Journal of large-scale research facilities

Journal of large-scale research facilities, 2, A65 (2016) http://dx.doi.org/10.17815/jlsrf-2-122

Published: 12.04.2016

AIM Research Intersection: Instrument for traffic detection and behavior assessment for a complex urban intersection

Deutsches Zentrum für Luft- und Raumfahrt e.V.,
Institute of Transportation Systems [*]

Instrument Scientists:
- Sascha Knake-Langhorst, Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Institut für Verkehrssystemtechnik, Braunschweig, Germany, phone +49 531 295-3474, email: sascha.knake-langhorst@dlr.de
- Kay Gimm, Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Institut für Verkehrssystemtechnik, Braunschweig, Germany, phone +49 531 295-3453, email: kay.gimm@dlr.de

Abstract: The Research Intersection as part of Test field AIM (Application Platform for Intelligent Mobility) is a field instrument for detection and assessment of traffic behavior for a complex urban intersection in the city of Braunschweig, Germany. It serves as tool for the purpose of analyzing natural traffic behavior and phenomena, e.g. in safety related traffic situations, based on empirically observed trajectories. Thus, the facility can be used for a number of applications in the field of intelligent mobility services.

1 Motivation

The test field AIM (Application Platform for Intelligent Mobility) has been built-up by the Institute of Transportation Systems of the German Aerospace Center (DLR) in Braunschweig, Germany to support and conduct research and development in the field of intelligent mobility services (Schnieder & Lemmer, 2012, 2014). It consists of different large scale research infrastructure facilities providing a wide range of services covering simulation environments, test tracks and field instruments. One of these services is the AIM Research Intersection, which resides on the North-Western corner of the inner ring road of Braunschweig. It is an instrument for detection and assessment of traffic behavior for a complex urban intersection.

[*] **Cite article as:** DLR Institute of Transportation Systems. (2016). AIM Research Intersection: Instrument for traffic detection and behavior assessment for a complex urban intersection. *Journal of large-scale research facilities, 2,* A65. http://dx.doi.org/10.17815/jlsrf-2-122

2 Technical description

The Research Intersection is based on a scalable and flexible architecture, which is depicted in Figure 1. The diagram shows the basic architecture elements allocated to their respective level of processing going from sensor level to application level. Two main subsystems can be identified considering the white boxes. These two subsystems, called Multi-Sensor System (MSS) and SENV are responsible for detecting, tracking, and classification of motorized (in the case of MSS) and non-motorized (in the case of SENV) traffic participants. In addition, one central architecture element can be found on application level that is called DISCUs. It is responsible for shielding the productive systems from disruptive outside effects by serving as well-defined gateway for information exchanges between these two worlds as well as processing instance for data aggregation and refinement, information processing, and system monitoring.
The following sections will describe the sensory set-up and give an overview about the in- and outputs of the facility.

