Enhanced UE Localization Precision Using Transformer with RTT and AOA Measurement

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RTT 및 AOA 측정과 Transformer를 사용한 향상된 UE 위치 파악 정밀도

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Abstract

Location-based services are one of the key services of 5G. In the past, localization schemes have yielded accuracies at the meter level, falling short of centimeter-level precision demanded by various 5G services. Despite the application of the popular deep learning algorithms in localization endeavors, attaining granular accuracies remains an ongoing challenge. This study proposes the use of a transformer model, by combining RTT and AOA measurements as a means to attain enhanced localization precision.

Ⅰ. Introduction

5G positioning has garnered increased attention for its high precision location estimation surpassing conventional systems like GNSS. The UE location can be estimated by extracting several measurements from the radio signal. These include but are not limited to TOF, TDOA, RTT, AOA/AOD, RSS, and CSI. Previous works made use of hybrid fingerprinting methodologies that leverage the strength of both RSS and CSI [1] using 4-layer deep neural networks. Although promising, the precision granularity is yet to be improved. This paper proposes the use of transformer model using Round Trip Time (RTT) and Angle of Arrival (AOA) data. The simplicity of RTT and the high spatial resolution offered by AOA provide a more reliable foundation for accurate UE localization. In addition, unlike other works, this paper proposes the use of a transformer model due to its superior ability to capture relationships among sequential data. Given the strong correlation between the current and previous locations of a UE, integration of a transformer emerges as a promising solution to significantly enhance the precision of UE localization.

Ⅱ. Method

Figure 1 aims to relate the localization problem to Natural Language Processing. Predetermined routes are considered as the sentence, and the individual positions (RP) along the route are considered as words. The RTT and AOA are measured for each RP and are considered as the input. The UE's location is the output. The positional encoding is used to keep track of the position order. The masked self-attention works by seeing how similar each position is to itself and all its preceding positions in the route. This paper considers the area between three base stations.

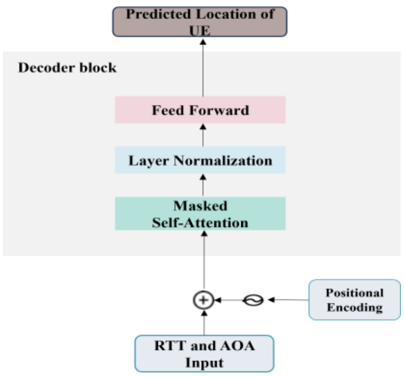

Figure 1. Decoder-only transformer model for localization

Ⅲ. Conclusion

This study proposed the use of a transformer model by harnessing the inherent advantages of both RTT and AOA data integration for enhanced UE location precision.

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