Intersection Monitoring System

INITIAL SITUATION
The rising economy in Chinese cities like the city Hefei leads to a rising traffic demand. More and more people are able to buy a motorized vehicle. According to their specific financial possibilities this is not necessarily a car. The numbers of motor (assisted) bicycles and scooters also increase strongly. This leads to various conflict situations, especially in areas of intersections. Most of the existing intersections in China are not designed and/or optimized to handle this kind of increasing traffic. Chaotic traffic situations in intersection areas are the consequences, which impact negatively on the quality of traffic and road safety. Goal of the Intersection Monitoring system is to improve the quality of traffic and road safety in intersection areas, keeping in mind that these are also influenced by infrastructural as well as traffic reasons.

APPROACH
The basic idea here is that the rising traffic demand and high percentage of bikes cause high and complex requirements to the design and steering of the intersections in Hefei. With the intersection monitoring using stationary video cameras traffic demand and traffic movements can be handled in a more efficient and secure way. Aim of this work is to analyze an intersection by collecting traffic related data over a long term period (3 - 6 months) to study the behavior of the different means of transport. This includes the following tasks:

- preoperative (during-) and postoperative exams of building activities at intersection
- different behavior of traffic participants and outside traffic participants (pedestrians and cyclists)
- creation of trajectories
- detection and analysis of incidents
- turn dependent traffic flows
- combination / data fusion of different detection methods
- Redlight violations
System set up and the first results

A test intersection at the Tianzhi - Huanshang Road, which locates in the ITS test field of the Chinese partner ASEC in Hefei, is equipped with a camera. Moreover, a Chinese camera manufacturer was chosen to produce the respective camera so that the transfer of such technology to other intersections in China is ensured. ASEC and DLR installed a video detection system at this four-arm intersection in Hefei.

![Camera view onto the Hefei intersection](image)

Figure 1: Camera view onto the Hefei intersection

It consists of a digital video camera which is connected to a video detection server via Wi-Fi. The detection software on the server analyzes motions in the images with a background estimator and tracks them with an extended Kalman filter (EKF). So the tracks (or trajectories) of the traffic objects are determined and recorded into a database. From this track data graphs for vehicle counts, average velocities or path variances can be created (see figures 2 - 4).

![Video detection system](image)

Figure 2: Vehicle counts for Hefei intersection (©Google Maps)

Figure 2 shows the number of vehicles having been tracked at the intersection within one hour. The thicker a line is the more vehicles have taken this path.

![Average velocities at Hefei intersection](image)

Figure 3: Average velocities at Hefei intersection (©Google Maps)

In figure 3 the average measured vehicle speed has been assigned to each map pixel. The highest avg. speed (red) was measured for vehicles driving west, out of the city with more than 66 km/h.

![Path variation for left turning vehicles at Hefei intersection](image)

Figure 4: Path variation for left turning vehicles at Hefei intersection (©Google Maps)

Figure 4 shows the variance for a certain path on the intersection, the left turning vehicles coming from north. As it can be seen they vary widely on their path with a maximum likely track marked as a white line.