MIMO-OFDM USING POWER ALLOCATION IN WATERFILLING ALGORITHAM BASED ON SVD PROCESS

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ABSTRACT:

In this paper, MIMO is paired up with OFDM improve the performance of wireless transmission systems. Multiple antennas square measure used each at the transmission moreover as receiving ends. The performance of associate OFDM system is measured, considering multipath delay unfold, channel noise, Lord Rayleigh attenuation channel and distortion. during this paper, bits square measure generated so mapped with modulation schemes like QPSK, 8PSK, and QAM. Then, the mapped knowledge is split into blocks of a hundred and twenty modulated knowledge wherever a coaching sequence of the info is inserted each at the start and ending elements of the block. Therefore, the capability is hyperbolic by transmission totally different completely different} streams of knowledge through different antennas at a same carrier frequency. Any put down image interference (ISI) created when the transmission is recovered by mistreatment abstraction sampling integrated with the signal process algorithmic program. what is more, the performance remains a similar with completely different combos of transmission and receiving antennas.

INDEX TERMS: water filling algorithm, ofdm process, isi process

1. INTRODUCTION

In older multi-channel systems mistreatment FDM, the entire out there information measure is split into N non-overlapping frequency sub-channels. every sub-channel is modulated with a separate image stream and also the N sub-channels area unit frequency multiplexed. OFDM may be a multi-channel modulation system using Frequency Division Multiplexing (FDM) of orthogonal sub-carriers, every modulating an occasional bit-rate digital stream. In FDM, the hindrance of spectral overlapping of sub-carriers reduces lay to rest channel Interference, however results in AN inefficient use of spectrum. The guard bands on either aspect of every sub-channel area unit a waste of precious information measure. to beat this downside, OFDM uses N overlapping (but orthogonal) sub carriers, every carrying a baud of 1/T and spaced 1/T apart. due to the frequency spacing selected , the sub-carriers area unit all mathematically orthogonal to every alternative. this allows the correct reception of the image streams while not the need of non overlapping spectra differently of specifying the sub-carrier Orthogonality condition is to need that every sub-carrier have precisely whole {number|number} number of cycles within the interval T. It are often shown that the modulation of those orthogonal sub-carriers are often painted as AN Inverse Fourier remodel. Instead, one might use a DFT operation followed by low-pass filtering to come up with the OFDM signal. It should be noted that OFDM are often used either as a modulation or a multiplexing technique .Orthogonal frequency-division multiplexing (OFDM) may be a methodology of secret writing digital knowledge on multiple carrier frequencies. OFDM has developed into a preferred theme for broadband electronic communication, whether or not wireless or over copper wires, employed in applications like digital

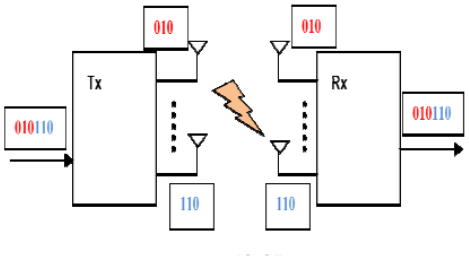
TV and audio broadcasting, DSL broadband web access, wireless networks, and 4G mobile communications.

OFDM is actually the image of coded OFDM (COFDM) and separate multi-tone modulation (DMT), and may be a frequency-division multiplexing (FDM) theme used as a digital multi-carrier modulation methodology. On many parallel knowledge streams or channels. every sub-carrier is modulated with a traditional modulation theme (such as construction modulation or phase-shift keying) at an occasional image rate, maintaining total knowledge rates just like standard single-carrier modulation schemes within the same information measure.

2. PRINCIPLES OF OFDM

OFDM could be a block transmission technique. Within the baseband, complex-valued knowledge symbols modulate an outsized range of tightly sorted carrier waveforms. The transmitted OFDM signal multiplexes many low-rate knowledge streams — every knowledge stream is related to a given subcarrier. This property is commonly measured via the signal's peak-to-average power quantitative relation. To be ready to transmit and receive these peaks while not clipping the signal, the A/D and D/A got to be designed with high demands on vary and preciseness.

The main advantage of this idea in {an exceedingly in a very} radio setting is that every of the info streams experiences an virtually flat weakening channel. In slowly weakening channels, the bury image buryference (ISI) Associate in Nursingd inter carrier interference (ICI) at intervals an OFDM image are often avoided with alittle loss of transmission energy victimisation the conception of a cyclic prefix.



