COLLECTING, ANALYSIS, CLASSIFICATION METHODS AND APPROACHES OF THE ROAD PAVEMENT DEFECTS DETECTION

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ABSTRACT

This project considers the problem of identifying and classifying the type of damage to the road surface according to the accelerometer installed on the car. The idea of the method lies in the fact that when the road surface is damaged, the acceleration of the car changes (for example, when driving through a damaged road, the amplitude of the car's vibrations increases, or there is a sharp change in the acceleration component when the driver tries to around the damaged section of the road). Accordingly, such a change in the accelerometer data can potentially determine the presence and type of defect.

INTRODUCTION

As was said above, the project touches on accelerometer data analysis. It was decided to take road pavement defect identification and classification issues. The process of pavement monitoring is a highly time-consuming process; it requires special skills and knowledge in the area. Another important aspect of the issue is the necessity to perform periodical monitoring of the surface in order to have an actual representation of the situation. There are already several methods and solutions based on computer vision technologies. Despite the relatively complex implementation, it works but requires expensive equipment. This research shows the possibility of solving this problem by processing data from the accelerometer, which could be a less expensive alternative to computer vision-based methods.

METHODICS

It was mentioned previously that road pavement defect detection topic has already been considered in the literature. It is possible to distinguish the following groups of approaches:

- Image analysis, a damage detection approach based on the image processing received from the camera using deep convolutional neural networks [1],
- Vibration data analysis, use of accelerometers or gyroscopes mounted on a vehicle [2],
- 3D data analysis: use of stereo images or LiDAR data for damage detection [3].

Our idea of data processing in road pavement state monitoring is an application of the Neural Networks to process accelerometer data. We used Long Short-Term Memory Recurrent Neural Networks (LSTM) and their modifications: CNN-LSTM and ConvLSTM. LSTM network models are a type of Recurrent Neural Network that can effectively learn and retain information over long sequences of input data, making them suitable for hundreds of steps.

Several results of applying the mentioned Neural Networks are shown below in fig. 1. Blue curve – original signal from the accelerometer, red curve – the identified defects. Green windows show the differences in identification for different Neural Networks.

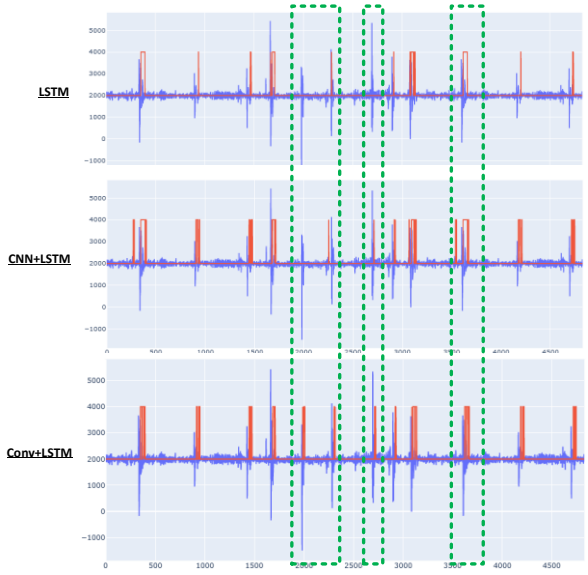

Figure 1: Comparison of the LSTM and modifications

RESULTS AND DISCUSSION

According to the nature of the task, we chose the following metrics to assess the performance:

- Recall - the metric that indicates that the desired defect of the pavement occurs,
- Precision - the metric- the proportion of correct positive combinations among all combinations.

Table 1: Metrics summary

Model	Precision	Recall
LSTM	0.79	0.65
CNN-LSTM	0.67	0.73
ConvLSTM	0.80	0.78

Acc0rding to the Table 1, CNN-LSTM and ConvLSTM, compared to the basic LSTM, have an 8-11% larger recall value; at the same time, comparing the CNN-LSTM and ConvLSTM, shows that the ConvLSTM has up to a 13% increase in the precision metric.

REFERENCES

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