DATA FROM SKY

Automatic vehicle trajectory extraction for traffic analysis from aerial video data

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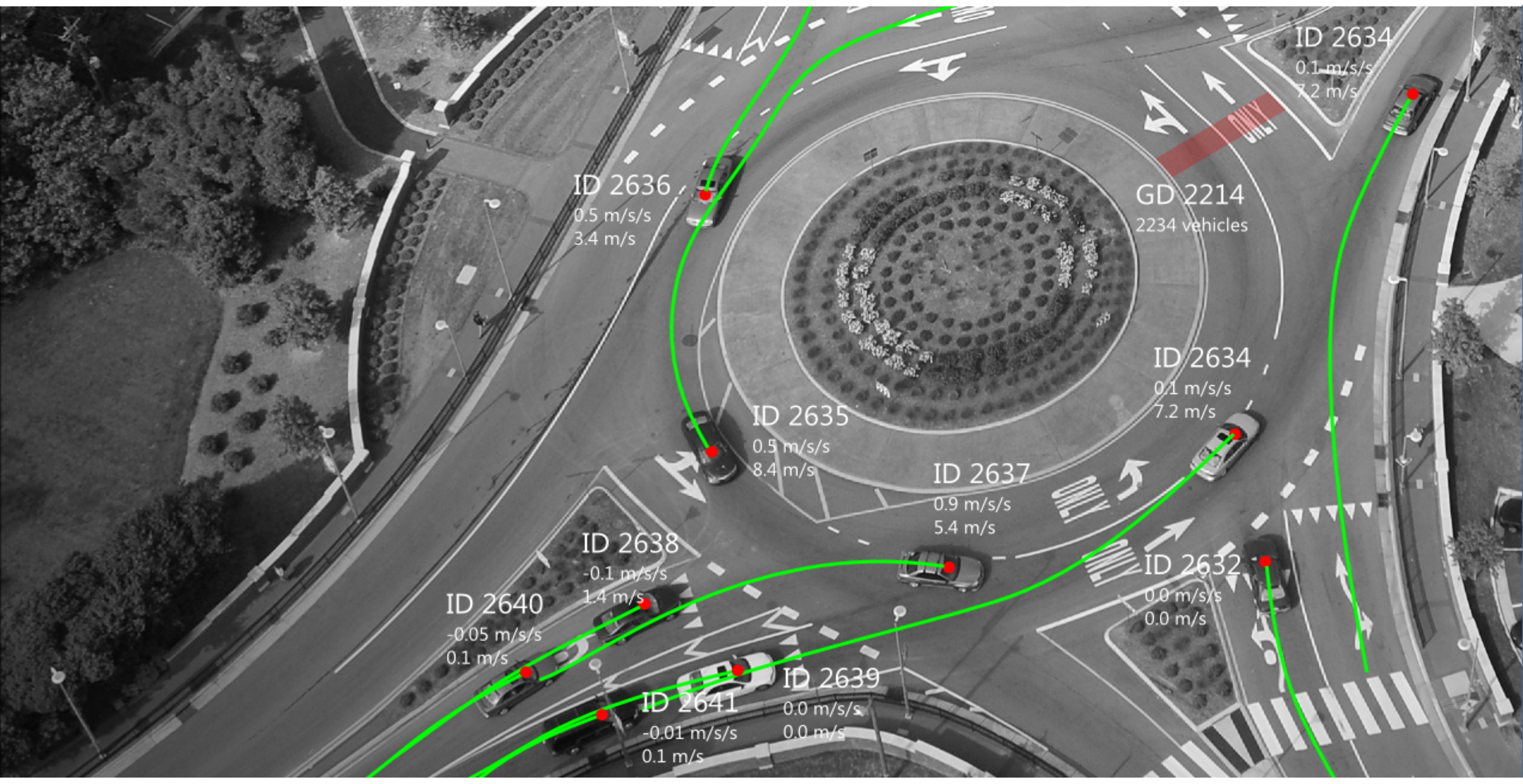

Features

- Gate counting
- Automatic trajectory extraction
- Advanced trajectory analysis
- Determination of used input and output gateways
- Measure speed, acceleration, and time of passage

DataFromSky is an advanced tool designed for monitoring and analyzing traffic flow in road networks by processing video data

A detailed analysis and evaluation of traffic flow is essential for a precise design and development of transport infrastructure. Aerial video surveillance using a wide field-of view sensor has provided new opportunities in traffic monitoring over such extensive areas. In fact, unmanned aircraft systems equipped with automatic position stabilization units and high resolution cameras could be the most effective choice for data acquisition in sufficient quality. UAVs, unlike satellites or airplanes, are able to collect visual data from low altitudes, and therefore provide images with adequate spatial resolution for further traffic inspection, i.e. vehicle detection and tracking.

This poster proposes a method for detection and tracking of vehicles passing through an intersection for a detailed traffic analysis. The results are used for evaluation of the design of intersection and its contribution in the traffic network. The output from the analysis needs to be in the orthogonal coordinate system of the analysed intersection; therefore the transformation between the reference image and the intersection's coordinate system is known. For simplicity's sake the interchange types of intersections are not addressed and the analysed area is approximated by a plane. Figure 1 depicts the overall design of the system, which can be divided into three main parts: preprocessing, vehicle detection, and tracking.

