INTRODUCTION TO U2D-ORG, U2D-ABS AND U2D-MAG

A PREPRINT

Zhenyu Liu, Lin Zhang, and Zhi Ding *

May 7, 2019

1 Introduction

In this section, we combine the bi-directional correlation with deep learning (DL) to infer the downlink CSI from the estimated uplink CSI in massive MIMO systems. Three architectures are designed, named as U2D-ORG, U2D-ABS and U2D-MAG. Different form the DualNet-ABS and DualNetMAG in [1], U2D-ABS and U2D-MAG recover the absolute values and magnitudes of downlink CSI from the corresponding uplink information directly without any feedback on the correlated parts. For U2D-ORG, it divides the downlink CSI into real part and imaginary part without separating their signs as the input to the DL network.

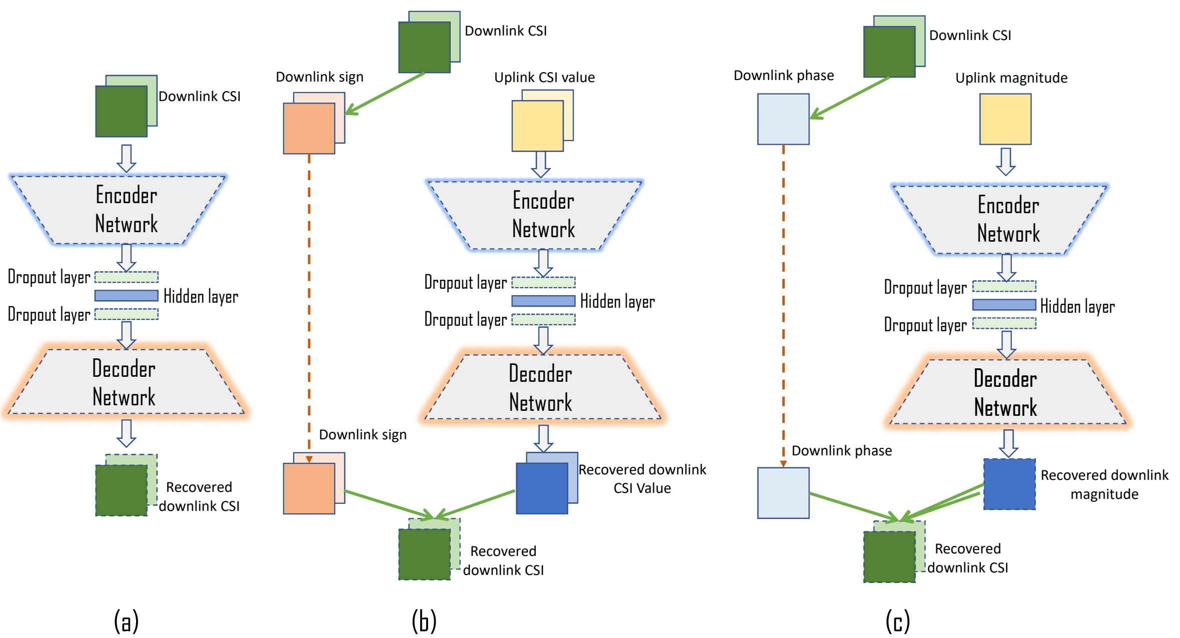
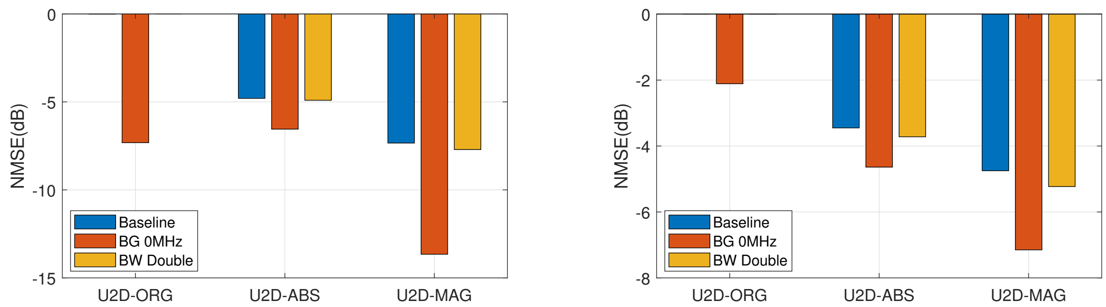


Figure 1: (a) Architecture of U2D-ORG. (a) Architecture of U2D-ABS. (b) Architecture of U2D-MAG.

Fig. 1 shows the structures of U2D-ORG, U2D-ABS and U2D-MAG. There are mainly three differences between U2D and DualNet in [1]. First, uplink CSI is used as the input in the U2D-MAG and U2D-ABS instead of downlink CSI. Second, different from DualNet-MAG and DualNet-ABS which try to compress the downlink CSI as the codeword for feedback, U2D-MAG and U2D-ABS use a hidden layer and try to enrich the feature information for the downlink CSI reconstruction, i.e., increasing the amount of neurons instead of reducing it for the compression. Two dropout layers are added to avoid overfitting from the hidden layer. Third, the conjugation layer is removed since the feedback of

*Z. Liu and L. Zhang are with Beijing University of Posts and Telecommunications, Beijing 100876, China (e-mail:{lzyu, zhanglin}@bupt.edu.cn). Z. Ding is with University of California, Davis (UC Davis), CA 95616, USA (e-mail: zding@ucdavis.edu). Z. Liu is currently a visiting Ph.D. student at UC Davis..



(a) Indoor (b) Outdoor

Figure 2: Performance comparison for different bandgap (BG) and bandwidth (BW).

magnitudes or absolute values of real/imaginary parts of CSI coefficients is removed. For U2D-ORG, it only divides the complex CSI into real part and imaginary part without separating their signs as the input to DL network.

Using the same dataset of Section V.A, we consider perfect knowledge of phases and signs of downlink CSI at gNB. The performance of U2D-ORG, U2D-ABS and U2D-MAG are summarized in Fig. 2. As shown in Fig. 2, both U2D-ABS and U2D-MAG can improve the downlink CSI recovery accuracy by reducing the bandgap and/or increasing the bandwidth while the bandgap has a more obvious contribution. For U2D-ORG, whose performance is terrible when bandgap is large, it also benefits from reducing the bandgap. On the one hand, U2D-MAG outperforms U2D-ABS and CU2D-ORG in all cases, while U2D-ABS outperforms U2D-ORG in all cases except for 0 MHz bandgap in the indoor scenario. This exception is owing to the wider coherence bandwidth in the indoor cases. CSI in uplink and downlink within the coherence bandwidth already has similarity, and removing signs can reduce the essential features and cause overfitting. Although U2D-ORG, U2D-ABS and U2D-MAG cannot perform as accurate as DualNet-MAG and DualNet-ABS currently, they can reduce the feedback payload and show a potential direction to further improve the downlink CSI estimation efficiency.

References

[1] Z. Liu, L. Zhang and Z. Ding, "Exploiting Bi-Directional Channel Reciprocity in Deep Learning for Low Rate Massive MIMO CSI Feedback," IEEE Wireless Communications Letters (2019).