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Spectral Efficiency Improvement with Massive System for IOT Applications in 5G

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ABSTRACT: In the recent years more research is going on in 5G technology. Massive MIMO (large-scale antenna systems, covering hyper MIMO) is more attractive and different from current practice in 4G technology, through the preferred use of more service antennas over active terminals and time-division, frequency division duplex operations. More number of Antennas can be used for the channel state information (CSI) estimation, which directly affects the normalized mean square error (NMSE) and spectrum efficiency. To provide high performance in 5G cellular networks, Massive MIMO is one of the promising methods with simple transmit and receive operations. But it is possible only with accurate channel state information at the transmitter. Because of usage of large dimensional channels is one of the challenging issues in current research. In this paper, we have designed massive system with the help of channel estimation technique. The all design is implement MATLAB software and calculate NMSE and spectrum efficiency.

KEYWORDS: Massive MIMO, Channel Estimation, NMSE, Spectrum Efficiency

I. INTRODUCTION

Wireless communications can be regarded as the most important developing area that has an extremely wide range of applications from TV remote control and cordless phones to cellular phones and satellite-based broadcasting systems. MIMO-OFDM technology has become one of the most promising solutions in the high data rate wireless channel transmissions [1, 2]. In the OFDM system with transmit diversity [3], when the receiver knows the channel information better, the space-time codes [4] can be decoded effectively. In order to enhance frequency efficiency, the receiver also needs to know the channel information for coherent detection. So channel estimation is directly related to the system performance. Clearly the performance improvement and capacity growth are based on accurate channel state information [5], which plays a significant role for MIMO-OFDM systems. The requirements of wireless communications have shifted from the low data rate voice services to real time video transmissions. Support for higher data rates [5] has become more essential and the development towards more advanced wireless systems is still ongoing. This involves the complexity of signal processing [6] algorithms in the receiver.

Among channel estimation algorithms the LS estimation is the simplest channel estimation. This algorithm has lower complexity. However, it has larger Mean Square Error (MSE) and it is easily influenced by noise and Inter Carrier Interference (ICI). LMMSE algorithm is a simplified algorithm of Minimum Mean Square Error (MMSE). Although they can achieve better performance than LS, they have higher computational-complexity and need to know the channel statistics which are usually unknown in real system. The method of least squares is a standard approach to the approximate solution of over determined systems, i.e., sets of equations in which there are more equations than unknowns. Least squares problems fall into two categories: linear or ordinary least squares and non-linear least squares, depending on whether or not the residuals are linear in all unknowns. The following discussion is mostly presented in terms of linear functions but the use of least-squares is valid and practical for more general families of functions.

II. PROPOSED METHODOLOGY

Information is encoded by channel encoders and scheduled by a computerized controller. The planned information is encoded using a MIMO encoder. Each information stream first passes through an OFDM modulator that performs an IFFT of length N blocks. It is then prepended with a cyclic prefix (CP). This includes a duplication of the last example for IFFT. At this point, sequential conversions are performed. Runs on a MIMO channel. At the receiver, the singular

characters are passed through an OFDM demodulator. The OFDM demodulator first processes the CP and then performs an N-point FFT.