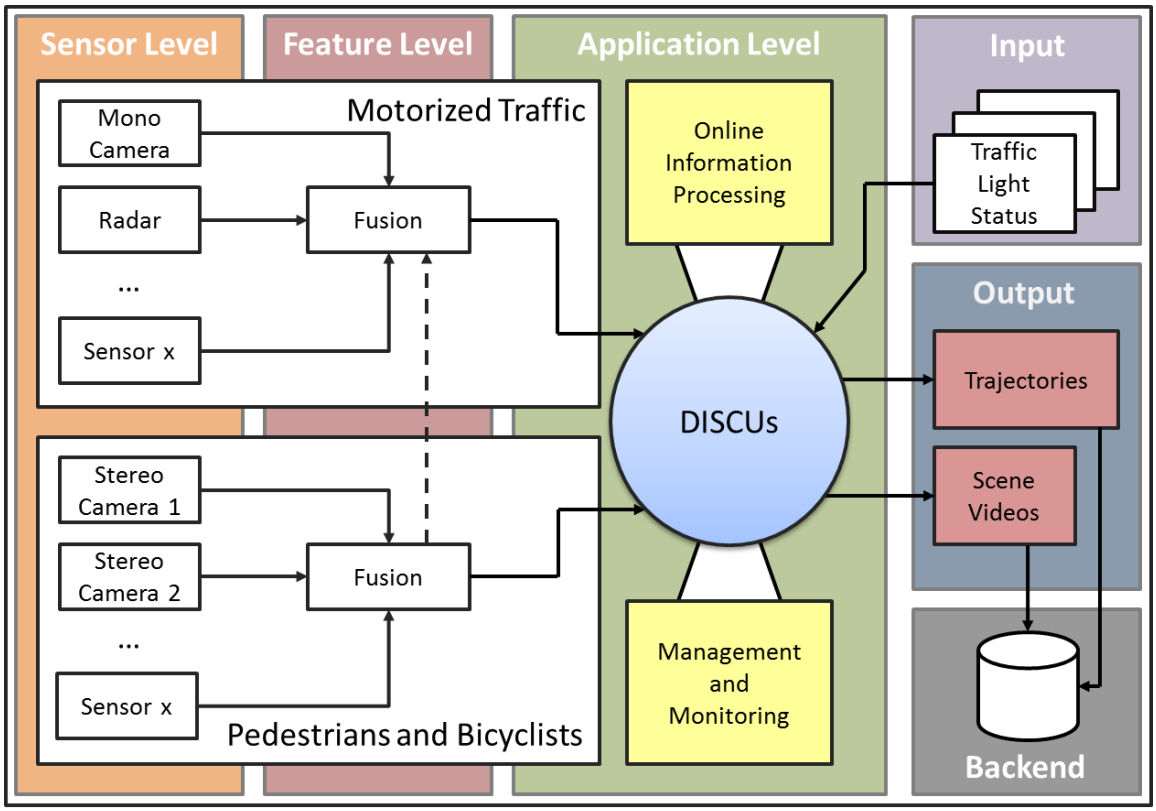

Figure 1: Functional architecture of AIM Research Intersection.

2.1 Sensory set-up

The sensory set-up of the Multi-Sensor System consists of four different installations on poles of stree lighting. Figure 2 (left) shows one of them which consist of a pair of mono-cameras, a 24 GHz multi-range radar system and active infrared lighting for artificial scene illumination. The four pole installations can be found on the four center islands of the intersection with every sensor oriented into the opposite side of the intersection, as displayed in the bird's eye view on the right. This redundant set-up allows detecting all relevant objects on the inner part of the intersection with a minimum number of occlusion issues.

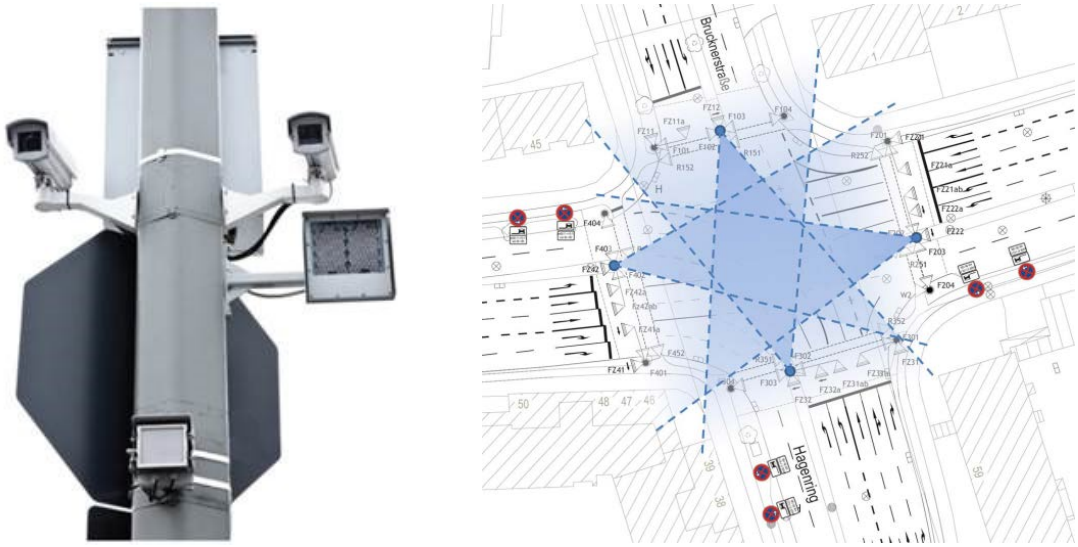

Figure 2: Single pole installation of MSS (left) and bird's eye view of all sensor locations (right) In addition, SENV is installed on the Western and Southern pedestrian crossing. There are four installations which are respectively attached on the opposite sides of the crossings. Each of these installations consists of a stereo camera system and an infrared lighting unit.

