SPATIAL REWEIGHTED SUPER-RESOLUTION CHANNEL ESTIMATION FOR MMWAVE MASSIVE MIMO WITH HYBRID PRECODING

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ABSTRACT

Channel estimation is challenging for millimeter wave (mm Wave) massive MIMO with hybrid precoding, since the number of radio frequency (RF) chains is much smaller than that of antennas. Conventional compressive sensing based channel estimation schemes suffer from severe resolution loss due to the channel angle quantization. To improve the channel estimation accuracy, Spatial Durbin Model (SDM)-based super resolution channel estimation is proposed in this project. By optimizing an objective function through the gradient descent method, the proposed scheme can iteratively move the estimated angle of arrivals/departures (AoAs/AoDs) towards the optimal solutions, and finally realize the super-resolution channel estimation. In the optimization, a weight parameter is used to control the tradeoff between the sparsity and the data fitting error. In addition, Spatial Durbin Model (SDM) -based preconditioning is developed to reduce the computational complexity of the proposed scheme. Simulation results verify the better performance of the proposed scheme than conventional solutions.

***Keywords:* Angle Of Arrivals/Departures (Aoas/Aods), Iterative Reweighted (IR),Multiple Input Multiple Output (MIMO), Millimeter Wave(Mm Waves), Radio Frequency (RF), Spatial Durbinmodel (SDM),**

I. INTRODUCTION

Millimeter waves(mm waves)massive MIMO has been recognized as a promising technology for future 5G wireless communication .To reduce the hardware cost and power consumption, hybrid recoding as been proposed for practical mm wave massive MIMO system.The analog and digital code sign in hybrid precoding requires accurate channel state information. In proposed the adaptive codebook based channel sounding scheme, where the transmitter and receiver search for the best beam pair by adjusting the predefined precoding and combining code book. On the other hand by exploiting the angular channel sparsity, the on-grid compressive sensing based method could estimate the channel with reduced training overhead. MIMO-OFDM is the foundation for most advanced wireless local area network and mobileboard band network standards because it achieves the greatest spectral efficiency.

II. OBJECTIVE OF WORK

The main concept of this project to improve the channel estimation accuracy AoAs/AoDs to decrease the weighted summation of the sparsity and the data fitting error.

III. EXISTING SYSTEM

Millimeter wave (mm wave)MIMO will likely use hybrid analog and digital precoding, which use a small number of RF chain to avoid energy consumption associated with mixed signal components like analog to digital components not to mention based processing complexity[2].Large scale orthogonal frequency division multiplexing(OFDM)multiple input multiple output(MIMO)is a promising candidate to achieve the spectral efficiency up to several tens of bps/Hz for future wireless communication[3].the use of outdoor millimeter wave communication for backhaul networking between call and mobile access with in cell. The performance of the proposed alignment technique is analyzed and compared with other search and alignment methods. The contribution of this paper are the follow. We propose a novel IR based super resolution channel estimation scheme for mmWave massive MIMO with hybride precoding[6]. The proposed SVD based preconditioning significantly reduces the computational complexity of the IR procedure,and make the methods practical in mm waves channel estimation.

IV. SYSTEM DESIGN AND ANALYSIS

Orthogonal Frequency Division Multiplexing is a form of signal modulation that divides a high data rate modulating stream placing them onto many slowly modulated narrowband close-spaced subcarriers, and in this way is less sensitive to frequency selective fading.

4.1 Data on OFDM

The data to be transmitted on an OFDM signal is spread across the carriers of the signal, each carrier taking part of the payload. This reduces the data rate taken by each carrier. The lower data rate has the advantage that interference from reflections is much less critical. This is achieved by adding a guard band time or guard interval into the system. This ensures that the data is only sampled when the signal is stable and no new delayed signals arrive that would alter the timing and phase of the signal.

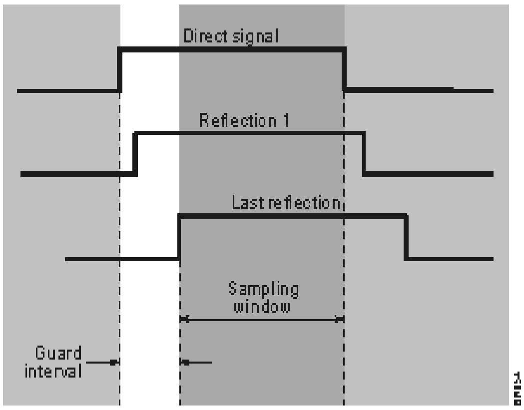

Fig :4.1 Data On OFDM

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4.2. MIMO Formats

The two main formats for MIMO are given below:

- Spatial diversity**:** Spatial diversity used in this narrower sense often refers to transmit and receive diversity. These two methodologies are used to provide improvements in the signal to noise ratio and they are characterized by improving the reliability of the system with respect to the various forms of fading.
- Spatial multiplexing**:** This form of MIMO is used to provide additional data capacity by utilizing the different paths to carry additional traffic, i.e. increasing the data throughput capability.

