Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
Journal of Tianjin University Science and Technology
ISSN (Online): 0493-2137
E-Publication: Online Open Access
Vol:55 Issue:02:2022
DOI 10.17605/OSF.IO/5DVK6

OPTIMAL DOWNLINK CHANNEL BEAM POWER ALLOCATION FOR MASSIVE MIMO ADCS AND DACS

V. MADHU KUMAR

Research Scholar/ Assistant Professor, Dept. of ECE, GITAM University/ BITS, Visakhapatnam/ Warangal

Dr. T. V. RAMANA

Professor, GITAM University, Visakhapatnam

Abstract

Massive multiuser multiple-input multiple-output (MUMIMO) is one of the fundamental wireless technologies compared to traditional MIMO technology. In MUMIMO, through the use of low resolution converters, made possible to solve problem of optimal power of bits quantized, through a single-bit resolution converters. Through this paper, the objective is to test and use simulated downlink resolution converters at the multi-bit level to reduce multi-user (MU) power allocation at the base station (BS). The proposed downlink resolution converters rely on biconvex relaxation (BCR) to optimize downlink power allocation by approaching the optimized error rate to quantization bit levels as compared with previous high resolution converters. The proposed work performance shows that there is a significant improvement in the implemented error-rate ADCs and quantization levels of DACs tracked by linear beam-formers used to optimize the power allocation beam in the MUMIMO massive downlink. .

Keywords-Massive MIMO, biconvex relaxation, beamforming, resolution, power allocation, quantization.

1. Introduction

Excessively precise ADCs with sufficient bandwidths for mm Wave systems are not available and expensive with the power utilized for communication mobile. For this, feasible answer is making use of bit-wise varying resolutions which is defined in ADCs, having optimized-power and precoder design implementations. Bit-wise varying resolutions in defined ADCs have additional advantages of MUMIMO, having power optimization in ADCs required in virtual-baseband precoders at different antennas required [1-10].

Massive MIMO technology has demonstrated excellent capability in next-generation wireless installations, including 5G [11, 12]. It deployed a MUMIMO antennas for BS to serve required customers simultaneously with equal signal.

A. Contributions:

In this work, through the reduction in UL and DL quantization problems by the use of general bit-wise varying resolutions for optimal power transmission is defined through the SINR constraints in the positions of the defined users.

In this paper, a position mm Wave MIMO precoder-channel resolutions with the general bit-wise varying resolutions ADCs is proposed, which is as follows:

Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
Journal of Tianjin University Science and Technology
ISSN (Online): 0493-2137
E-Publication: Online Open Access
Vol:55 Issue:02:2022
DOI 10.17605/OSF.IO/5DVK6

1) User position estimation with few-bit ADCs having short sequences of optimized power [13-17].

2) Precoder ADCs and DACs precision with the type of estimation algorithm through mean-square error (MSE) [18-20] are considered.

2. Literature Survey

In recent work, algorithms [1-22] have been estimated in channel requirements through power constraints and pilot detection for MUMIMO channel with the general bit-wise varying resolutions ADCs. In the proposed work, the coefficients of required power level channels are analyzed through iid Gaussian distribution and limit the use of channel parameter in MUMIMO estimations. And, in considered and proposed power optimization MUMIMO depends on estimators of iid Gaussian variations. During simulation, the proposed work considers the mm Wave broadband, which is used for a substantial reduction in complexity.

Through analog-digital precoding as a new method in mm Wave MIMO systems [23] - [24] has made MUMIMO systems to utilize the channel estimation parameters. In among those [25] - [26], the completely connected analog-digital structures of precoders are utilized in MUMIMO and mm Wave channel allocations.

However, much research work [27] - [32] is made through the implementation of partially connected analog-digital structures of precoders. The user-position and code-related design of partially connected analog-digital structures of precoders is implemented in [29], [30]. And these are also designed for narrowband limited precoder structures and OFDM for improvement in large bandwidths through POMA. Loss of performance, and is not available in previous works, the overall performance benefit can be further improved.