In the preprocessing step, the acquired image is undistorted and geo-registered against a user-selected reference frame. The methods for image undistortion have been addressed in literature several times. In our case, radial and tangential distortions are employed. The perspective transformation model is used in the geo-registration process. First, local ORB features are extracted both from the acquired undistorted frame and the reference frame. The features are then matched based on their descriptor distances and cross-validated, forming pairs of points which are used for estimation of geometrical transformation. Robustness of the algorithm is achieved utilizing RANSAC procedure.

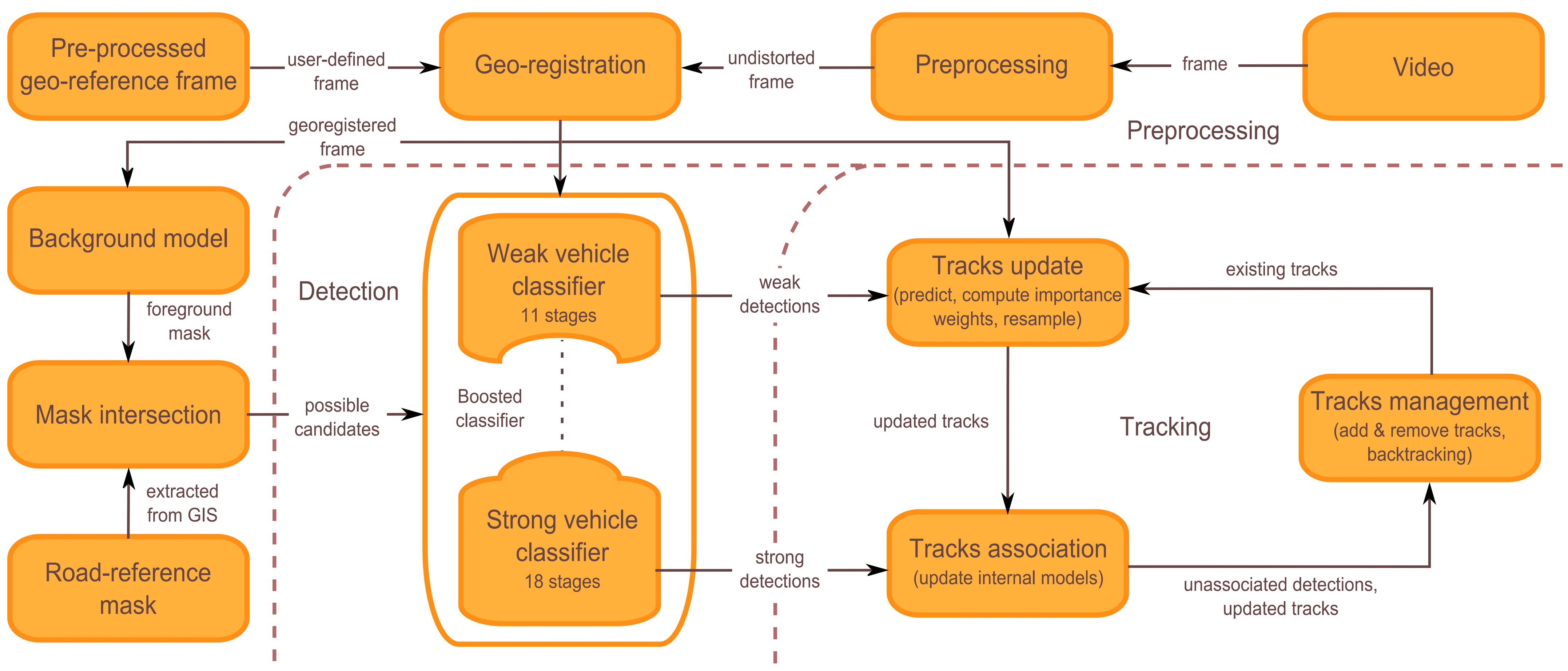

Figure 1: System architecture – the Boosted classifier is divided into two parts, the weak and the strong classifier. The detections taken from the strong classifier are used for initialization of new targets and/or for the update of the appearance models of existing targets when an association occurs. The detections returned by the weak classifier are used as clues in the tracking procedure.

Due to its outstanding detection performance, the boosting technique introduced by Viola and Jones was adopted for the vehicle detection. In order to increase robustness to changes in illumination and to accelerate the training phase, Multi-scale Block Local Binary Patterns was employed. The searching space is restricted to the intersection of the motion and street masks with aim to considerably decrease false positive rate and computational demands. The detections which are not associated with existing tracks are added to the tracker as new targets.

For tracking, a sequential particle filter has been adopted. However, due to exponential complexity in the number of tracked targets, the system utilizes a set of fully independent Bootstrap particle filters, one filter per vehicle, rather than the joint particle filter. A target is represented by a gradually updated rectangular template. To further improve the tracker's robustness to cluttered background, a weak vehicle classifier with high positive detection rate is introduced to generate possible candidates for each frame. In fact, the weak classifier is obtained as an earlier stage of the robust one. Therefore, the acquired detections naturally contain a lot of false alarms; however, the probability of true positives is also not inconsiderable. Thanks to the high frame rate of input video, it seems to be beneficial to assume that the true positive detections and the predicted target states are very close to each other. The application of this assumption can effectively eliminate false alarms and can help avoid the tracking failures.

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