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論　文　内　容　要　旨

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学位論文題目	Research on Traffic Object 3D Pose Estimation Integrated with Prior Knowledge (事前知識を統合した交通物体の３Ｄ姿勢推定に関する研究)		

内容要旨

Pose estimation is an important research field of computer vision, which has contributed to many domains, such as industry, medical care, education, and autonomous driving. In this thesis, aiming to the demands of unmanned vehicle technologies, some related methods are designed for perusing more accurate pose estimation of traffic objects. Due to the limitation of time and length of the thesis, the two kinds traffic objects (i.e. traffic signs and roads) are mainly taken into consideration for pose estimation. In order to overcome the influences of noises by sensors and vehicle's motion, the specific methods are proposed for corresponding objects utilizing their shapes and structure information as prior knowledges. In experiments, the comparative results on the public available dataset of real traffic scenarios validate the superiority of the proposed methods.

This thesis first introduces the definition of pose estimation on the traffic objects. The mathematical expression is employed to distinguish the 6DoF pose from others. Besides, the oriented objects from all traffic objects are selected and study. Then the background and significance of the pose estimation on traffic objects have been expatiated. In the end, the organization of the thesis is presented.

Secondly, the method for pose estimation of traffic signs is put forward. The homography constraint utilized in the method assumes that the traffic signs captured by various viewpoints are stable and localized in the 3D plane. The feature correspondences are established and shifted through a series of processing. The objective function is established to combine the shifted feature correspondences and the traffic sign plane for optimization. Meanwhile, in order to test the proposed method, the KITTI^{+} dataset is proposed after space-time synchronization. The comparative experiments with state-of-the-art methods have been conducted on the KITTI^{+} and BelgiumTS datasets. The quantitative results prove that the proposed method has better localization performance than others do.

Subsequently, the pose estimation of traffic road problem has been investigated and converted into the problem of non-perspective pose estimation from line correspondences. Thus, for the traffic road, the two-stage coarse-to-fine registration method is proposed to estimate the road pose from line correspondences. To begin with, the ICP method is employed for estimating the road pose coarsely. Then, the objective function is designed to combine the point-to-line correspondences for refining the coarse pose. Besides, we propose a convenient and free way

to acquire the wire-frame road from GIS information, which can be applied in this task. The quantitative and qualitative experiments are conducted to validate the proposed method. Besides, in these experiments, the state-of-the-art methods are re-implemented for comparison. The results prove that our method estimates the road pose more accurate than other state-of-the-art methods do.

Furthermore, since the way of acquiring the wire-frame road model is relatively time-consuming, we propose a new framework to acquire the structure and estimate the pose of a road simultaneously. The main improvement is that the proposed method only need the central line of a road rather than the whole wire-frame model. To begin with, the road boundaries are parameterized by the central line of the road. The point-to-line correspondences are established with the 3D points of parameterized boundaries and the 2D lines on the images. Then, the objective function utilizes the correspondences to estimate the pose and structure of the road. The experimental results prove the effectiveness of the proposed method.

Finally, according to the existing researches and weakness in this thesis, we conclude the whole thesis and introduce the future works. The future works are based on the previous works and extended to be applied for other kinds of traffic objects. Besides, the dynamical moving objects (such as vehicles, pedestrians) are more concerned. Their poses of each frame are estimated to form moving trajectories.