EVALUATION OF ROTATION INVARIANT AND EQUIVARIANT CNN FOR CATADIOPTRIC PANORAMA

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Abstract:
Panoramic images which can unfold wide field of view on fixed grid have been good auxiliary data for GIS users because of its larger amount of information, although equirectangular panorama using multiple cameras can be easily messed up by distorted pixels caused by tilted sensor pose. In several studies, catadioptric images which can project direction vectors from center of virtual sphere in circular image after being reflected against hyperbolic or parabolic surface has been adopted to resolve the distortion problems and has demonstrated its capability. Especially, catadioptric image maintains its rotational variance along each axis to spinning point keeping pixel information in a single image, so that it can retain potential features as it is. On the other hand, complex image classification process which has been implemented by complicated handcrafted works can be solved by a single deep learning model with an outstanding result. Accordingly, sustainability of image features including rotation invariance and equivariance of network-based model is re-considered as a crucial method. Although several novel research which has proposed rotation-invariant and equivariant network-based models, they show somewhat deviated results in terms of dataset, and the evaluation of applicability was not sufficiently suggested.
In this study, we present a prototype to show applicability of catadioptric panoramas in deep learning models, by utilizing rotation invariant and equivariant network models trained with panorama images in terms of data type and model structure. RiCNN(Rotation Invariant CNN) and G-CNN(Group Equivariant CNN) are trained using different type of data including RGB panorama images and RGB point cloud images for evaluation. Panorama images are acquired at intervals of 10m over a 180m x 250m area. They are projected to 3-D RGB points obtained from LiDAR for the same area and sequentially indexed location data of each image is used as the reference data to train and validate the CNN models. This experiment will show the rotation invariant and equivariant CNN can be expanded to the GIS applications using catadioptric panorama.

Keywords: Catadioptric Panorama, Rotation Invariant and Equivariant CNN