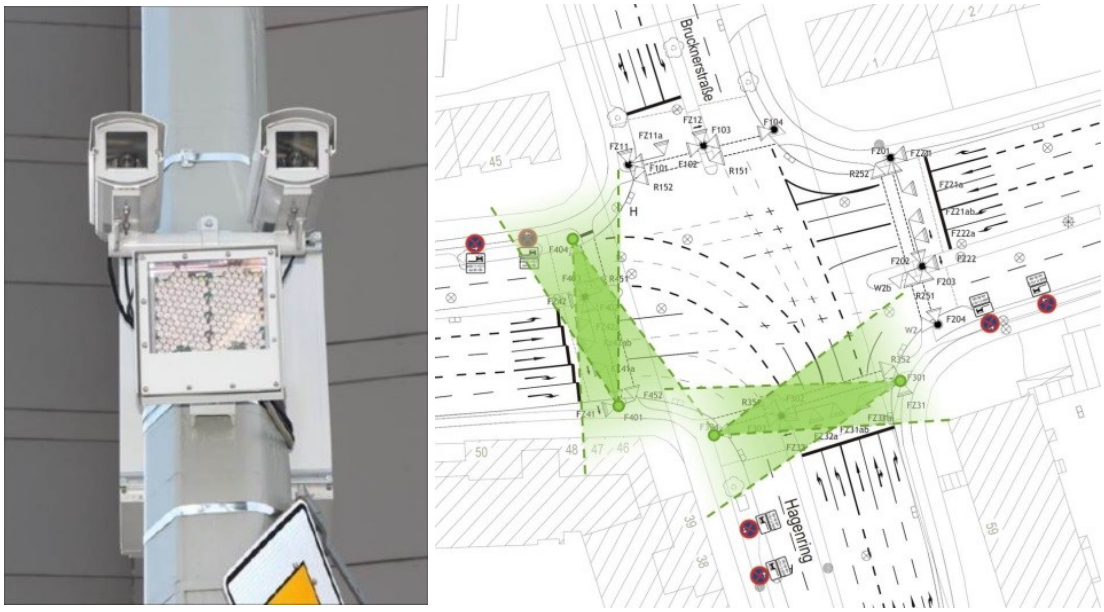

Figure 3: Single pole installation of SENV (left) and bird's eye view of all sensor locations (right).

2.2 In- and outputs

The sensor data is fused and processed to obtain the main output of the Research Intersection, which are trajectories of the detected traffic participants. These trajectories hold information about the classification and dimensions of the object as well as its location, velocity and other dynamic state variables. Figure 4 shows a visualization of a traffic scene from the four MSS perspectives with augmented object information.
These trajectories are produced with a rate of 25Hz. They can be processed by online to enable real-time applications. In addition, they are automatically stored in a data base for offline analysis purposes with the respective scene videos for manual assessment and validation.

3 Project application exampels

The Research Intersection serves as measuring instrument for analyzing natural traffic behavior and phenomena, especially all types of interaction. One focus of works is the analysis of safety-critical situations and near-misses. A good overview about the activities is given in Knake-Langhorst et al. (2016, 2015).
Beyond this, the facility can be used as element of system networks for setting-up cooperative driver assistance systems or automation systems. Knake-Langhorst et al. (2016) illustrates this approach and shows the possibilities by combining the Research Intersection with the AIM Reference Track, another AIM service. This approach is picked up in EU funded project XCYCLE of the H2020 MG.3.4 program (http://www.xcycle-project.eu).

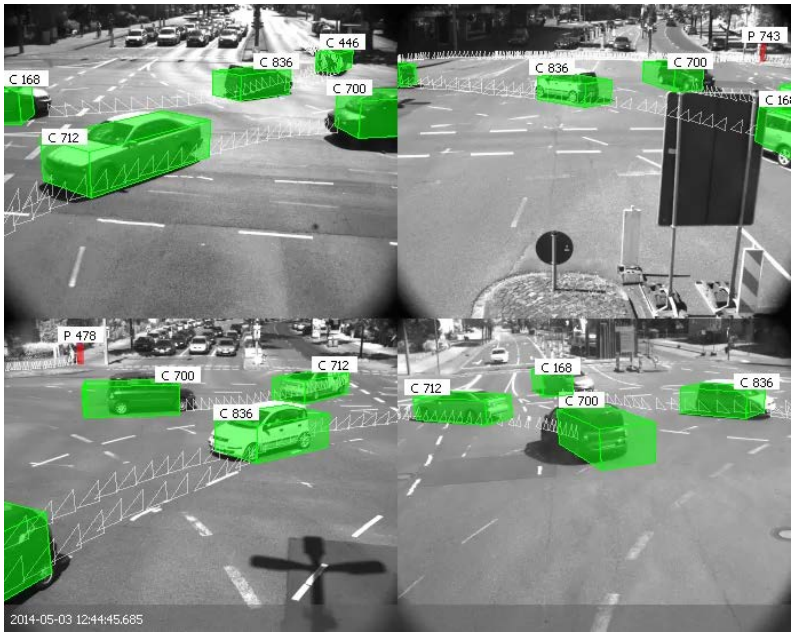

Figure 4: Visualization of a given traffic scene from the four MSS perspectives with augmented object information.

References

Knake-Langhorst, S., Gimm, K., Frankiewicz, T., & Köster, F. (2016). Test Site AIM - Toolbox and Enabler for Applied Research and Development in Traffic and Mobility. *Transportation Research Procedia*. (submitted)

Knake-Langhorst, S., Gimm, K., & Köster, F. (2015). AIM Forschungskreuzung - Baustein für den Aufbau von kooperativer Fahrerassistenz und Automation. In *Intelligente transport- und verkehrssysteme und -dienste niedersachsen* (p. 117-136). Braunschweig: AAET - Automatisierungssysteme, Assistenzsysteme und eingebettete Systeme für Transportmittel.

Schnieder, L., & Lemmer, K. (2012). Anwendungsplattform Intelligente Mobilität - eine Plattform für die verkehrswissenschaftliche Forschung und die Entwicklung intelligenter Mobilitätsdienste. *Internationales Verkehrswesen*, *64*(4), 62-63.

Schnieder, L., & Lemmer, K. (2014). Entwicklung intelligenter Mobilitätsdienste im realen Verkehrsumfeld in der Anwendungsplattform Intelligenten Mobilität. *Internationales Verkehrswesen*, *66*(2), 77-79.