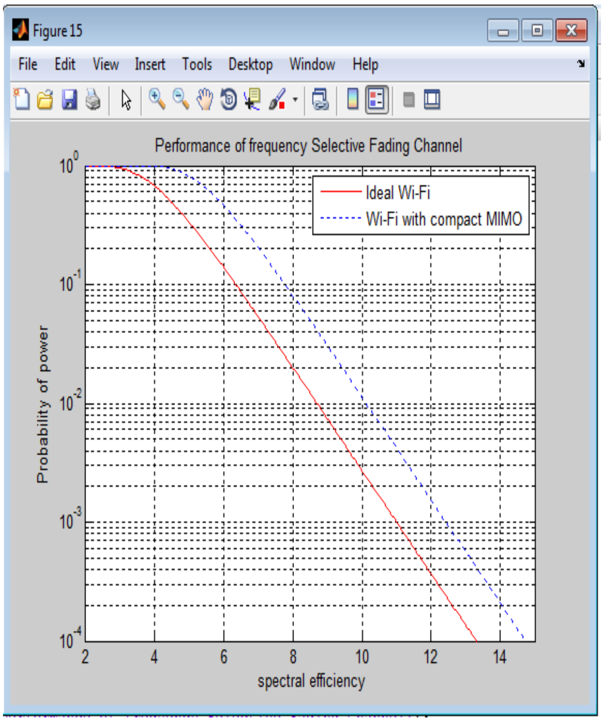


**Fig 4 Comparison 3**

## 6. Conclusion and Outlook

In this Dissertation we propose a compact MIMO system in frequency-selective fading channels which improves the performance of Wireless Media. A MIMO beam forming system model with mutual coupling and matching network is proposed to cope with frequency-selective fading channels. We apply the diversity criteria by which we can make the code output pair which is distinct. So we can obtain two different pairs one is shows the below value in the MIMO System one is the Higher value. It is the only way to achieve orthogonally. One particular problem with this is that it has uneven power among the symbols it transmits. This means that the signal does not have a constant envelope and that the power each antenna must transmit has to vary, both of which are undesirable. We can take the middle value which overcomes this problem. Our Simulation result shows that the performance is increased by our proposed methodology.

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