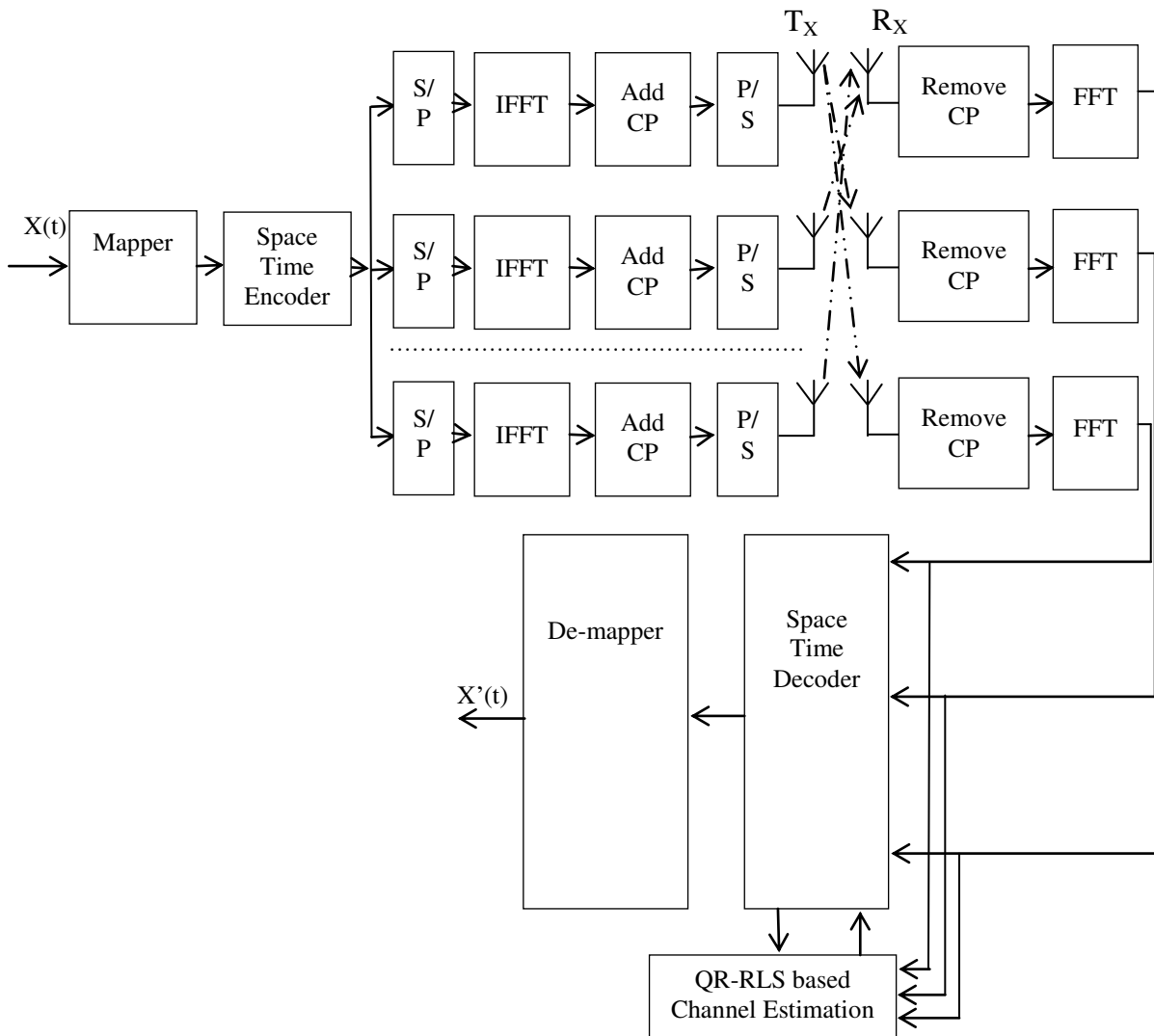


Figure 1: proposed Methodology of MIMO-OFDM system using QR-RLS Channel Estimator

The results from the OFDM demodulator are finally separated and passed through the MIMO decoder as an ML finder. This information is demodulated and then decoded. MIMO-OFDM devices were used with useful MATLAB/SIMULINK functionality. The execution device consists of two realities: one that regulates the use of QAM, and one that is integrated into the Star grouping component. The virtual adjustment plan delivers a set of datasets by distributing images to each subchannel, and the optimization plan determines the phase scheduling of the subchannels through a complex I-Q scheduling vector shown in Figure 1. Similar meandering flows of reality must be translated into simple symbols meaningful to the transmission channel. Similar meandering flows of reality must be translated into simple symbols meaningful for transmission channels. This is done to add a cyclic prefix to the baseband balanced signal since the baseband signals do not cross over. Then the character divides her at least two sections according to the requirements.

Square Root Recursive Least Square (QR-RLS) Algorithm

An QR-RLS based MIMO-OFDM channel estimation is proposed. Which uses given rotation based QR factorization for estimator updating. Because it is not possible to measure every wireless channel in the field, it is important to use

training sequences to estimate channel parameters, such as attenuations and delays of the propagation path. Since in most UWB receivers correlate the received signal with correlated a predefined template signal, a prior knowledge of the wireless channel parameters is necessary to predict the shape of the template signal that matches the received signal. However, as a result of the wide bandwidth and reduced signal energy, UWB pulses undergo severe pulse distortion.

IOT Application

Smart Home: With IoT creating the buzz, ‘Smart Home’ is the most searched IoT associated feature on Google. But, what is a Smart Home? Wouldn’t you love if you could switch on air conditioning before reaching home or switch off lights even after you have left home? Or unlock the doors to friends for temporary access even when you are not at home. Don’t be surprised with IoT taking shape companies are building products to make your life simpler and convenient. Smart Home has become the revolutionary ladder of success in the residential spaces and it is predicted Smart homes will become as common as smartphones. The cost of owning a house is the biggest expense in a homeowner’s life. Smart Home products are promised to save time, energy and money.

