Bosch Case Study – First Year Report

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This document summarizes the work carried out within the AMETIST project on the case study "Real-time service allocation for Car Periphery Supervision" that was provided by Bosch.

The term *Car Periphery Supervision (CPS)* refers to technology for obtaining information about the environment of a car. Such technology can serve as the basis for many driver assistance services, e.g., parking assistence, pre-crash detection, blind spot supervision, lane change assistance, etc., most of which are still under development. There are different sensor technologies available for CPS realizations, e.g., ultrasonic, radar, lidar, infrared and video. In the case study we concentrate on Short Range Radar (SRR) technology. In Deliverable 3.3.1 [4], a preliminary description of the CPS system was provided by Bosch, as well as a list of timing related problems.

An initial study by partners UT and KUN made it clear the initial description in [4] contained insufficient information to make formal analysis possible. In particular, the system requirements, assumptions on timing behavior of the various system components, and a listing of the assumptions on the environment (e.g., number and relative speed of approaching objects) were unclear. Hence a visit by a delegation from UT and KUN to the Robert Bosch GmbH facilities in Frankfurt was arranged on March 5-7, 2003. Based on the fruitful discussions at this meeting with the domain experts from Bosch, study of relevant literature, and the use of MatLab to visualize the sensor visibility areas and to analyse possible trajectories of approaching objects, we were able to supplement the preliminary description of [4] with the necessary information to permit formal modelling and analysis [1, 3]. Ou results show once more the importance of such an analysis: they allow us to make the right abstractions in the dynamical model of the system, and to interpret correctly the results obtained by analysing this model.

The next step we took was to actually construct a formal dynamical model using UPPAAL. In this model the environment, the sensors and the ECU are all modelled as timed automata. The environment in front of the car is divided into a finite number of regions, and lower bounds are given (as derived using the MatLab model) for the time approaching objects need to move from one region to another. By encoding the various assumptions on the environment within our UPPAAL model, we were able to establish a key correctness property of the system (the ECU has a sufficiently accurate view on what is happening in the environment) for the simple case with one sensor. A preliminary description of our results is reported in [2].

Future work will include (a) verification of the model with two sensors, (b) a refinement of our system and environment models, to make them as realistic as possible, (c) verification of the refined model.

References

[1] B. Gebremichael, H. Hermanns, T. Krilavičius, and Y.S. Usenko. Hybrid modelling of a vehicle surveillance system with real-time data processing. In *Proceedings International Conference on Dynamical Systems Modeling and Stability Investigation,* May 27-30, 2003, Kyiv, Ukraine, 2003. Available from World Wide Web: `http://www.cs.kun.nl/ita/publications/papers/biniam/gkhu.html`. To appear.

[2] B. Gebremichael, T. Krilavičius, and Y.S. Usenko. Formal model of car periphery supervision (CPS) system - BOSCH GmbH /AMETIST case study, 2003. Available from World Wide Web: `http://www.cs.kun.nl/ita/publications/papers/biniam/gku.html`.

[3] B. Gebremichael, T. Krilavičius, and Y.S. Usenko. Real-time service allocation for car periphery supervision: Requirements and environment analysis, 2003. Available from World Wide Web: `http://www.cs.kun.nl/ita/publications/papers/biniam/gku2.html`.

[4] S. Kowalewski and M. Rittel. Real-time service allocation for car periphery supervision, September 2002. Available from World Wide Web: `http://ametist.cs.utwente.nl/RESEARCH/AMETIST_CPSPrelimDescription_1_0.pdf`. Deliverable 3.3.1 from the IST project AMETIST.