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VEHICLE'S ORIENTATION MEASUREMENT METHOD BY SINGLE-CAMERA IMAGE USING KNOWN-SHAPED PLANAR OBJECT

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Abstract. *This paper describes the development of a vehicle's orientation (3D distance and direction) measurement system using a single camera. We propose a new approach for measuring both 3D distance and direction from a camera to a vehicle using its license plate image. The key technique of this approach is based on a single camera calibration method by using a planar pattern. With this method, the orientation from camera to planar object can be obtained using more than four feature coordinates on the camera image of a known-sized planar object. We thus calculate a vehicle's orientation using its license plate image as the planar object. The license plate's corner points necessary to calculate orientation are tracked by an active contour tracking method. The effectiveness of our proposed method has been verified through experiments using real vehicle images.*
Keywords: Image measurement, Single camera, Planar object, Active contour tracking

1. **Introduction.** A lot of research has recently been carried out on anticollision systems for automobiles. In particular, inter-vehicular distance measurement systems using an on-board camera image have been developed and are already in practical use. One conventional method using a single-camera image utilizes the relative size of the vehicle or license plate character image. Another utilizes the relative distance between the ground and the vehicle's base. Although these approaches are very simple, they have some problems. First, the algorithm using relative size or distance to image makes it difficult to achieve measurement accuracy. Besides, these approaches can only measure the linear distance from camera to vehicle. Here, we consider an inter-vehicular measurement system that can measure both 3D distance and direction from a camera to a vehicle using a single-camera image. There have been many researches on 3D distance measurement systems [1, 2]. If the direction to the vehicle in front can be obtained, this information is useful for predicting its course. Such a technique is important for anticollision systems or unmanned carrier operations.

This paper proposes a vehicle's orientation measurement method using a single-camera image. The key technique of our approach is based on a single-camera calibration method using the planar pattern proposed by Zhang [3, 4]. With this method, the orientation (the object's 3D distance and direction) from camera to planar object can be obtained by using more than four feature coordinates on the camera image of a known-sized planar object. We employ this fact to develop a method for measuring a vehicle's orientation. The vehicle's license plate image is used as the known-sized planar object. However, to obtain the vehicle's orientation using our proposed method, it is necessary to detect and track at least four feature points of the planar object image with high accuracy. To achieve