Graduate School of Science and Technology Master's Thesis Abstract

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Abstract

With the development of modern media and the internet, there is an increasing demand for higher communication transmission efficiency. Among them, mmWave has become a crucial technology for the development of 5G and 6G. At the same time, Massive MIMO technology, as an essential auxiliary technology for mmWave communication, has also gained significant attention in recent years. Improving the accuracy of beam training while reducing the training overhead and the influence of noise has become an important issue for massive multiple-input multiple-output (MIMO) millimeter-wave (mmWave) communication systems.

In this paper, I propose a deep learning-based multi-scale neural network for beam training in massive MIMO mmWave communication system. The model predicts the orientation of narrow beams by learning the characteristics of wide beams, achieving high accuracy and low training overhead.

Specifically, my model consists of four modules. In the first module, I deploy a convolutional neural network (CNN) to extract features from the wide-beam instantaneous received signals. In the second module, I develop a multi-scale convolution approach to extract wide-beam features from different temporal combinations. In the third module, I employ the idea of layer pooling to select the most relevant information from the extracted features for training, thereby reducing the complexity of subsequent training. In the fourth module, I employ a long short-term memory (LSTM) network to calibrate the direction of the narrow beam based on previous predictions, thereby enhancing the model's robustness against noise. Finally, based on experimental results, our model improves the accuracy of beam training with low training cost, mitigates the impact of noise, and reduces training time.