Wearables:- Wearables have experienced a explosive demand in markets all over the world. Companies like Google, Samsung have invested heavily in building such devices. But, how do they work?

Wearable devices are installed with sensors and software which collect data and information about the users. This data is later pre-processed to extract essential insights about user.

Connected Cars: The automotive digital technology has focused on optimizing vehicles internal functions. But now, this attention is growing towards enhancing the in-car experience.

A connected car is a vehicle which is able to optimize its own operation, maintenance as well as comfort of passengers using onboard sensors and internet connectivity.

Most large auto makers as well as some brave startups are working on connected car solutions. Major brands like Tesla, BMW, Apple, and Google are working on bringing the next revolution in automobiles.

Industrial Internet: Industrial Internet is the new buzz in the industrial sector, also termed as Industrial Internet of Things (IIoT). It is empowering industrial engineering with sensors, software and big data analytics to create brilliant machines. According to Jeff Immelt, CEO, GE Electric, IIoT is a “beautiful, desirable and investable” asset. The driving philosophy behind IIoT is that, smart machines are more accurate and consistent than humans in communicating through data. And, this data can help companies pick inefficiencies and problems sooner.

IIoT holds great potential for quality control and sustainability. Applications for tracking goods, real time information exchange about inventory among suppliers and retailers and automated delivery will increase the supply chain efficiency. According to GE the improvement industry productivity will generate \$10 trillion to \$15 trillion in GDP worldwide over next 15 years.

Smart Cities: Smart city is another powerful application of IoT generating curiosity among world’s population. Smart surveillance, automated transportation, smarter energy management systems, water distribution, urban security and environmental monitoring all are examples of internet of things applications for smart cities.

IoT will solve major problems faced by the people living in cities like pollution, traffic congestion and shortage of energy supplies etc. Products like cellular communication enabled Smart Belly trash will send alerts to municipal services when a bin needs to be emptied.

By installing sensors and using web applications, citizens can find free available parking slots across the city. Also, the sensors can detect meter tampering issues, general malfunctions and any installation issues in the electricity system. To understand better the functioning of Smart Cities check out this video.

III. SIMULATION RESULT

Fig. 4 represents the Normalized MSE of 8x8 Massive system using channel estimation with the help of QAM-16, QAM-32 and QAM-64. QAM -64 provide best Normalized MSE compared to QAM-16. Farzana Kulsoom et al. [1] is providing NMSE 9×10^{-4} dB for common support, 9.1×10^{-4} dB for number of users and 10^{-4} dB for number of antenna at each user. The proposed scheme is provide NMSE 3×10^{-5} dB for QAM-64, 5×10^{-5} dB for QAM-32 and 6×10^{-5} dB for QAM-16. Clearly that, the proposed schemes is 16.08% improvement compared to Farzana Kulsoom [1].

