Electric bicycle travel trajectory semi-supervised classification model for supporting road planning

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The use of electric bicycles and scooters in urban areas is significantly increasing. In Tel-Aviv, Israel, for example, over 50% of present traffic is associated with this type of vehicles. Their increasing popularity coupled with inadequate infrastructure has led to a growing number of unfortunate road accidents. There is still not enough understanding of these vehicles’ mobility patterns and behavior in terms of user preferences, which are required for developing proper road infrastructure, such as designated lanes and renting and parking areas, while allocating resources and take actions to improve the safety of all road users. With today’s unprecedented volume of crowdsourced GNSS data collected by various service providing companies and municipal authorities, analyzing users mobility behavior on a large scale is made possible – as opposed to field surveys, which are limited, time consuming and expansive.

This research attempts to expand the current capabilities of semi-supervised neural networks to automatically classify electric bicycles transportation mode given anonymous three-dimensional movement trajectories. Common machine learning-based classification algorithms mostly follow a supervised approach that can be limited for transportation mode classification since they may lead to poor generalization (overfitting). Accordingly, our development relies on Dabiri’s semi-supervised Convolutional Autoencoder and implementing the Attention mechanism to solve this limitation. Pre-training deep neural networks with unlabeled data is designed to provide better initialization when compared to supervised networks.

Preliminary results of the developed classification model reached an accuracy of 76.8% after training simultaneously over labeled and unlabeled trajectories. We plan to extend our algorithm with additional travel features and implement algorithmic modifications to extend the classification to electric scooters. We believe that this classification model can serve decision makers with quantitative data to gain better understanding associated with travel behavior and preferences of these “new” road users, allowing them to make aware and attentive road planning decisions.