Through [31], [32] the realization of position based SIC is required for POMA estimators and the use by bit-wise varying resolutions in virtual analog-digital precoding as a new method for the partially structures connected is implemented in [32]. The virtual precoder design is assumed by digital precoding matrix in estimating as a diagonal value in the use by bit-wise varying resolutions, providing the usage as that the virtual precoders design of analog-digital structures of precoders with the resolution defined optimized power to the information of the user data with the number of bit-wise varying resolutions for the RF required chains with an equivalent requirements of user position defined information necessity. It is observed that, during beam-formation, defined analog precoders reduces the gain and bandwidths in-turns to a sub-optimal method for resolutions required in ADCs and DACs, which also defined as the need for hybrid precoding. Recently, from the analyzed survey methods and works, there is a need of a method that directly optimizes hybrid precoders without additional constraints, and to overcome this limitation, in this paper an optimized power allocation is proposed.

Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
Journal of Tianjin University Science and Technology
ISSN (Online): 0493-2137
E-Publication: Online Open Access
Vol:55 Issue:02:2022
DOI 10.17605/OSF.IO/5DVK6

3. Proposed work:

Let [.Y.] address the comparing quantized estimation channel position set values [.h.] with the defined number sequences related to x as pilot. To characterize the quantized estimations of the defined bit-wise varying resolutions ADCs channels, P (.), as P: is defined with user position vector [Y] → related to channel positions [h].

By considering the number of positions available which are able to define, then possibility of the channel vector [h] to generate from the defined bit-wise varying resolutions ADCs quantized channels received user positions [.Y.]. Then, estimate the positions existing in Method1 for the proposed precoder ADCs and DACs framework.

Method1: Consider the framework and design the model with N = 0 and user positions channels estimated as [h]. Characterize the antenna position angle with user position variation parameter α as

$$\propto = min_{h_v \epsilon [h]_y} max_{\forall h} |\theta [h_v]_y, \text{ [1]}$$

The presence of pilot sequence x is provided with N length by N ≥ [π/2α], through pilot complex symbols angles consistently in [0, π/2] range values, between these position valued P (.) function exists.

Method1 implies that once the pilot succession is applied with the particular design depicted in the Method1, then, at that point, there exists a coordinated user position P (.). To have the option to use this user position estimation techniques, optimize the user position through a non-trivial linear quantization. With this, to make use of optimization capabilities of user position power allocation to locate the user position and improving the channel gains by reducing user position power requirements. Further, the proposed optimization method increases channel beam gain illustrated in MUMIMO based 1-bit converters.

Method1 with its confirmation, the user positions grouping have a length that ensures each two distinct values in {h}. This optimization can be systematically described for a considerable user channel position. In the following Method 2, considering the downlink channel model, and illustrate that more antennas at receiver need optimized gains.

Method2: A BS having a ULA with 1/2 λ antenna position variations and a paths =L = 2. Let δP antenna position variations of user 1 and 2. From the Method 1, user position sequence is represented through position valued function P (.) as:

$$P(.) = \left[\frac{1}{L*(sin^2\left(\frac{\delta P}{2}\right))}\right], \text{ [2]}$$

Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
Journal of Tianjin University Science and Technology
ISSN (Online): 0493-2137
E-Publication: Online Open Access
Vol:55 Issue:02:2022
DOI 10.17605/OSF.IO/5DVK6

Method2 results the optimization process of proposed work, where more antenna require optimized user power allocation, through the position function P (.), for similar channel estimation requirement.

A. Biconvex Relaxation (BCR):

Now reformulate the above optimization requirement utilizing BCR [33]. Before it, start by optimize the beam power in α Subsequent optimal scaling parameter α^ is

$$\alpha^{-} = arg\ arg\ min_{\alpha \epsilon R} ||\alpha s^{-} - H^{-}x^{-}||_2^2 = \frac{s^{-T}H^{-}x^{-}}{||s^{-}||_2^2}, [3]$$

Where H is the downlink channel and s is transmit constellation points for beamforming in the downlink and x⁻ is binary-valued solution vector and a vector vector$q^{-} = x^{-}$. Here P is the instantaneous power constraint, $||x^{-}||\infty = \frac{\sqrt{P}}{2}$ is related as $\left||x^{-}|\right|\infty \leq \frac{\sqrt{P}}{2}, b = 1, \ldots., 2B,$ results in to:

$$[x^{-}] = min_{\left||x^{-}|\right|\infty \leq \frac{\sqrt{P}}{2}, [1,\ldots,2B]} ||q^{-}||_2^2 + \gamma||q^{-} - x^{-}||_2^2, [4]$$

This issue constrained structure results in to:

$$[x^{-}] = min_{||x^{-}||\infty \leq \frac{\sqrt{P}}{2}} ||q^{-}||_2^2 + \gamma||q^{-} - x^{-}||_2^2, [5]$$

Now the BCR is to optimization is accomplished by including a non-convex term in the channel positions as a low power requirements results in to BCR resolutions as

$$x^{-BCR} = arg\ arg\ min_{||x^{-}||\infty \leq \frac{\sqrt{P}}{2}} ||q^{-}||_2^2 + \gamma||q^{-} - x^{-}||_2^2 - P(.)||x^{-}||_2^2, [6]$$

Where the two Method requirements should fulfil 0 < P < γ. With these two implementation, there is an optimization in beam power and improve the performance of proposed work.

