

Spatial Reweighted Based Super-Resolution Channel Estimation for MM Wave Massive MIMO with Hybrid Precoding

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ABSTRACT: Channel estimation is challenging for millimeter wave (mmWave) 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, we propose a Spatial Durbin Model (SDM)-based super resolution channel estimation scheme in this paper. 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: Spatial Durbin Model (SDM), OFDM

I. INTRODUCTION

Millimeter-wave (mmWave) massive MIMO has been recognized as a promising technology for future 5G wireless communications. To reduce the hardware cost and power consumption, hybrid precoding has been proposed for practical mmWave massive MIMO systems, where hundreds of antennas are driven by a much smaller number of radio frequency (RF) chains. The analog and digital code sign in hybrid precoding requires accurate channel state information. However, the digital baseband cannot directly access all antennas due to the small number of RF chains, so it is difficult to accurately estimate the high-dimensional MIMO channel. Several novel channel estimation schemes have been recently proposed for mm Wave massive MIMO with hybrid precoding. Specifically, 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 codebooks. However, the channel estimation resolution is limited by the codebook size. It was able to achieve better angle estimation by performing an amplitude comparison with respect to the auxiliary beam pair. On the other hand, by exploiting the angular channel sparsity, the on-grid compressive sensing based methods could estimate the channel with reduced training overhead. However, such solutions assumed that the angle of arrivals/departures (AoAs/AoDs) lie in discrete points in the angle domain (i.e., "on-grid" AoAs/AoDs), while the actual AoAs/AoDs are continuously distributed (i.e., "off grid" AoAs/AoDs) in practice. The assumption of on-grid AoAs/AoDs results in the power leakage problem, which severely degrades the channel estimation accuracy. To solve this resolution limitation caused by the on-grid angle estimation, we propose an iterative reweight (IR)-based super resolution channel estimation scheme to estimate the off-grid AoAs/AoDs.

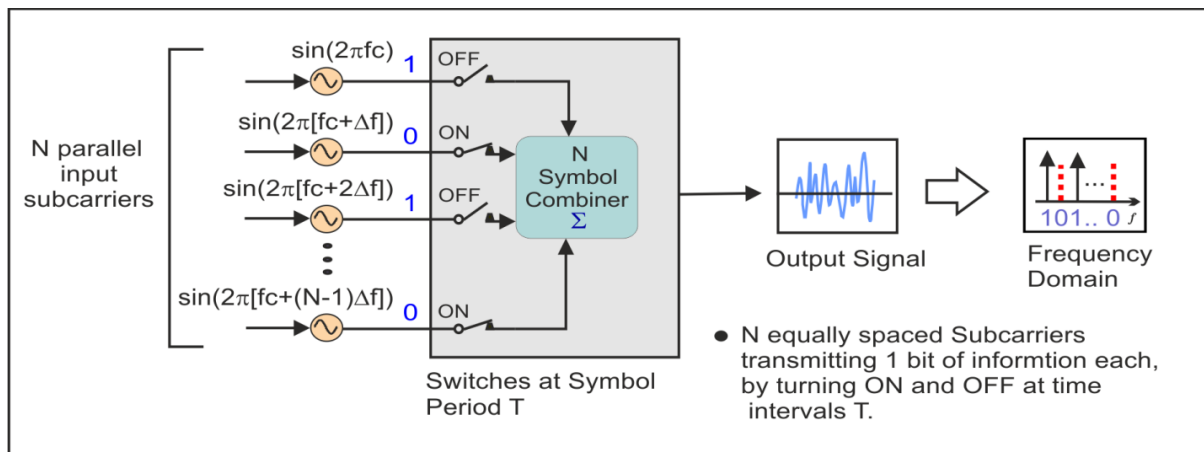
II. LITRATURE SURVEY

Millimeter wave (mmWave) MIMO will likely use hybrid analog and digital precoding, which uses a small number of RF chains to avoid energy consumption associated with mixed signal components like analog-to-digital components not to mention baseband processing complexity. However, most hybrid precoding techniques consider a fully-