4.3. Software Implemented

4.3.1 MATLAB 2013a

MATLAB is a high-level language and interactive environment for numerical computation, visualization, and programming. Using MATLAB, you can analyze data, develop algorithms, and create models and applications. The language, tools, and built-in math functions enable you to explore multiple approaches and reach a solution faster than with spreadsheets or traditional programming languages, such as C/C++ or Java. You can use MATLAB for a range of applications, including signal processing and communications, image and video processing, control systems, test and measurement, computational finance, and computational biology.

V. PROPOSED SYSTEM

Spatial Durbin Model (SDM) is one method of spatial autoregressive. This model was developed because the dependencies in the spatial relationships not only occur in the dependent variable, but also on the in dependent variables. In the assessment of parameter estimation, the process is carried out by Maximum Likelihood Estimation (MLE). This estimation can be approximation by Spatial Autoregressive Models (SAR). By MLE, the matrix of independent variable in SAR is X and in SDM is [I X W1X], so that the estimation in SDM was done by replace matrix X in SAR by [I X W 1X]. This estimation perform the unbiased estimator for β and σ 2 . Estimate ρ was done by optimize the concentrated log-likelihood function with respect to ρ

5.1 Objective of Project

- Signal generation
- Eigen beam forming
- Spatial modulation
- Apply OFDM
- Analyze the precoding output
- Maximum likelihood estimation
- Spatio-Temporal Context
- Maximal Ratio Combining

5.2 Flow Chart

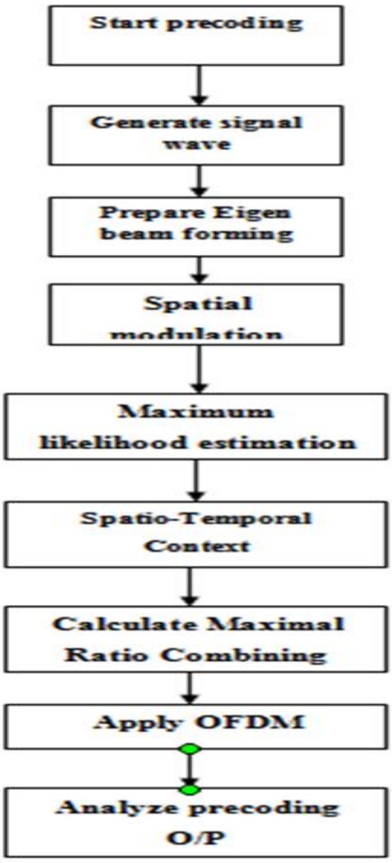

Fig: 5.2 Flow chart

5.3 Beam Forming

Beam forming is a kind of radio frequency (RF) management in which an access point makes use of various antennas to transmit the exact same signal. Beam forming is considered a subset of smart antennas or Advanced Antenna Systems (AAS).

$$\mathrm{AMP} = \frac{\sum_{i=1}^{M} \min(p_i)}{M},$$

Signal generation is process of create the sample communication signal by randomized signal process method.

int number = a + rand( )%n;

Beam forming is a kind of radio frequency (RF) management in which an access point makes use of various antennas to transmit the exact same signal. Beam forming is considered a subset of smart antennas or Advanced Antenna Systems (AAS).

Df =λf

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5.4 Spatial Modulation

Spatial modulation is a transmission technique

$$N_s = \min(N_t, N_r)$$

In MIMO wireless communication and fiber wireless communication technology to transmit independent variable and separately encode data signal is called "stream". Therefore space dimension is reduced or multiple more than one time.

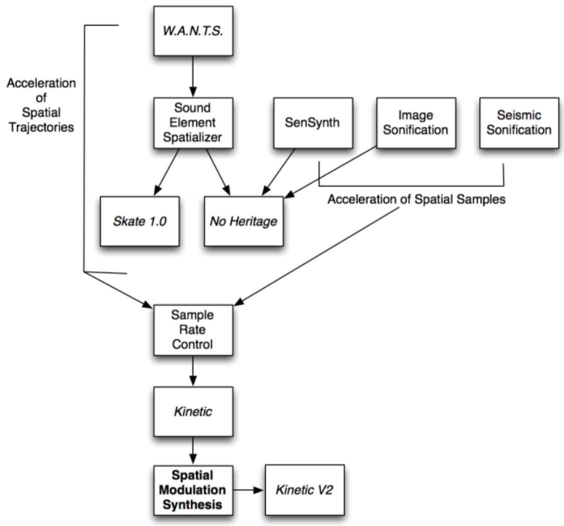

Fig: 5.4. Spatial Modulation

5.5 OFDM

OFDM is a form of multicarrier modulation. An OFDM signal consists of a number of closely spaced modulated carriers. When modulation of any form - voice, data, etc. is applied to a carrier, then sidebands spread out either side. It is necessary for a receiver to be able to receive the whole signal to be able to successfully demodulate the data. As a result when signals are transmitted close to one another they must be spaced so that the receiver can separate them using a filter and there must be a guard band between them. This is not the case with OFDM. Although the sidebands from each carrier overlap, they can still be received without the interference that might be expected because they are orthogonal to each other.This is achieved by having the carrier spacing equal to the reciprocal of the symbol period.

