A Machine Learning-Assisted Framework for Determination of Performance Degradation Causes and Selection of Channel Switching Strategy in Vehicular Networks

Technology Transfer Activities

by

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Table of Contents

TECHNOLOGY TRANSFER ACTIVITIES

1 Outputs

At the end of the study, the research goals were accomplished. We shared research results through two conference presentations and have two journal articles in review. Below is the outline plan to disseminate the research results.

1.1 Accomplished Outputs

Conference Article Presentation

Liu, J., Nazeri, A.H, Zhao, C., Abuhdima, E.M., Comert, G., Huang, C.-T., Pisu, P. "Investigation of 5G and 4G V2V Communication Channel Performance Under Severe Weather," 2022 IEEE International Conference on Wireless for Space and Extreme Environments (WiSEE), Winnipeg, MB, Canada, 2022, pp. 12-17, doi:10.1109/WiSEE49342.2022.9926867

Abuhdima, E.M., Comert, G., Tadessa, N., Chambers, F., Niyomugabo, K., Pisu, P., Nazeri, A., Huang, C.-T., Liu, J., Zhao, C. "The Effect of Dust and Sand on the Propagating EM Millimeter Plane Wave," 2022 IEEE International Conference on Wireless for Space and Extreme Environments (WiSEE), Winnipeg, MB, Canada, 2022, pp. 1-5, doi: 10.1109/WiSEE49342.2022.9926914.

1.2 Future Output

Peer-Reviewed Journal Article

Currently, we have two journal articles in review.

“Switching Strategy for Connected Vehicles Under Variant Harsh Weather Conditions”. IEEE Journal of Radio Frequency Identification

“Propagating Uniform Millimeter Plane Wave in Dusty and Sandy Medium”. IEEE Journal of Radio Frequency Identification

2 Outcomes

The research has produced the following critical outcomes:

We extend NS3-Millicar model by adding weather impacts to path loss functions; we then use NS-3 as a simulator to study the effect of harsh weather of dust or sand on the propagating loss of 5G mm-Wave and 4G LTE signal. We investigate their performance degradation and use LSTM to predict future 5G and 4G signal strengths. We also propose a switching strategy for connected vehicles between 5G and 4G under severe weather conditions.

Our second approach uses MATLAB to simulate the effect of dust and sand on the propagating electromagnetic millimeter wave. The simulation result shows that the amplitude of the propagating electric field in linear polarization is affected less by dust and sand compared to circular polarization. The effect of dust and sand is more evident when the visibility is less than 10m. Our results help to design a wireless system in the similar dusty/sandy regions to avoid disconnected channel.

3 Impacts

We expect this study to add knowledge to the transportation community and the public. Our research suggests that LSTM has the potential to forecast communication degradation in future autonomous vehicle designs. Additionally, our simulation results indicate that the amplitude of linearly polarized electric fields is less affected by dust and sand compared to circularly polarized fields.