Rebuttal for ACM MobiHoc 2019 Submission

1 PAPER INFORMATION

Paper Title: “Side-information-aided Non-coherent Beam Alignment Design for Millimeter Wave Systems"
Paper no. “224"

2 RESPONSE TO THE REVIEWERS

We thank all four reviewers for the constructive comments. We provide a point-by-point response to the comments below.

2.1 Reviewer 1 #224A

Comment 1: *The specific contribution of the testbed design is difficult to discern in the paper as it is written at the moment. The introduction to the paper focuses mainly on beam alignment. From the related work and the conclusions it seems that the contribution is in enabling a low-cost testbed?*
Response 1: Thanks for pointing this out. In terms of the specific contribution of the testbed design, our work not only enables a low-cost testbed but more importantly develops the first mmWave testbed with phased array calibration, which enables true mmWave beamforming rather than using irregular and fixed beam patterns. We will make our contribution clear in the revision.
Comment 2: *Fig. 1's labels are too small; the figure is difficult to understand.*
Response 2: Fig. 1 shows the hardware connection and the real system setup. We will update Fig. 1 by enlarging its labels and updating its images to a higher resolution so that all key information is recognizable and easy to understand.

2.2 Reviewer 2 #224B

Comment 1: *The paper treats certain components of a path gain vector as noise. It is not clear if these are also assumed to be independent of the other components that are used.*
Response 1: Yes, the channel paths are assumed independent and hence the insignificant paths are treated as noise. We will clarify this in the description of the channel model in the revision.
Comment 2: *What is meant by a "geometric channel model"? Are you saying that something is a geometric random variable, or are you saying that fading depends on path length geometry?*
Response 2: Your latter understanding is correct. The geometric channel model refers to approximating the propagation of electromagnetic waves with the geometry based on ray tracing techniques, which is widely used to model the mmWave channel. We will revise to make this clear.
Comment 3: *The first sentence of the system model (Section 2) could be made easier by saying the paper considers "a single transmitter" and "a single receiver" (rather than using "Tx" and "Rx"s).*
Response 3: We will revise the sentence as suggested.

2.3 Reviewer 3 #224C

Comment 1: *Even though the authors claim that using the side information can reduce the training overhead, which is indeed evident, there is no result indicating by how much time they can reduce it when applying this technique in practice.*
Response 1: Thanks for the comment. This has been addressed in one way in Fig. 10 in the Appendix through numerical simulations. This quantitatively shows how side information helps in reducing the number of training measurements (which is directly proportional to training time).
Comment 2: *Since other algorithms can actually use the more efficient random sensing matrix option, a complete comparison should be made between another algorithm using random sensing matrix and their algorithm using overlapped directional beam sensing matrix while taking into account the additional overhead from the use of the overlapped directional beam sensing matrix.*
Response 2: Thank you for pointing this out. We studied this issue but did not include the result, because we found that the benchmarking results that we presented are superior to those with random sensing matrices. Specifically, when compared with the spectrum efficiency (SE) shown in Fig. 9 (a) in the submitted paper, the classic compressive sensing (OMP) using a 2-bit quantized random sensing matrix (2-bit phased array used in this work) only achieves around 25% of the SE of our proposed algorithm. In addition, the classic phase retrieval algorithm (CPRL) with the same sensing matrix achieves less than 60% of the SE with respect to our algorithm, and its computation complexity is much higher. The poor performance of the random sensing matrix is due to two reasons: (1) a random matrix wastes energy to the spatial domain outside the searching region given by the side information, which degrades the SNR and hence the estimation; (2) a random matrix inevitably disregards the side information, and thus increases the number of measurements for covering the full angular domain (this issue is especially severe in our scenario where the phase information is not available).
Comment 3: *If the two-stage algorithm requires overlapped directional beam sensing matrix, and the later requires side information to keep overhead relatively low, claim on page 3 that the incorporation of side information is optional to the algorithm is somewhat misleading because not incorporating it would increase overhead a lot.*
Response 3: By optional, we only meant that the unavailability of side information does not change the algorithm itself. The lack of side information, however, degrades system performance as the reviewer pointed out. We will rephrase this to avoid ambiguity.
Comment 4: *Some important related work is missing. For example, H. Hassanieh, O. Abari, M. Rodriguez, M. Abdelghany, D. Katabi, and P. Indyk, "Fast millimeter wave beam alignment," in ACM SIGCOMM 2018. In this paper, they also discuss how to reduce the training overhead, and increase the beam accuracy and the SNR performance.*
Response 4: We have cited a workshop version of this work as ref. [1] in the submitted version. We will update it to the SIGCOMM reference in the revision.

2.4 Reviewer 4 #224D

Comment 1: *The label for Fig 7 is missing.*
Response 1: The label issue will be corrected in the revision.