A basic MIMO-OFDM system

3. SIGNAL GENERATION

An ideal OFDM signal that may be generated by a bank of oscillators. Such associate implementation may, however, become prohibitively complicated because the range of subcarriers becomes giant. Like the reception of the information samples with the DFT, the baseband signal is generated digitally by means that of associate IDFT OFDM transmitter. This has made-up the manner for sensible use of OFDM. Contemplate the signal

$$\tilde{s}(t) = \sum_{n=0}^{lN-1} s_n g(t - \frac{nT}{l}), \qquad \text{for all } t,$$

Where

$$s_n = \frac{1}{\sqrt{N}} \sum_{k=0}^{N-1} x_k e^{j2\pi \frac{kn}{lN}}, \qquad n = 0,\ldots,lN-1,$$

Is the oversampled IDFT of the constellation symbols Xk, the number L>1 associated g(t) is an interpolating filter. The signal from the D/A, s(t) , is created terribly near the best signal s(t) as outlined. the standard of the approximation depends on, for instance, the characteristics of the D/A together with the interpolation filter and therefore the IDFTA spectrum of associate OFDM signal is shown. The spectrum decays with 1/f and spectral outpouring into close bands is usually large to satisfy regulation needs. many approaches are taken to combat this out-of-band emission. the foremost easy is maybe to use an oversized range of subcarriers to slim the spectra, but at the price of increased quality, increased

sensitivity to physicist effects, and better demands on the accuracy of frequency synchronization. Another approach is to use pulse shaping of the OFDM image to vary the spectral occupancy. Pulse shaping is done either by applying a time OFDM image or by passing the OFDM signal through a filter, usually combined with the interpolation filter on top of. Pulse shaping must be applied with care since orthogonality between the subcarriers is never maintained. In associate N subcarriers MIMO-OFDM system, the information streams area unit initial {passed through|skilled|older| more matured more experienced| more responsible more established|seasoned|knowledgeable|versed|capable|competent|skillful|well-versed|tried associated true gone through|had|undergone|saw|felt|responded to suffered} an OFDM modulator. Then, the ensuing OFDM symbols area unit launched at the same time through the transmit antennas. Within the receiver aspect, the individual received signals area unit older OFDM rectifier. The outputs of the OFDM rectifier area unit decoded and rearranged to urge the required output. Fig. shows the schematic diagram of a basic MIMO-OFDM system.

4. IFFT PROCESS

This methodology involves computing the quantile perform of the distribution — in alternative words, computing the accumulative distribution perform (CDF) of the distribution (which maps variety within However, it is a useful method for building more generally applicable samplers such as those based on rejection sampling.

5. COGNITIVE RADIO NETWORKS

Cognitive radio is an intelligent radio that can be programmed and configured dynamically. Its transceiver is designed to use the best wireless channels in its vicinity. Such a radio automatically detects available channels in wireless spectrum, then accordingly changes its transmission or reception parameters to allow more concurrent wireless communications in a given spectrum band at one location.For the normal distribution, the lack of an analytical expression for the corresponding quantile function means that other the domain to a chance between zero and 1) so inverting that perform. this can be the supply of the term "inverse" or "inversion" in most of the names for this methodology. Note that for a separate distribution, computing the CDF isn't generally too difficult: we have a tendency to merely add up the individual possibilities for the varied points of the distribution. For a nonstop distribution, however, we'd like to integrate the chance density perform (PDF) of the distribution, that is not possible to try and do analytically for many distributions (including the traditional distribution).

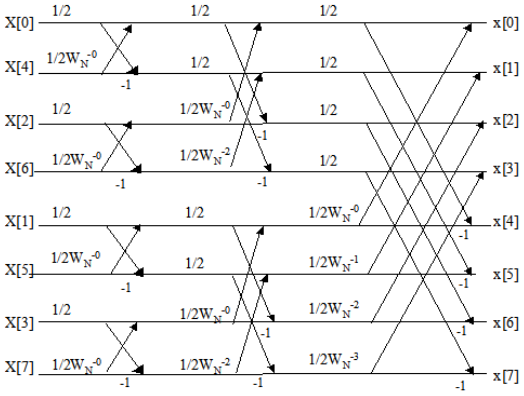


Fig: FFT TO IFFT PROCESS

As a result, this method may be computationally inefficient for many distributions and other methods are preferred;

methods (e.g. the Box–Muller transform) may be preferred computationally. It is often the case that, even for simple distributions, the inverse transform sampling method can be improved on. See, for example, the ziggurat algorithm and rejection sampling.

