AVSS 2011 demo session: Level of Service Classification for Smart Cameras

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At the Industrial Surveillance Day, ASFINAG and the Alpen Adria Universitât Klagenfurt (in particular the Institute of Information Technology and the Institute of Networked and Embedded Systems) demonstrate a show case of their video-based level of service (LOS) classification for smart cameras. This LOS classification system has been developed in a joint Lakeside Labs project in Klagenfurt, Austria. It is part of a case study which aims at improving the quality of traffic messages for the two particular traffic situations level-of-service (LOS) and weather-related road conditions (WRRC) on two dedicated test tracks on Austrian motorways. Using a live connection to a smart camera at one of these test tracks, we plan to show a live demonstration for visual speed estimation and LOS classification. This demo is coordinated with our partner SLR Engineering, which provided the smart cameras for the case study.

Video-based LOS detection method

<table>
<thead>
<tr>
<th>Level</th>
<th>1 Lane</th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Velocity (km/h)</td>
<td>Density (v/km)</td>
</tr>
<tr>
<td>1 (free flow)</td>
<td>[80,∞]</td>
<td>[0,20]</td>
</tr>
<tr>
<td>2 (heavy)</td>
<td>[80,∞]</td>
<td>[20,50]</td>
</tr>
<tr>
<td>3 (queuing)</td>
<td>[30,80]</td>
<td>[0,50]</td>
</tr>
<tr>
<td>4 (stationary)</td>
<td>[0,30]</td>
<td>[50,∞]</td>
</tr>
</tbody>
</table>

Table 1. LOS level classification for a single lane.

The LOS describes the operational conditions of a segment or traffic stream. For Austrian motorways, four LOS classes are defined. The LOS is computed from the average velocity and vehicle density as shown in Table 1. in our live-demo, we show a feature-based LOS classification method. The presented method uses KLT-based motion features and Sobel-based edge features in conjunction with a Gaussian Radial Basis Function Network (GRBFN) to classify the prevailing LOS. Features are only calculated for a predefined analysis area as shown in Figure 1(a). The features are computed for every frame and aggregated over a certain observation period (e.g. one minute). To classify the LOS, the following features are calculated:

- median KLT vector length
- average KLT vector length per frame
- average edge occupancy

To obtain the motion vectors of the analysis area, KLT feature tracking is used (Figure 1(b)). Using the length of KLT vectors that point in the dominant direction, the median vector length and the average vector length per frame are calculated.

The block-based edge occupancy is calculated from a binary edge mask (Figure 1(c)). For each block of the analysis area, our method counts the number of edge pixels. If the number of edge pixels exceeds a certain threshold, a block is considered active. The edge occupancy feature is calculated from the average number of active blocks.

The algorithm [1] is designed to run on a smart camera equipped with an Intel Atom 1.6 GHz processor, 1GB RAM and a 1280x1024 color CCD sensor. For evaluation of the
algorithm, we used an 11 hours test video with a resolution of 352x288 containing all LOS levels. Using 10 hours for training with cross validation, the method achieves an average accuracy of 77.3%. Figure 2 shows the result of our LOS classification (Figure 2(b) method compared to the ground truth (Figure 2(a)). Utilizing a simple 3-point rectangular smoothing function to eliminate oscillating classifications provides classification results close to the ground truth as shown in Figure 2(c).

References