Proposal for a contribution to ESAR 2018

Title:
Crash Rate Estimation by Aerial Image Analysis

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Abstract:
Estimating road safety is a major concern of a large body of theoretical research as well as for practitioners all over the world. Most related studies heavily rely on structured data as tables concerning the road geometry, infrastructural items, traffic volumes, etc., which are not always available.
A more and more universally available source of data, which has rarely been used in conjunction with road safety research are aerial or satellite images. These images potentially contain a wealth of information relevant to the prediction of road safety if they could be thoroughly analyzed in great numbers.
Coincident with the widespread availability of satellite and aerial images, machine learning algorithms for image processing and automatic object detection and classification are maturing. This allows the automated processing of huge amounts of images by artificial neural networks (ANNs) or related machine learning systems – an area in which convolutional neural networks have shown a significant improvement over conventional methods.
In the submitted work we present our initial results on the application of machine learning on aerial images to determine an estimation of road safety levels. We have trained ANNs to predict crash frequencies for road intersections relying merely on aerial images of the intersections. The used data consists of police recorded crashes in the city of Berlin and aerial images provided by the Berlin Senate Department for Urban Development.
The performance of the ANN suggests that the line of research is worth further pursuit. For instance, the trained ANN was able to predict the presence of crashes on intersections in a Berlin district excluded from the training process with an accuracy of approximately 70%.
Most probably the conjunction of aerial image analysis with classical methods may result in a boost for the accuracy of automatic road safety mapping.
As a practical implication aerial image analysis may for instance assist road safety authorities to identify possible hotspots or problematic parts in their road network before they become apparent due to an increased number of crashes.
Another interesting application is the utilization of digital road safety maps for assistance systems as, e.g., routing or warning devices as well as for automated driving. In particular, the developed methods allow a localization of hotspots on a more fine-grained level then per road element. In principle a spatially continuous rate of road safety for whole road networks can be determined.