

Road Infrastructure Assessment with Smartphones in Vehicles

CMU University Transportation Center
 SmartSigns Conference
 Rebuilding and Retrofitting
 the Transportation Infrastructure

Carnegie Mellon
 THE ROBOTICS INSTITUTE

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The Challenge

- Inspecting city roads **manually** is a tedious and error-prone.
- Using **specialized vehicles** gives accurate results but is expensive.
- Citizen reports** are unreliable and address only major problems.



Distributed data collection

Collection system: Imaging is done with a portable Android device mounted inside a vehicle.



Can be used in service vehicles - no special personnel required for data collection



Obtain time-stamped images, GPS, accelerometer, compass and gyroscope measurements city-wide, on a regular basis

Stop sign inventory and assessment



Stop signs detected in the city of Pittsburgh.

- 1500 km unique roads
- 3 years
- 500 hours
- 14M images

Stop signs with problems:



Road Crack Detection

using computer vision and machine learning



Segmentation of road area



Detection of cracks

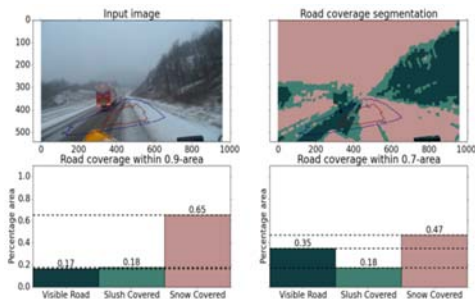


Map of Road Damage



Severity: Low Medium High Average score of each road segment

Road Condition: Snow and Slush cover

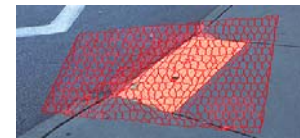


Other road infrastructure assessments

current research



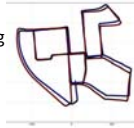
General traffic sign detection using deep learning and synthetic images for initial training



The texture detection software can also be trained to **find tactile patches in sidewalks**.



Measuring size of traffic sign (left) using GPS and **visual odometry** (right) to scale the detected sign in the image.



flash on flash off subtracted



Subtract image with flash off from image with flash on to **measure retroreflectivity of the traffic sign**.

Outlook

We will be adding more capabilities of detecting, classifying and assessing infrastructure that can be observed from a vehicle. Our long term goal is to have a detailed, up-to-date map of all relevant objects and their status around the road. This map can then be used for assessment, maintenance, driver assistant systems and autonomous driving.

We are also commercializing these technologies, the company RoadBotics (www.roadbotics.com) has been founded at the end of 2016*.

* Disclosure: The first author is a co-founder of the company.

Inspection Possibilities



Acknowledgements

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