5.6. Analyze The Precoding Output by Maximum Likelihood Estimatio,Spatio-Temporal Context and Maximal Ratio Combining

In statistics, maximum likelihood estimation(MLE)is a method of estimating the parameters of a statistical model, given observation. The method obtains the parameter estimates by finding the parameter values that maximize the likelihood function. The estimation are called maximum likelihood estimates.

$$P(x;\mu,\sigma) = \frac{1}{\sigma\sqrt{2\pi}} \exp\left(-\frac{(x-\mu)^2}{2\sigma^2}\right)$$

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The method of maximum likelihood is used with a wide range of statistical analyses.

$$L(\mu,\sigma;data) = P(data;\mu,\sigma)$$

VI. RESULT

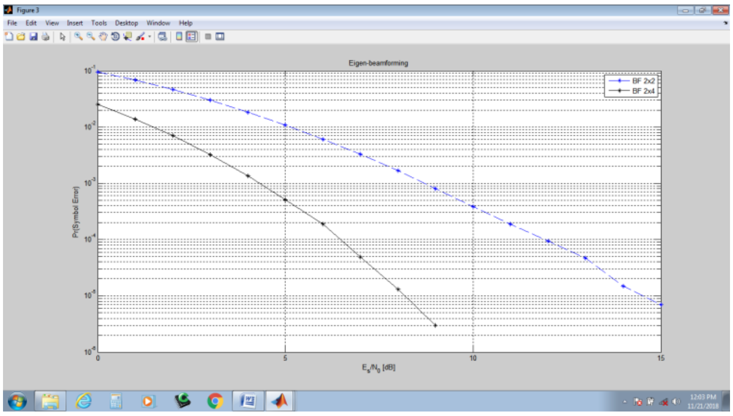

Fig.6.1 waveform of Eigen beam form

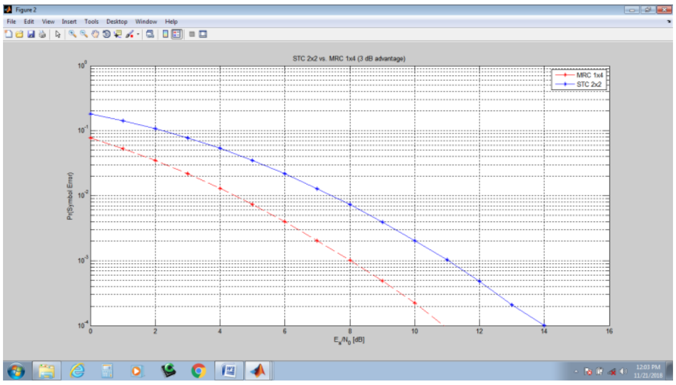

Fig:6.2.waveform of OFDM

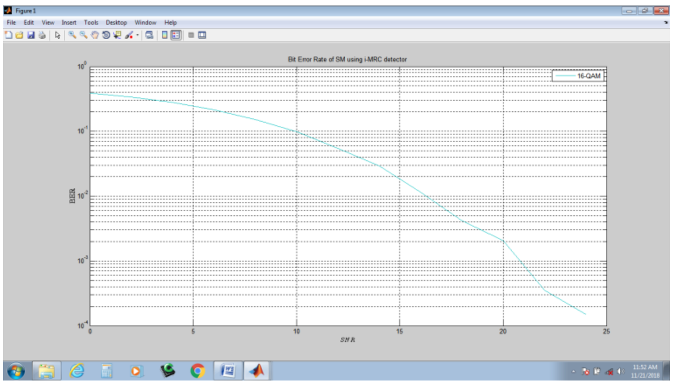

Fig:6.3.waveform of maximum likelihood estimation

VII. CONCLUSION

In this paper, we have proposed an SR-based super resolution channel estimation scheme for mm Wave massive MIMO with hybrid preceding. Specifically, we have transformed the channel estimation problem to the optimization problem of a new objective function, which is the weighted summation of the sparsity and the data fitting error. The proposed scheme starts from the on-grid points in the angle domain, and iteratively moves them to the neighboring off grid actual positions via gradient descent method. In addition, we have proposed an SVD-based preconditioning to reduce the computational complexity. Simulation results have confirmed that the proposed super-resolution channel estimation scheme can advance the state-of-art by estimating the off-grid AoAs/AoDs with much increased accuracy. Angle estimation is the key of channel estimation for mm Wave massive MIMO. Estimating the AoAs/AoDs with higher resolution is a practical way to realize higher spectral efficiency.