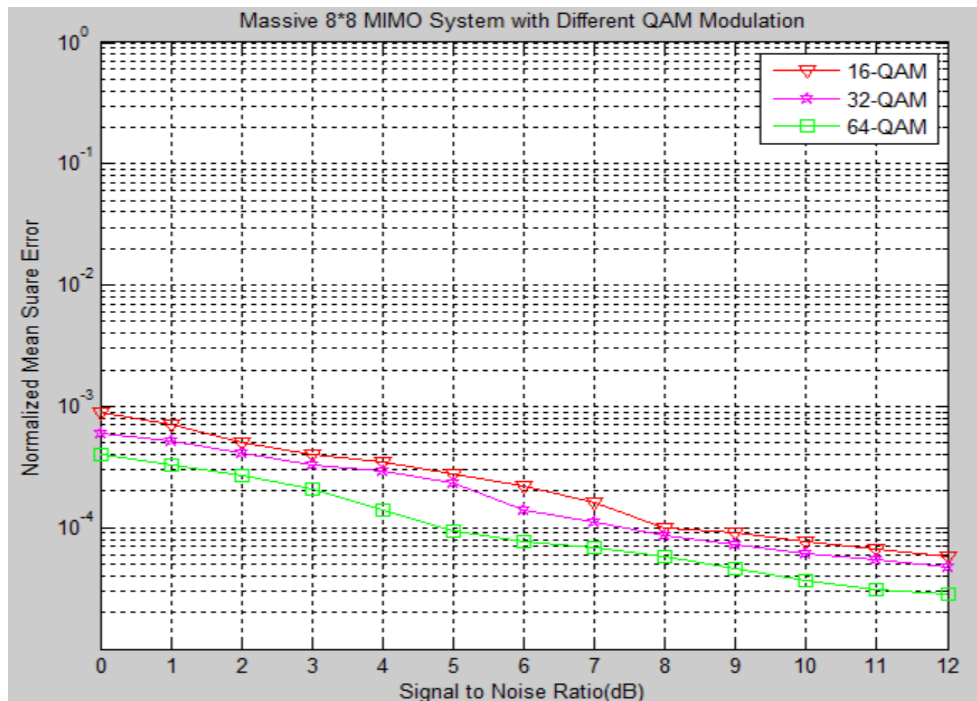


Figure 2: NMSE of Massive 8x8 System using Channel Estimation Technique

Fig. 3 represents the Normalized MSE of 16x16 Massive system using channel estimation with the help of QAM-16, QAM-32 and QAM-64. QAM -64 provide best Normalized MSE compared to QAM-16. Farzana Kulsoom et al. [1] is providing NMSE 9×10^{-4} dB for common support, 9.1×10^{-4} dB for number of users and 10^{-4} dB for number of antenna at each user. The proposed scheme is provide NMSE 2×10^{-5} dB for QAM-64, 4×10^{-5} dB for QAM-32 and 5×10^{-5} dB for QAM-16. Clearly that, the proposed schemes is 19.8% improvement compared to Farzana Kulsoom [1].

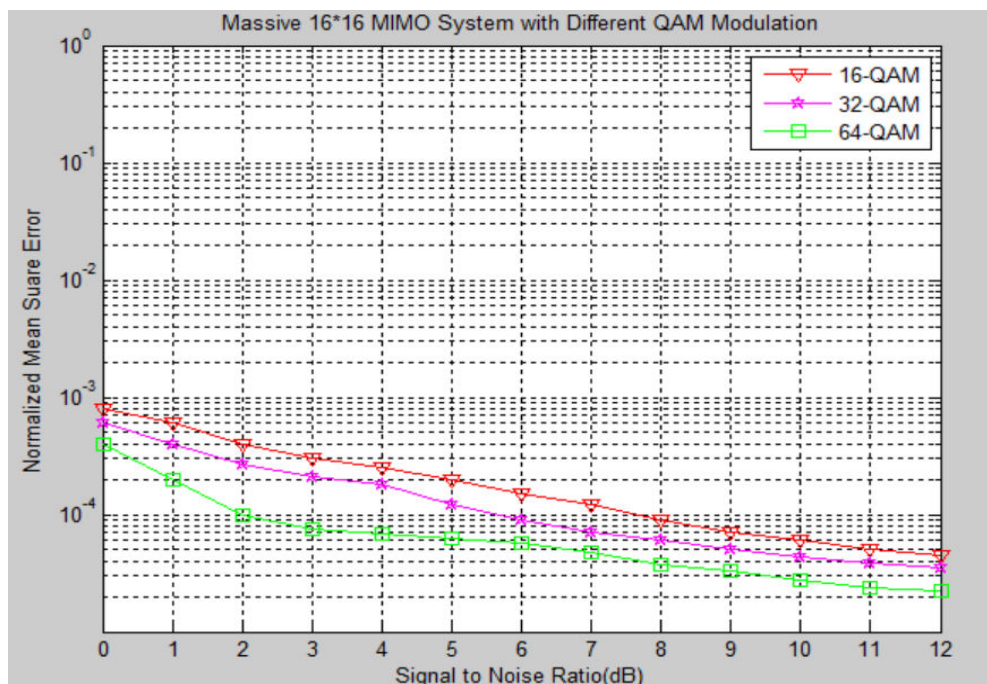


Figure 3: NMSE of Massive 16x16 System using Channel Estimation Technique

Fig. 4 shows the spectrum efficiency of 16×16 Massive system using CE with the help of BPSK, QPSK and QAM-16. QAM-16 offers the most efficient spectrum efficiency when compared to BPSK. Mustafa S. Aljumaily et al. [2] provide an 22 bits/s/Hz spectrum efficiency of 15 SNR for 16×4 systems, 40 bits/s/Hz spectrum efficiency of 15 SNR for 64×16 systems and 51 bits/s/Hz spectrum efficiency of 15 SNR for 144×36 systems. The proposed method provides 83 bits/s/Hz spectrum efficiency of QAM-16, 81 bits/s/Hz spectrum efficiency of QPSK and 79 bits/s/Hz spectrum efficiency of BPSK. Clearly, the proposed methods represent a 5.5% improvement over Mustafa S. Aljumaily et al. [2].

