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Jingchao Jiang
jiangjc@hdu.edu.cn

Junzhi Liu
liujunzhi@njnu.edu.cn

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Extraction of Urban Waterlogging Depth Information from Video Images Using Transfer Learning and Ridge Regression

Jingchao Jiang[a*], Junzhi Liu[b]
([a]Smart City Research Center, Hangzhou Dianzi University, Hangzhou, Zhejiang 310012, China, jiangjc@hdu.edu.cn;
[b]Key Laboratory of Virtual Geographic Environment, Ministry of Education, Nanjing Normal University, Nanjing, Jiangsu 210023, China, liujunzhi@njnu.edu.cn;)

Abstract: Spatially detailed waterlogging depth information is essential for urban flood and drainage control. Due to the high costs of existing waterlogging monitoring methods of water level gauges, only limited numbers of waterlogging points are monitored, which makes it difficult to obtain the spatially detailed information of urban waterlogging. Ubiquitous video supervising equipment in cities records urban waterlogging process in visual ways, which has the potential to obtain spatially detailed waterlogging information. We developed a methodology to extract urban waterlogging depth information from video images. Firstly, extract feature vectors from the video image set of urban waterlogging using a transfer learning model. In this study, Inception v3 architecture model was employed as the transfer learning model, and output of the bottleneck layer of Inception v3 was considered as the feature vector of waterlogging depth for each image. Secondly, the image feature vector dataset were divided into a training set and a testing set, and each image was given an observed value of waterlogging depth. In the training procedure, one or more ridge regressions were built based on the feature vectors of the training set and the corresponding observed values. In the testing procedure, the above regressions were used to calculate waterlogging depth directly and the feature vectors of the testing set are taken as input of these regressions. At last, RMSE was used to measure the difference between the calculated value and the observed value of waterlogging depth in the training and testing procedures. To prove the effectiveness of the proposed methodology, a video image data set from the video monitoring system of a city waterlogging road and the corresponding observed values of waterlogging depth were employed. The results showed that this methodology could effectively extract waterlogging depth from video images. The achievements of this study could strengthen the capability of monitoring for urban waterlogging.

Keywords*:* urban waterlogging depth; transfer learning; ridge regression; video data