International Co-operation on Theories and Concepts in Traffic Safety

# Detecting vulnerable road user behaviour under adverse visibility – using AI for resolution enhancement in observation data

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## Introduction

Road safety researchers frequently rely on video-based roadside observations to register safety-related behaviour of vulnerable road users. Novel computer vision-based approaches allow the automated registration of such behaviours through the application of machine learning methods (Siebert et al., 2023; 2024). While these methods allow comprehensive behaviour registration, they currently do not work well under adverse visibility conditions, i.e. when low-lighting levels result in blurry images of road users in the early morning or late afternoon hours, where it is possible to identify that a road user is present, but their specific behaviour cannot be observed (Siebert & Lin, 2020; Siebert et al., 2021). This is a critical shortcoming, since studies find time-of-day related behavioural effects of e.g., motorcycle helmet use (Siebert et al., 2019), which can be missed if automated detection tools have low accuracy during certain times of the day. Hence, in this study, we investigate the use of super-resolution methods, which use machine learning to increase sharpness and resolution of images. We apply these techniques to image data from roadside observations collected in Myanmar (Siebert et al., 2019) to test whether automated detection approaches can benefit from preprocessing through super-resolution methods. In the following we will first describe the dataset and methods used, followed by first results and example image comparisons, and finally we discuss the potential impact of our findings for road safety researchers.

## Methods

To test our approach, we use image data from the HELMET dataset (https://osf.io/4pwj8/), which contains roadside video recordings from 12 observation sites in Myanmar. The dataset contains human-annotations of active motorcycles, i.e. motorcycles that are currently in use. From the dataset we extract the bounding box images of these active motorcycles, resulting in cut-outs of motorcycles (top row Figure 1). The resolution of these images is relatively low, although for a human observer it is still possible to correctly identify if a helmet is used or not. We then apply a state-of-the-art super-resolution image enhancement algorithm (Wang et al., 2021) to increase sharpness and resolution of the active motorcycle images.

## Results

Original and super-resolution enhanced example images from the HELMET dataset are presented in Figure 1. Descriptively, the enhanced images are sharper, with a generally clearer visual for edges of e.g. helmets, riders, and motorcycles. This indicates that super-resolution enhanced images could support human-observer-based road user behaviour registration, even when no automated-registration methods are employed. A preliminary analysis of helmet detection accuracy also indicates improvements in automated helmet use registration, although a larger sample assessment is necessary to explore this further.

Figure 1. Original (non-enhanced) images (top). Super-resolution enhanced images (bottom).

**Discussion**

In this study, we propose the use of super-resolution image enhancement to increase detection accuracy in road safety observation surveys. Our preliminary results point to the usefulness of image enhancement, as higher resolution and increased sharpness increases ease of e.g., helmet use identification. However, further analysis and a quantification of these preliminary findings is needed. For this, we plan to compare the impact of image enhancement on the helmet use detection accuracy of the whole HELMET dataset.

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