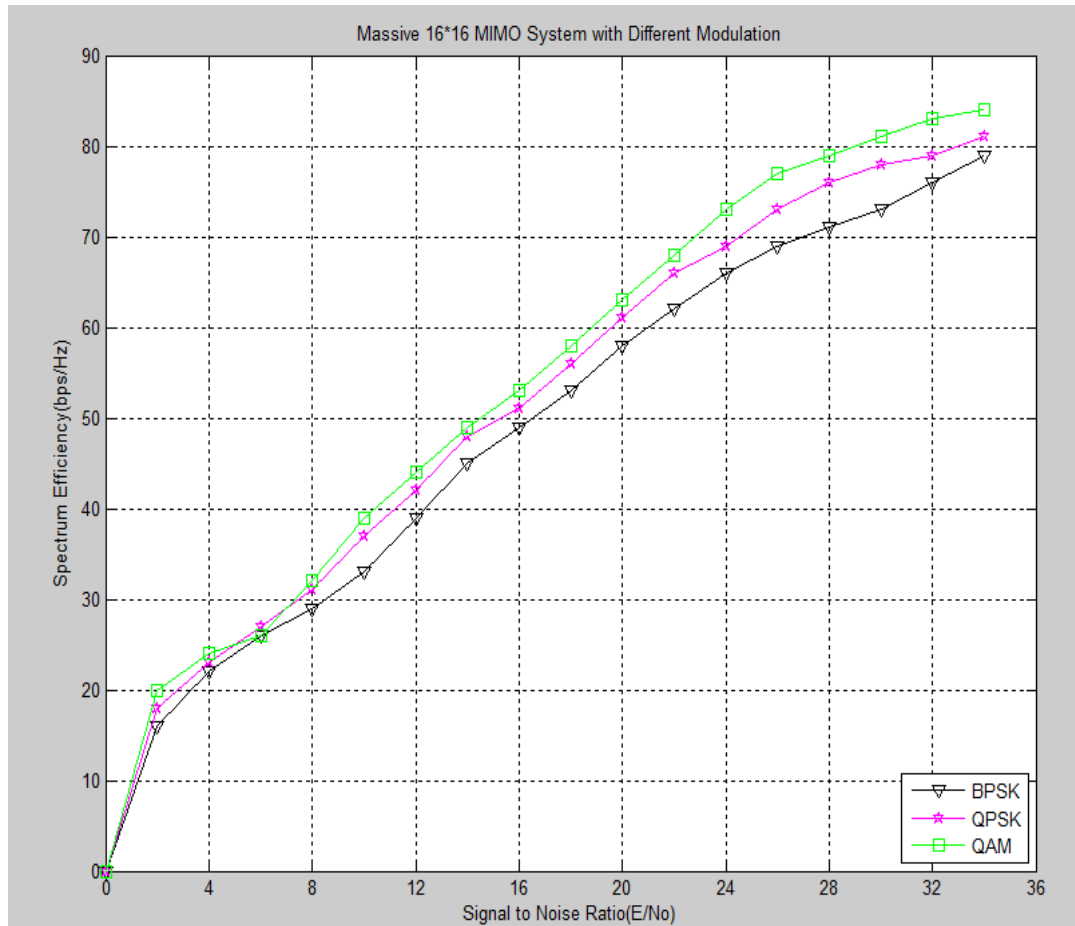


Figure 4: Estimating the Spectrum Efficiency of a Massive 16×16 System using CE Technique

IV. CONCLUSION

The prime aim of the research work carried in the thesis is to propose an optimal hybrid beamforming technique for millimeter Wave massive MIMO systems with respect to spectral efficiency and computational complexity. The optimal hybrid beamforming technique is key enabler technology for future wireless communication systems. The future wireless communication systems are expected to completely revolutionize the user experience by providing the key services like device-to-device communication, augmented reality, autonomous vehicles, smart homes, smart cities, smart wearable devices, smart healthcare, machine-to-machine communication, smart agriculture and industrial IOT.

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