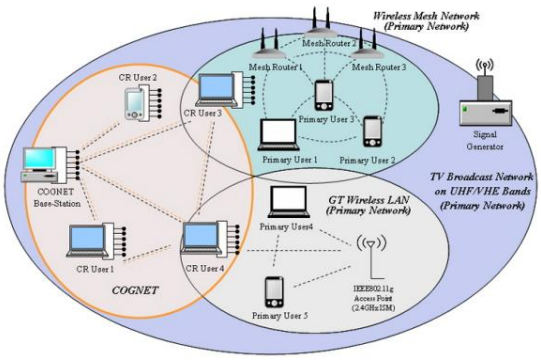


fig: Cooperative Relay Cognitive Radio Network.

On the other hand, it is possible to approximate the quantile function of the normal distribution.extremely accurately using moderate-degree polynomials, and in fact the method of doing this is fast enough that inversion sampling is now the default method for sampling from a normal distribution in the statistical package R

1. SPATIAL FILTERING

The transmission of multiple data streams over more than one antenna is called spatial multiplexing Spatial Diversity Spatial diversity improves the signal quality and achieves a higher signal to noise ratio at the receiver side. The principle of diversity relies on the transmission of structured redundancy. This redundancy can be transmitted at any time, from any antenna, over any frequency or at any polarization. Two kinds of spatial diversity need to be considered:

2 .MIMO CHANNEL MATRIX

The MIMO system has multiple links and operates on the same frequency whereas the non-MIMO system is linked over multiple channels by several frequencies. The challenge of this technology is the separation and the equalization of the signal in all paths. The channel model includes the channel matrix H with the direct and the indirect channel components.

Consider an OFDM symbol of N sub-symbols and cyclic prefix, P, the length of which is less than the last significant tap delay. The sent signal is 'x' and the received signal is 'y'. A time and narrowband channel is assumed. The output y can be expressed in a matrix format as follows;

$$y = H x \eta$$

s

Where y is the received vector, x is the transmitted vector and η is complex AWGN vector.

1. Capacity:

Equation for the theoretical channel capacity:

$$c_{SISO} = f_g \log_2(1 + S/N)$$

It includes the transmission bandwidth fig and the signal noise ratio. Most channel capacity improvements are based on bandwidth extensions or modulations. The Shannon capacity of MIMO Systems additionally depends on the number of antennas. For MIMO the capacity is given by the following equation:

$$c_{MIMO} = Mf_g \log_2(1 + S/N)$$

Where M is the minimum of MT (number of transmitting antennas) or MR (number of receiving antennas) and represents the number of spatial streams. For example, a 2 x 3 system can only support two spatial streams, which is also true for a 2 x 4 system. Asymmetrical antennas constellations are referred to receive or transmit diversity.

$$c_{Tx/Rx} = f_g \log_2\left(1 + M\left(\frac{S}{N}\right)\right)$$

2. SNR Threshold:

In the proposed transmission control scheme, the threshold value identifies whether multiple transmit antennas should be used or not. Therefore, it is obvious that selecting the right threshold value has significant effect on the performance of the MIMO system. A small threshold increases the complexity without achieving high multiplexing gain.

OFDM SYSTEM PARAMETERS USED FOR SIMULATION

PARAMETER	VALUE
CARRIER MODULATION	QPSK
FFT SIZE	128
NO OF CARRIERS	120
GUARD TIME	32 SAMPLES (40 deg)
GUARD PERIOD TYPE	FULL CYCLE

	CALCULATION

6. SIMULATION RESULT ANALYSIS

In this simulation, a highly scattered environment is considered. The capacity of a MIMO channel is analyzed with the antenna configuration as shown in Table.

Each channel is considered as a parallel flat fading channel. The power in a parallel channel (after decomposition) is distributed as water filling algorithm. Channel matrix H is measured using Rayleigh distribution function.

The complexity of the optimal power profile that was obtained in the previous section may be quite high, especially when the number of the antennas is high, since several iterations may be required in finding the value of c from (10b). Therefore it is highly interested to propose the sub-optimal power loading profile.

