Asphalt Pavement Surface Objects Detection - Denoising Concept

Rafal Kapela, Andrzej Pozarycki, Adam Turkot
Poznan University of Technology
rafal.kapela@put.poznan.pl, andrzej.pozarycki@put.poznan.pl,
adam.turkot@put.poznan.pl

Abstract

In the field of noninvasive sensing techniques for civil infrastructures monitoring, image recognition techniques become very handy. On the other hand, the ability of an autonomous image recognition system in the task of accurate asphalt surface crack detection due to the range of difficulties seems to be challenging. Usually, the first task in these kinds of systems is the elimination of the noise and the surface artifacts that are present in the images. Given that there is a whole range of different asphalt surfaces that are featured with diverse texture characteristics this task is not trivial. As a result, the image processing system has to adapt to the asphalt texture parameters in order to extract valuable information from the surrounding background. For this reason, two-fold denoising system is presented in this paper.

The first stage of the denoising system presented in this paper is the noise removal caused by the vehicle onboard system hardware and adaptive feature enhancement. This is a challenging task given the vast variety of asphalt surface texture homogeneities. For this reason, the adaptive contrast enhancement is required. Next, the image is presented to the feature enhancement procedure which produces two outputs for feature calculation: enhanced luminance features and enhanced edge features. The second stage of the system is the actual asphalt texture extraction (i.e., asphalt image region denoising). For this purpose, we designed and implemented an automatic procedure that utilizes a Convolutional Neural Network (CNN). It proceeds with a manual image annotation system where the user picks the image regions which belong to a certain class (e.g., a hatch or curb). Then, in a fully automatic way, the training data for the CNN is prepared together with a definition of the network. The next step involves training of the network with use of GPU acceleration.

The system is based on OpenCV and caffe libraries and is implemented in C++ language. Computational experiments show that it is featured with higher denoising ratio than presented in previous works.

References

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