

# REPORT OF RESEARCH RESULTS

## A. Title

Usage-based Insurance service for Motorcycle logistics – The Case of Food Delivery Service

## B. Primary Researcher:

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## C. Co-Researcher:

Name	Job Title / Organization	Last institution attended / Year of graduation	Highest Academic Qualification	Role in this project
Lee, Wei-Hsu	Associate Professor/Department of Transportation and Communication Management Science	National Chiao Tung University/2009	Ph.D. degree	Consultant

Lin, Xuan-Yu	M.S. student/ Department of Computer Science and Information Engineering	National Chung Hsing university	M.S. degree	System engineer
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#### **D. Summary:**

Usage Based Insurance (UBI) is a trend in auto insurance industry over the world which is based on individual driving behavior and driving risk, reflecting in the customized insurance rates. Although UBI is regarded as a promising approach to provide more accurate insurance services, with the rise of people's awareness of privacy, more and more drivers are unwilling to provide their data to others for storage and use, especially the daily GPS information. As a result, UBI service is difficult to implement recently. In addition, there is still no relevant research on motorcycles in the current UBI literature. Except Taiwan's special geographical and cultural environment, the scooters that most Taiwanese ride and the motorcycles that most foreigners ride are different, resulting in different driving characteristics.

In order to break through the dilemma of research, this study proposes a UBI service framework for scooters, which includes proposing a multi-dimensional driving

risk level suitable for scooters and establishing a risk-aware fingerprint model for predicting driving risk. Using the computational characteristics of neural networks to effectively solve the limitations of previous research. This study could help overcome the difficulties in the implementation of UBI in the past, fundamentally improve driver behavior, and enhance road safety.

### **E. Aim of Research:**

In this context, to address the aforementioned issues, especially the privacy issue of UBI service. We propose a Risk-aware fingerprint model (RAF model) by fusing autoencoder and different machine learning classifiers. Using RAF as input to build a model, the goal is to make the prediction performance of the RAF model accurate enough to replace the past model using raw data or behaviors features as input. The major contributions of this paper are summarized as follows:

1. Proposing a UBI service framework with scooter as target and proposing a driving risk prediction model for scooter, which could provide insurance company a pricing basic.
2. A suitable definition of scooter driving risk level was proposed, which is referred to six-dimensional information such as three-axis acceleration and angular velocity that could represent scooter driver's risks.
3. Risk-aware fingerprint model were proposed to solve the privacy issues of UBI service. Using deep learning methods to compress time series data to risk-aware fingerprint (RAF), which can effectively represent the driver's driving information. Directly use RAF which is not contain personal information to predict driver risk instead of behavior variables or raw data. Furthermore, the limitations of Behavior-centric model can be resolved.

### **F. Method of Research & Progression:**

To propose a UBI service framework with scooters as target, and solve privacy issues of UBI, we construct a RAF model for predicting driver's risk level. The framework will be divided into two stages, the model training stage and the implementation stage.

The model training stage includes labeling, autoencoder training, Risk-aware fingerprint model training, and risk level prediction for each journey. The implementation stage includes future expectations and subsequent management analysis.

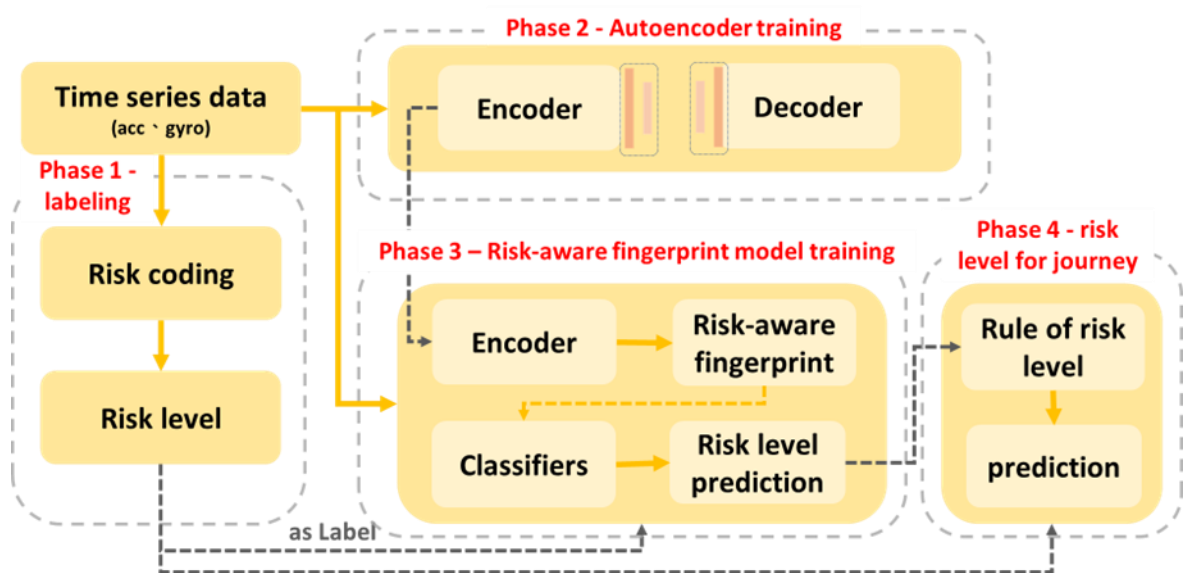


Fig. 1 Research Flow Chart

## G. Results of Research:

Based on the research assumptions, under the premise that the proposed multi-dimensional driving risk level is true risk of driver. The proposed achieved following goals:

### 1. Verify the effectiveness of RAF model:

The classification performance of the RAF model is good with at least 78% F1-score. According to three kinds of threshold segmentation standards, three of the RAF

models' overall F1-score are 78.73%, 80.04%, and 81.87% respectively. Compared with three of the RAW models' overall F1-score respectively, there is only about 10% difference. It indicates that the RAF we proposed can effectively extract high-dimensional features and verify the effectiveness of the RAF model.

## **2. Effectively predict low-risk levels and high-risk level**

The classification results on risk level 1 of the RAF model performs well. According to three kinds of threshold segmentation standards, three of the RAF models' F1-score are 81.36%, 74.77%, and 62.96% respectively. Furthermore, the classification performance of risk level 3 is good as well. Three kinds of the RAF models' F1-score by different threshold segmentation standards are 82.39%, 75.59%, and 83.56% respectively.

## **3. Effectively predict the risk level for journey**

The RAF model has good prediction results on risk level of journey. According to different thresholds, F1-score are 89.62%, 87.14%, and 96.86%. Additionally, high and low risk level could be accurately predicted by models. As the threshold increases, the impact of data imbalance is not significant. Analyzing journey risk level through a rule-based approach can overcome overfitting caused by data imbalance.

## **H. Future Areas to Take Note of, and Going Forward:**

1. Lack of real world motorcycle delivery couriers' dynamic data
2. More specific motorcycle maneuvers can be used in risk evaluated model, for example rash deceleration, over leaning.....and so on.
3. Overcome the vibration influencing the data accuracy of motorcycle in future work.

## **I. Means of Official Announcement of Research Results:**

Proposed as a dissertation of master's degree of graduate program of transportation science, Department of Transportation and Communication Management Science, National Cheng Kung University.