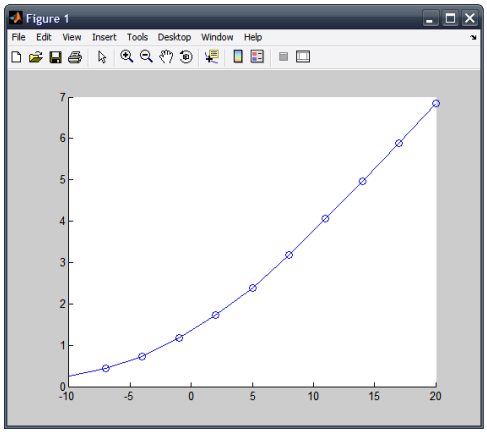


Fig : 1Tx-1RX Operation

This simulation computes channel capacity and PDF (probability density function) of elements in SVD of matrix H, by varying the SNR from -10 dB to 20 dB, where 104 iterations are performed.

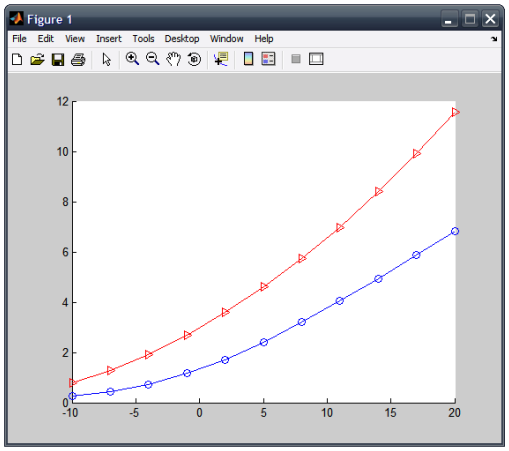


Fig : 2Tx-2RX Operation

TRANSMITTING AND RECEIVING ANTENNA COMBINATION

COMBINATION	No of TX	No of RX
1	1	1
2	2	2
3	2	3
4	3	2
5	4	4

MIMO-OFDM Simulation Results:

The CHANNEL CAPACITYVS SNR curve of different MIMO systems is shown in Fig.5. Fig.6 represents the power spectral density (PDF) VS SNR.These graphs depict that the 4 x 4 MIMO systems provides better channel capacity and PDF than other combinations. This indicates that a higher order MIMO system increases the system performance. This motivates the search for simpler power allocation schemes that can perform close to the optimal. The water filling algorithm is based on iterative procedure

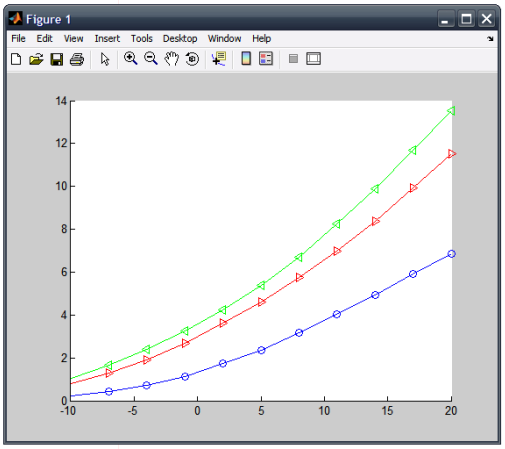


Fig : 2Tx-3RX Operation

In case, where T ≠ R, the number of spatial channelsbecome restricted to the minimum of T and R. If the number oftransmit antennas is greater than the receive antennas (T > R),U will be an R x R matrix, V will be a T x T matrix and ∑will be made of a square matrix of order R followed by T-Rzero columns

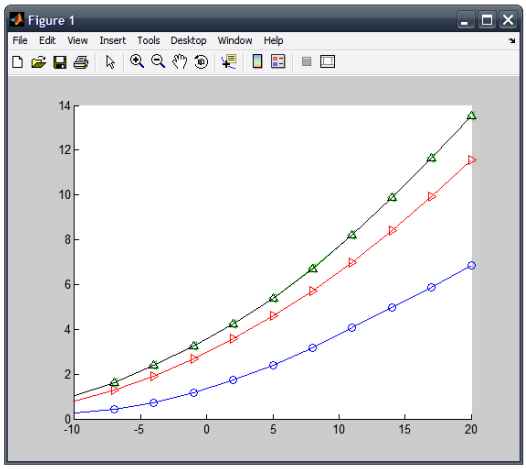


Fig : 3Tx-2RX Operation

It is interesting to note that the system performance remains almost the same when the number of transmitter and receiver antennasis altered (2x3 MIMO and 3x2 MIMO systems).

