Predictive Modeling of Throughput with User Location and RSSI

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사용자 위치 및 RSSI를 이용한 사용자 처리량 예측 모델링

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Abstract

Anticipating user demands in advance enables mobile operators to effectively manage resources. Prediction of resource allocation becomes increasingly challenging with the proliferation of subscribers in the 5G and future 6G era, especially in the context of autonomous vehicles where throughput prediction remains a formidable task. Recent advancements in cellular network throughput prediction predominantly rely on time series methods [1], with an increasing focus on Machine Learning (ML). Unlike common methods that heavily depend on time series data, this paper presents a Bi-directional LSTM model for predicting throughput. The model emphasizes user location and a singular network parameter, RSSI. The notable advantage of this approach lies in its minimal dependence on network parameters, demonstrating efficient future throughput prediction.

Ⅰ. Introduction

Cellular networks, specifically 4G, 5G, and the prospective 6G, are intricately designed to deliver enhanced bandwidth and reduced latency, particularly catering to applications such as autonomous driving. Despite their advanced capabilities, accurately predicting Quality of Service (QoS) parameters, specifically user downlink throughput during movement, poses a persistent challenge. The dynamism introduced by users on the move requires operators to smoothly adapt without resorting to additional hardware deployment, thereby avoiding potential issues associated with exceeding network capacity. A critical challenge stems from the finite bandwidth resources contingent upon the cellular network coverage at a given location. This limitation is especially pronounced in transportation hubs characterized by dense traffic, where the risk of surpassing maximal capacity is heightened. In such dynamic scenarios, predicting throughput emerges as a key factor in enhancing network performance. In response to these challenges, this study proposes a concept employing ML algorithms to predict downlink throughput from the user's perspective.

Ⅱ. Method

RSSI plays a pivotal role in wireless communication throughput. The correlation between RSSI and throughput is typically inversely proportional, signifying that higher RSSI values correlate with improved throughput, and vice versa. However, our research concentrates on user location and a singular signal parameter, namely RSSI. Consequently, our approach involves feeding these data into a five-layer bi-directional LSTM network to predict user throughput.

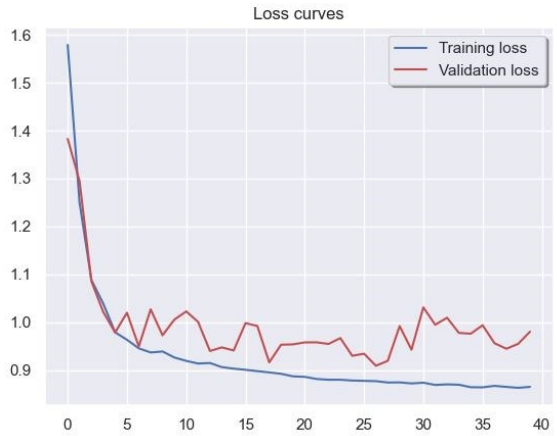

Fig. 1: Model efficacy evaluation in throughput prediction

Ⅲ. Conclusion

The loss curve indicates a consistent reduction in prediction losses, showcasing the model's success in forecasting future throughput with minimal input information. Future studies will focus on minimizing Mean Squared Error (MSE) loss and incorporating 5G RSSI to enhance the prediction accuracy of 5G network throughput.

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