4. Simulation Results and Discussions:

In this paper, a linear 1-bit downlink channel beam formation is proposed which has shown an improvement in the linear-quantized algorithms for user position and beam power allocation compare to non-linear [34, 35]. Proposed work depends on BCR [12] for power optimization, which is implemented in liner 1-bit model used, which solved the user positions power optimization problems. This proposed framework earlier introduced in [29-32] approach used for optimal downlink beam formation for infinite precision values of ADCs and DACs. Proposed work is compared with a linear quantized zero-forcing (ZF) beamforming [36, 37] method and a DR [10].

Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
Journal of Tianjin University Science and Technology
ISSN (Online): 0493-2137
E-Publication: Online Open Access
Vol:55 Issue:02:2022
DOI 10.17605/OSF.IO/5DVK6

Fig. 1 shows simulation of BER in rayleigh multiple fading resolutions of channel numbers of antennas = 2 system. For a transmit power normalized value P, Monte-Carlo parameters performed.

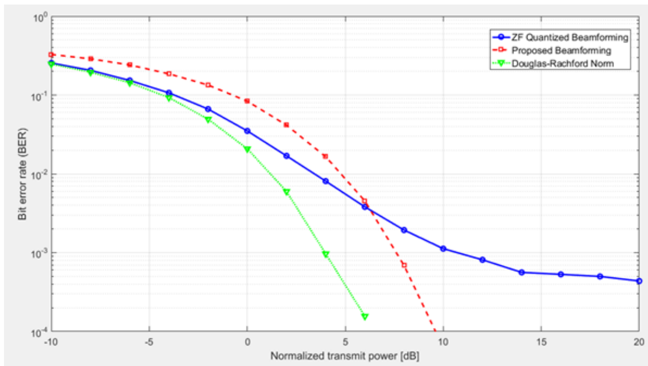

Figure 1: Comparison of Transmit Power with BER.

In figure 1, a better quantization method linear 1-bit DAC case is illustrated. And able to provide beam formation nearer to ZF beamforming for power allocation. And with [10], proposed optimization having a similarity in user position estimation through error-free analysis. Using MATLAB simulation environment, the observations are analyzed. And, the proposed optimization method has improved the throughput and the spectral efficiency in MU MIMO systems.

5. Conclusions

Proposed work have shown that linear models utilizing 1-bit massive MIMO can be optimized by BCR to improve the user position estimation and beam power allocation. Proposed work through BCR has improved the accuracy of quantization of hybrid precoders for error-rate performance with quantized ZF method and non-linear DR method and low computational complexity. Proposed work simulation results shows that 1-bit massive MIMO can outperform for mm Wave and MUMIMO schemes. The proposed optimization procedure can help in implementing a real-time LTE device for reduced power utilization.

References

1) J. Choi, J. Mo, and R. W. Heath Jr., "Near maximum-likelihood detector and channel estimator for uplink multiuser massive MIMO systems with one-bit ADCs," IEEE Trans. Commun., vol. 64, no. 5, pp. 2005–2018, May 2016.
2) J. Choi, V. Va, N. Gonzalez-Prelcic, R. Daniels, C. R. Bhat, and R. W. Heath, "Millimeter-wave vehicular communication to support massive automotive sensing," IEEE Communications Magazine, vol. 54, no. 12, pp. 160–167, December 2016.

Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
Journal of Tianjin University Science and Technology
ISSN (Online): 0493-2137
E-Publication: Online Open Access
Vol:55 Issue:02:2022
DOI 10.17605/OSF.IO/5DVK6

3) J. Mo, P. Schniter, and R. W. Heath, “Channel estimation in broadband millimeter wave MIMO systems with few-bit ADCs,” IEEE Transactions on Signal Processing, vol. 66, no. 5, pp. 1141–1154, March 2018.
4) J. Choi, J. Mo, and R. W. Heath, “Near maximum-likelihood detector and channel estimator for uplink multiuser massive MIMO systems with one-bit ADCs,” IEEE Trans. Comm., vol. 64, no. 5, pp. 2005–2018, 2016.
5) Studer and G. Durisi, “Quantized massive mu-mimo-ofdm uplink,” IEEE Trans. on Commun., vol. 64, no. 6, pp. 2387–2399, 2016.
6) J. Choi, Y. Cho, B. L. Evans, and A. Gatherer, “Robust learningbased ML detection for massive MIMO systems with one-bit quantized signals,” in IEEE Global Commun. Conf., 2019, pp. 1–6.
7) Y. Cho and S.-N. Hong, “One-bit successive-cancellation soft-output (OSS) detector for uplink MU-MIMO systems with one-bit ADCs,” IEEE Access, vol. 7, pp. 27 172–27 182, 2019.
8) J. Choi, B. L. Evans, and A. Gatherer, “Resolution-adaptive hybrid MIMO architectures for millimeter wave communications,” IEEE Trans. on Signal Process., vol. 65, no. 23, pp. 6201–6216, 2017.
9) S. Jacobsson, G. Durisi, M. Coldrey, T. Goldstein, and C. Studer, “Quantized Precoding for Massive MU-MIMO,” IEEE Trans. on Commun., vol. 65, no. 11, pp. 4670–4684, 2017.
10) J. Dai, J. Liu, J. Wang, J. Zhao, C. Cheng, and J.-Y. Wang, “Achievable rates for full-duplex massive MIMO systems with low-resolution ADCs/DACs,” IEEE Access, vol. 7, pp. 24 343–24 353, 2019.
11) E. G. Larsson, O. Edfors, F. Tufvesson, and T. L. Marzetta, “Massive mimo for next generation wireless systems,” IEEE Communications Magazine, vol. 52, no. 2, pp. 186–195, 2014.
12) L. Lu, G. Y. Li, A. L. Swindlehurst, A. Ashikhmin, and R. Zhang, “An overview of massive mimo: Benefits and challenges,” IEEE Journal of Selected Topics in Signal Processing,vol. 8, no. 5, pp. 742–758, 2014.
13) G. Zeitler, G. Kramer, and A. C. Singer, “Bayesian parameter estimation using single-bit dithered quantization,” IEEE Trans. Signal Process., vol. 60, no. 6, pp. 2713–2726, 2012.
14) X. Rao and V. K. N. Lau, “Distributed compressive csit estimation and feedback for fdd multi-user massive mimo systems,” IEEE Trans. Signal Process., vol. 62, no. 12, pp. 3261–3271, 2014.
15) “5g channel model for bands up to 100 ghz (v2.3), aalto university, at&t, bupt, cmcc, ericsson, huawei, intel, kt corporation, nokia, ntt docomo, new york university, qualcomm, samsung, university of bristol, university of southern california,” pp. 1–107, October 2016, [Online]. Available: http://www.5gworkshops.com/5gcm.html.
16) S. Rangan, “Generalized approximate message passing for estimation with random linear mixing,” in Proc. IEEE Intl. Symp. Info. Thy. (ISIT), July 2011, pp. 2168–2172.
17) S. Rangan, P. Schniter, and A. Fletcher, “Vector Approximate Message Passing,” ArXiv e-prints, Oct. 2016.
18) P. Schniter, S. Rangan, and A. K. Fletcher, “Vector Approximate Message Passing for the Generalized Linear Model,” in Proc. Asilomar Conf. Signals, Systems and Computers, 2016, pp. 1525–1529.
19) J. Vila and P. Schniter, “Expectation-maximization Gaussian-mixture approximate message passing,” IEEE Trans. Signal Process., vol. 61, no. 19, pp. 4658–4672, Oct 2013.
20) K. Fletcher and P. Schniter, “Learning and Free Energies for Vector Approximate Message Passing,” in Proc. IEEE Intl. Conf. Acoust., Speech, Signal Process. (ICASSP), 2017.
21) Y. Jeon, S. Hong, and N. Lee, “Supervised-learning-aided communication framework for MIMO systems with low-resolution ADCs,” IEEE Transactions on Vehicular Technology, vol. 67, no. 8, pp. 7299–7313, Aug 2018.
22) S. Asaad, A. M. Rabiei, and R. R. M¨uller, “Massive mimo with antenna selection: Fundamental limits and applications,” IEEE Trans. Wirel. Commun., vol. 17, no. 12, pp. 8502–8516, 2018.
23) W. Roh, J.-Y. Seol, J. Park, B. Lee, J. Lee, Y. Kim, J. Cho, K. Cheun, and F. Aryanfar, “Millimeter-wave beamforming as an enabling technology for 5G cellular communications: theoretical feasibility and prototype results,” IEEE Commun. Mag., vol. 52, no. 2, pp. 106–113, Feb. 2014.