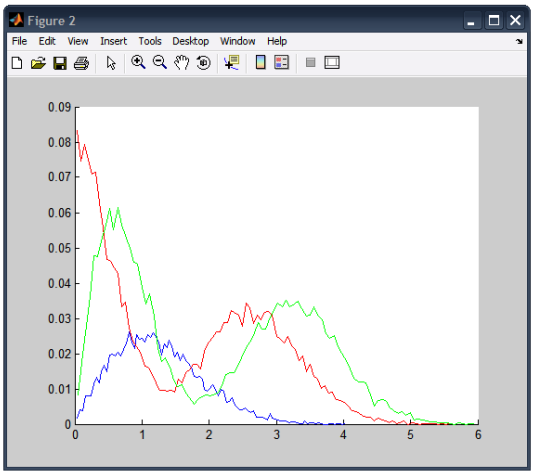


Fig Comparison of PDF of different MIMO system.

Bandwidth is the difference between the upper and lower frequencies in a continuous set of frequencies.

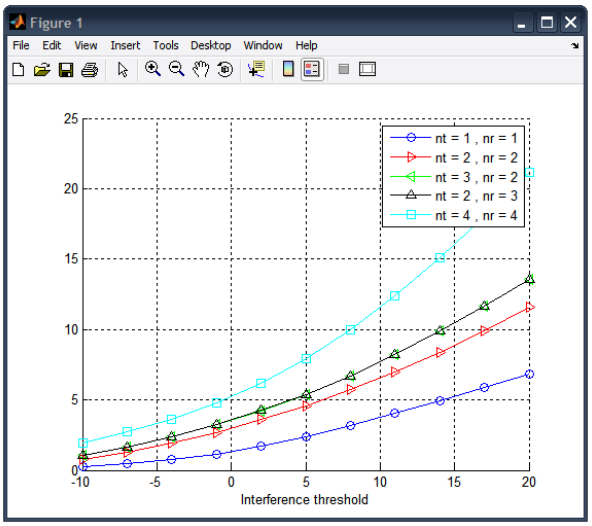


Fig Comparison of channel capacity of different MIMO system.

It is typically measured in hertz, and may sometimes refer to pass band bandwidth, sometimes to baseband bandwidth, depending on context. Pass band bandwidth is the difference between the upper and lower cut off frequencies of, for example, a band pass filter, a communication channel, or a signal spectrum.

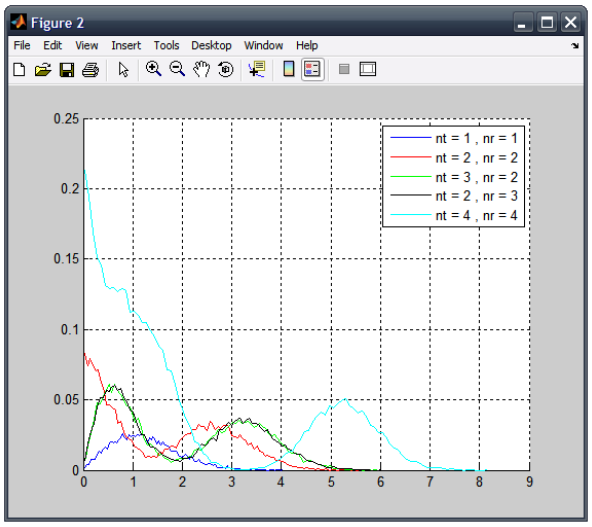


Fig Comparison of PDF of different MIMO systems.

In case of a low-pass filter or baseband signal, the bandwidth is equal to its upper cut off frequency. Bandwidth in hertz is a central concept in many fields, including ECE, IT, DCE RD DSP and Spectroscopy..

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

7. CONCLUSION

An OFDM link was demonstrated through computer simulations and practical tests performed on a low bandwidth base-band signal. Four main performance criteria were tested, which include OFDM's tolerance to multipath delay spread, channel noise, peak power clipping and start time error. Several other important factors affecting the performance of OFDM have only been partly measured. In the past, there were a lot of problems with multiple wave propagation which led to creation of ISI. The MIMO has helped to reduce the ISI problem. With the implementation of MIMO-OFDM, the probability that the transmission arrives at the receiver with little or no error is greatly increased compared to the rest of the transmission techniques. In this system, the capacity is increased significantly by transmitting the different streams of data through different antennas at a same carrier frequency.

8. REFERENCES

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