connected architecture requiring a large number of phase shifters, which is also energy intensive. In this paper, we focus on the more energy-efficient hybrid precoding with sub-connected architecture, and propose a successive interference cancellation (SIC)-based hybrid precoding with near-optimal performance and low complexity. Inspired by the idea of SIC for multi-user signal detection, we first propose to decompose the total achievable rate optimization problem with non-convex constraints into a series of simple sub-rate optimization problems, each of which only considers one sub-antenna array. Then, we prove that maximizing the achievable sub-rate of each sub-antenna array is equivalent to simply seeking a precoding vector sufficiently close (in terms of Euclidean distance) to the unconstrained optimal solution. Finally, we propose a low-complexity algorithm to realize SIC based hybrid precoding, which can avoid the need for the singular value decomposition (SVD) and matrix inversion. Complexity evaluation shows that the complexity of SIC-based hybrid precoding is only about 10% as complex as that of the recently proposed spatially sparse precoding in typical mmWave MIMO systems. Simulation results verify the near-optimal performance of SIC-based hybrid precoding.

III. METHODOLOGY

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. Orthogonal Frequency Division Multiplexing or OFDM is a modulation format that is being used for many of the latest wireless and telecommunications standards. OFDM has been adopted in the Wi-Fi arena where the standards like 802.11a, 802.11n, 802.11ac and more. It has also been chosen for the cellular telecommunications standard LTE / LTE-A, and in addition to this it has been adopted by other standards such as WiMAX and many more. Orthogonal frequency division multiplexing has also been adopted for a number of broadcast standards from DAB Digital Radio to the Digital Video Broadcast standards, DVB. It has also been adopted for other broadcast systems as well including Digital Radio Mondiale used for the long medium and short wave bands.



Simple OFDM Generation

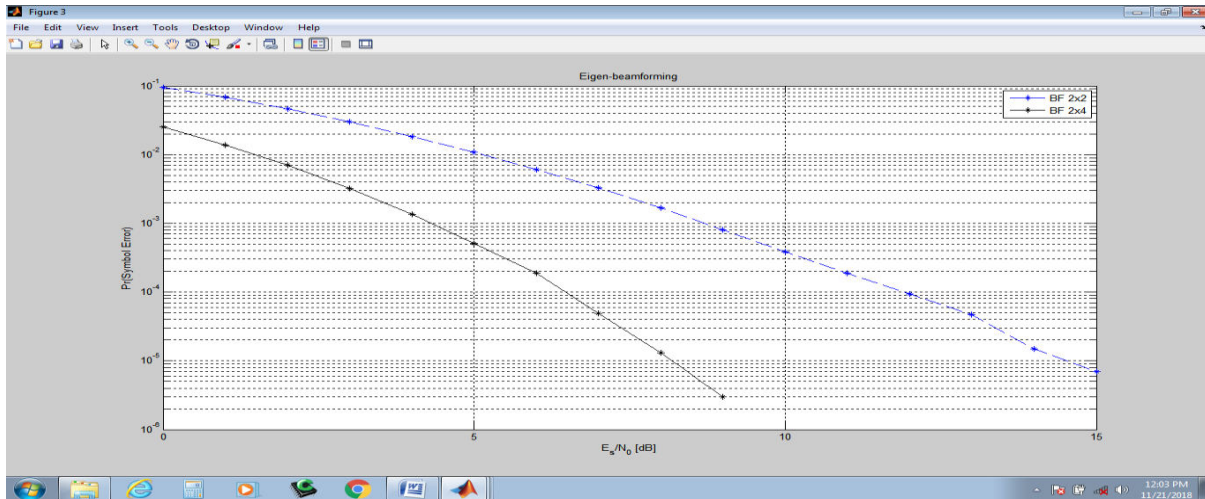
Figure.3.1. Simple OFDM Generation

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. To see how OFDM works, it is necessary to look at the receiver. This acts as a bank of demodulators, translating each carrier down to DC. The resulting signal is integrated over the symbol period to regenerate the data from that carrier. The same demodulator also demodulates the other carriers. As the carrier spacing equal to the reciprocal of the symbol period means that they will have a whole number of cycles in the symbol period and their contribution will sum to zero

