

Estimation of the human performance for pedestrian detectability based on visual search and motion features

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Abstract

This paper proposes a method for estimating the human performance of pedestrian detectability from in-vehicle camera images in order to warn a driver of the positions of pedestrians in an appropriate timing. By introducing features related to visual search and motion of the target, the proposed method estimates the detectability of pedestrians accurately. Support Vector Regression (SVR) is used to estimate the detectability. Here, SVR is trained using features calculated by the proposed method with the ground truth obtained through experiments with human subjects. From experiments using in-vehicle camera images, we confirmed that the proposed features were effective to estimate the detectability of pedestrians.

1. Introduction

In recent years, driving safety support systems are becoming important to prevent car accidents. One of the most important functions of such systems is to warn a driver of the positions of pedestrians by making a sound or indicating on a head-up display. Figure 1 shows an illustration of a driver's vision with two pedestrians that have different detectabilities. As can be seen in the image, since pedestrian A can be observed in a large size at the center of the image, it seems that it is easy to be detected by a driver. In contrast, it seems to be difficult to detect pedestrian B due to its small size and complex background. Since the driver may not be able to detect pedestrian B, he/she cannot cope with a sudden action of the pedestrian B. From these points of view, it can be considered that warning systems based on the de-

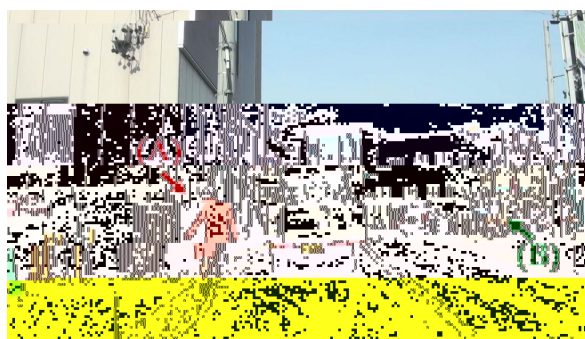


Figure 1. Examples of various appearances of pedestrians.

tectability of the pedestrian will be important. However, over-warnings may decrease the concentration of the driver. Therefore, it is important to develop a method to select appropriate information for driving and to provide them to a driver. In this paper, to provide useful information that is important to prevent collisions with pedestrians, we focus on the detectability estimation of a pedestrian from in-vehicle camera images.

Several research groups have proposed methods for estimating the detectability (or the visibility) of pedestrians, traffic signals and traffic signs [3, 4, 6]. Kimura et al. proposed a method for estimating the visibility of traffic signals by evaluating the contrast of image features between a traffic signal and its surroundings [6]. Doman et al. extended this idea to the estimation of traffic signs [3]. Engel et al. proposed a method for estimating the detectability of pedestrians from a still image [4]. In this research, the detectability of pedestrians was estimated by Support Vector Regression (SVR) [1] using several types of image features extracted from a

still image. To obtain the ground truth of the detectability of pedestrians, they conducted experiments with human subjects. First, an in-vehicle camera image was displayed for an instant to each human subject, and they were asked the positions of pedestrians that can be seen in the image. Finally, the detectability of each pedestrian was computed as the percentage of pedestrian detected by human subjects. However, all of the above methods used still images for estimating the detectability (or the visibility) of targets, but the use of motion features have not been considered. In addition, although the detection of the targets by drivers is strongly related to the task of visual search, this was not considered either.

Therefore, this paper proposes a method for esti-