REFERENCE

[1] S. Mumtaz, J. Rodriquez, and L. Dai, MmWave Massive MIMO: AParadigm for 5G, Academic Press, Elsevier, 2016.

[2] O. E. Ayach, S. Rajagopal, S. Abu-Surra, Z. Pi, and R. W. Heath,“Spatially sparse precoding in millimeter wave MIMO systems,” IEEE Trans. Wireless Commun., vol. 13, no. 3, pp. 1499-1513, Mar. 2014.

[3] X. Gao, L. Dai, S. Han, C.-L. I, and R. Heath, “Energy-efficient hybridanalog and digital precoding for mmWave MIMO systems with large antenna arrays,” IEEE J. Sel. Areas Commun., vol. 34, no. 4, pp. 998-1009, Apr. 2016.

[4] L. Dai, Z. Wang, and Z. Yang, “Spectrally efficient time-frequency training OFDM for mobile large-scale MIMO systems,” IEEE J. Sel. Areas Commun., vol. 31, no. 2, pp. 251-263, Feb. 2013.

[5] S. Hur, T. Kim, D. J. Love, J. V. Krogmeier, T. A. Thomas, and A. Ghosh, “Millimeter wave beamforming for wireless backhaul and access in small cell networks,” IEEE Trans. Commun., vol. 61, no. 10, pp. 4391-4403, Oct. 2013.

[6] A. Alkhateeb, O. E. Ayach, G. Leus, and R. W. Heath, “Channel estimation and hybrid precoding for millimeter wave cellular systems,” IEEE J. Sel. Topics Signal Process., vol. 8, no. 5, pp. 831-846, Oct.2014.

[7] D. Zhu, J. Choi, and R. W. Heath, “Auxiliary beam pair enabled AoD and AoA estimation in closed-loop large-scale millimeter-wave MIMO systems,” IEEE Trans. Wireless Commun., vol. 16, no. 7, pp. 4770-4785, May 2017.

[8] J. Lee, G. T. Gil, and Y. H. Lee, “Channel estimation via orthogonal matching pursuit for hybrid MIMO systems in millimeter wave communications,” IEEE Trans. Commun., vol. 64, no. 6, pp. 2370-2386, Jun. 2016.

[9] Z. Marzi, D. Ramasamy, and U. Madhow, “Compressive channel estimation and tracking for large arrays in mm-wave picocells,” IEEE J. Sel. Topics Signal Process., vol. 10, no. 3, pp. 514-527, Apr. 2016.

[10] J. Fang, F. Wang, Y. Shen, H. Li, and R. S. Blum, "Super-resolution compressed sensing for line spectral estimation: An iterative reweighted approach," IEEE Trans. Signal Process., vol. 64, no. 18, pp. 4649-4662, Sep. 2016.

[11] S. Haghighatshoar and G. Caire, Massive MIMO Pilot Decontamination and Channel Interpolation via Wideband Sparse Channel Estimation, IEEE Transactions on Wireless Communications, vol. 16, no. 12, pp. 8316-8332, Dec. 2017

[12] D. Zhu, J. Choi, and R. W. Heath, Auxiliary Beam Pair Enabled AoD and AoA Estimation in Closed-Loop Large-Scale Millimeter-Wave MIMO Systems, IEEE Transactions on Wireless Communications, vol. 16, no. 7, pp. 4770-4785, July 2017.

[13] C. Lin, G. Y. Li, and L. Wang, Subarray-Based Coordinated Beamforming Training for mmWave and Sub-THz Communications, IEEE Journal on Selected Areas in Communications, vol. 35, no. 9, pp. 2115-2126, Sept. 2017.

[14] S. Park, A. Alkhateeb, and R. W. Heath, Dynamic Subarrays for Hybrid Precoding in Wideband mmWave MIMO Systems, IEEE Transactions on Wireless Communications, vol. 16, no. 5, pp. 2907-2920, May 2017.

[15] K. Venugopal, A. Alkhateeb, N. González Prelcic, and R. W. Heath, Channel Estimation for Hybrid Architecture-Based Wideband Millimeter Wave Systems, IEEE Journal on Selected Areas in Communications, vol. 35, no. 9, pp. 1996-2009, Sept. 2017.

[16] Z. Chen and C. Yang, Pilot Decontamination in Wideband Massive MIMO Systems by Exploiting Channel Sparsity, IEEE Transactions on Wireless Communications, vol. 15, no. 7, pp. 5087-5100, July 2016.