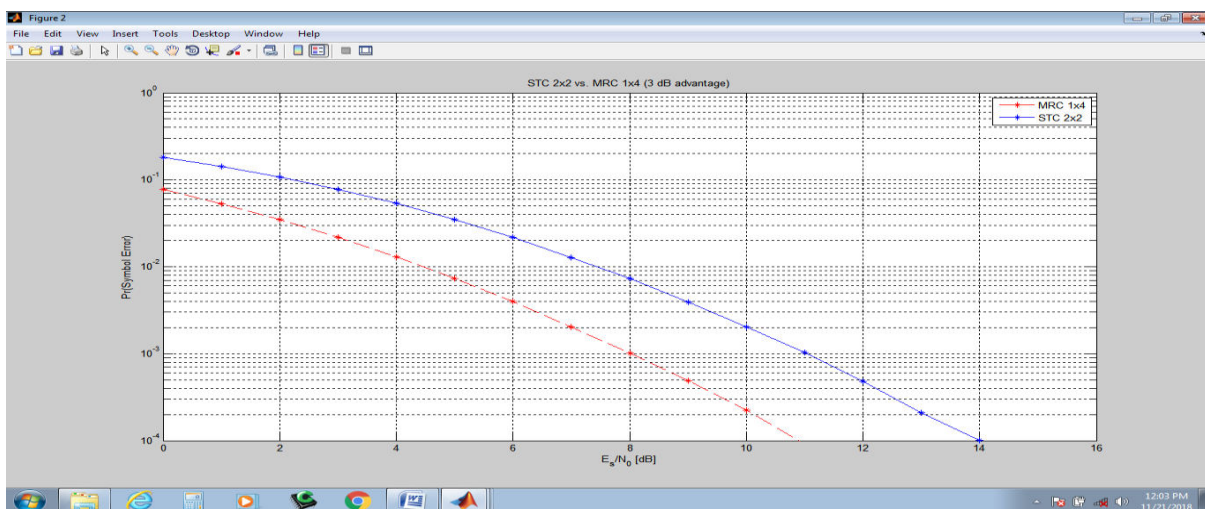
- in other words there is no interference contribution. One requirement of the OFDM transmitting and receiving systems is that they must be linear. Any non-linearity will cause interference between the carriers as a result of inter-modulation distortion. This will introduce unwanted signals that would cause interference and impair the orthogonality of the transmission.

IV. EXPERIMENTAL RESULTS

Spatio temporal Context is patterns that occur in a wide range of natural phenomena and are characterized by a spatial and a temporal patterning. The general rules of pattern formation hold. In contrast to "static", pure spatial patterns, the full complexity of spatiotemporal patterns can only be recognized over time. Any kind of traveling wave is a good example of a spatiotemporal pattern. Besides the shape and amplitude of the wave (spatial part), its time-varying position (and possibly shape) in space is an essential part of the entire pattern. All communication, language, relies on spatiotemporal encoding of information, producing and transmitting sound variations or any type of signal i.e. single building blocks of information that are varied over time. -Even though written language appears to exist only as a (2D) spatial concatenation of letters - strings, it must be decoded sequentially over time.



(a)



(b)

V. CONCLUSION

In this paper, we have proposed an SR-based super resolution channel estimation scheme for mmWave massive MIMO with hybrid precoding. 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 offgrid 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 mmWave massive MIMO. Estimating the AoAs/AoDs with higher resolution is a practical way to realize higher spectral efficiency.

REFERENCES

- [1] S. Mumtaz, J. Rodriguez, and L. Dai, *MmWave Massive MIMO: A Paradigm 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 hybrid analog 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.



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