Tianjin Daxue Xuebao (Ziran Kexue yu Gongcheng Jishu Ban)/
Journal of Tianjin University Science and Technology
ISSN (Online): 0493-2137
E-Publication: Online Open Access
Vol:55 Issue:02:2022
DOI 10.17605/OSF.IO/5DVK6

24) S. Sun, T. S. Rappaport, R. W. Heath, A. Nix, and S. Rangan, “MIMO for millimeter-wave wireless communications: beamforming, spatial multiplexing, or both?” IEEE Commun. Mag., vol. 52, no. 12, pp. 110– 121, Dec. 2014.
25) Y. Lee, C.-H. Wang, and Y.-H. Huang, “A hybrid RF/baseband precoding processor based on parallel-index-selection matrix-inversion-bypass simultaneous orthogonal matching pursuit for millimeter wave MIMO systems,” IEEE Trans. Signal Process., vol. 63, no. 2, pp. 305–317, Jan. 2015.
26) J. Lee and Y. Lee, “AF relaying for millimeter wave communication systems with hybrid RF/baseband MIMO processing,” in Proc. 2014 IEEE Int. Conf. Commun. (ICC), Sydney, NSW, June 2014, pp. 5838–5842.
27) E. Zhang and C. Huang, “On achieving optimal rate of digital precoder by RF-baseband codesign for MIMO systems,” in Proc. 80th IEEE Veh. Technol. Conf. (VTC Fall), Vancouver, BC, Sept. 2014, pp. 1–5.
28) G. Wang and G. Ascheid, “Joint pre/post-processing design for large millimeter wave hybrid spatial processing systems,” in Proc. 20th Euro. Wireless Conf., Barcelona, Spain, May 2014, pp. 1–6.
29) V. M. Kumar and T. V. Ramana, "Position-based Fully-Scheduled Precoder Channel Strategy for POMA Structured LTE Network," 2019 IEEE International Conference on Electrical, Computer and Communication Technologies (ICECCT), 2019, pp. 1-8, doi: 10.1109/ICECCT.2019.8869133.
30) Kumar, VM, Ramana, TV. Fully scheduled decomposition channel estimation based MIMO-POMA structured LTE. Int J Commun Syst. 2019;e4263. https://doi.org/10.1002/dac.4263
31) V.Madhu Kumar, T.V.Ramana, " Virtual Iterative Precoding Based LTE POMA Channel Estimation Technique in Dynamic Fading Environments", International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-8 Issue-6, April 2019.
32) V. Madhu Kumar, T. V. Ramana, Rajidi Sahithi, "User Content Delivery Service for Efficient POMA based LTE Channel Spectrum Scheduling Algorithm", International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-9 Issue-2S3, December 2019.
33) S. Shah, A. Kumar, D. Jacobs, C. Studer, and T. Goldstein, “Biconvex relaxation for semidefinite programming in computer vision,” in Proc. European Conf. Comput. Vision (ECCV), Oct. 2016, pp. 717–735.
34) S. Jacobson, G. Durisi, M. Coldrey, T. Goldstein, and C. Studer, “Quantized precoding for massive MUMIMO,” arXiv preprint: 1610.07564, Oct. 2016.
35) S. Jacobsson, G. Durisi, M. Coldrey, T. Goldstein, and C. Studer, “Nonlinear 1-bit precoding for massive MUMIMO with higher-order modulation,” in Proc. Asilomar Conf. Signals, Sys., Comp., Nov. 2016.
36) O. B. Usman, H. Jedda, A. Mezghani, and J. A. Nossek, “MMSE precoder for massive MIMO using 1-bit quantization,” in Proc. IEEE Int. Conf. Acoust., Speech, Signal Process. (ICASSP), May 2016, pp. 3381–3385.
37) K. Saxena, I. Fijalkow, and A. L. Swindlehurst, “On one-bit quantized ZF precoding for the multiuser massive MIMO downlink,” in Proc. IEEE Sensor Array and Multichannel Signal Process. Workshop (SAM), Jul. 2016.