

Practical Course

# Automotive Software Engineering Project

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Software Methodologies for Distributed Systems  
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You are expected to hand in the solutions until

**September, 20th at 23:59 o'clock.**

Don't forget to document your code, models and results.

Please provide all documents inside your team's git repository.

**At the final exam you will be asked questions on your team's solutions of the Project. You should be able to explain what you did and why you made certain design decisions.**

## Introduction to Intersection Assistants

Intersection assistants (also referred to as crossing assistants) shall help to prevent accidents at intersections. An intersection assistant warns of priority traffic when approaching a crossing and performs an emergency stop if the driver ignores the warning. Sensors (e.g. radar, video and lidar sensors) as well as information received from car-to-car and car-to-infrastructure communication are used to detect other vehicles, their trajectory and velocity. The crossing assistant will warn the driver if a threat is detected and might also initiate a warning or emergency braking in order to prevent an accident. (See [1], [2], [3], [4], [5] and [6] for further information.)

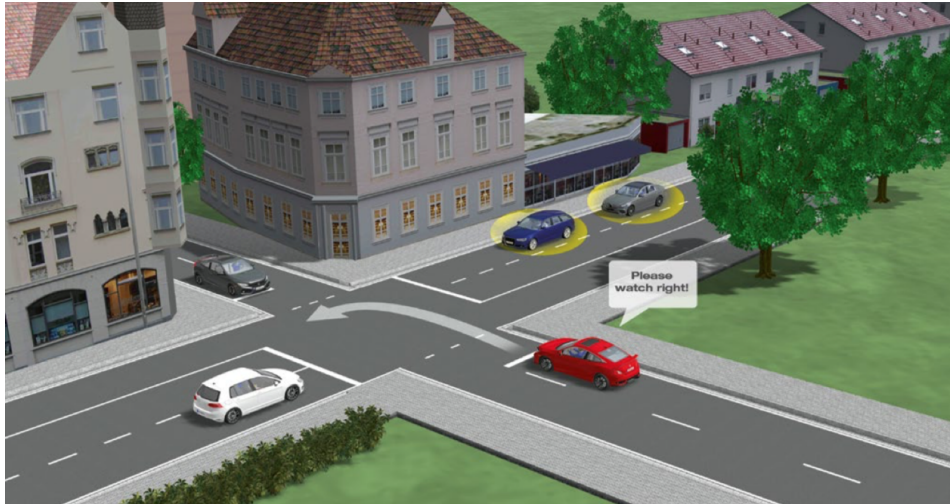


Figure 1: Turn Left Scenario [7]

## Project Goals and Requirements

- Do a scientific research on intersection assistants, especially focusing on intersection warning systems
- Equip the simulated car with a CarMaker "Free Space Sensor"
- Design your own model for the car-internal computations
- Implement your model in Simulink and add it to the CarMaker Simulink model (It is recommended to use one of the predefined CarMaker Simulink Models.)
- **Minimum implementation requirements:**
  - the simulated car shall automatically detect priority traffic when approaching an intersection without traffic lights
  - priority traffic warnings shall be visualized (considering the desired direction of the assisted car)
  - crashes during intersection crossing scenarios shall be prevented by an automated emergency brake if the driver ignores the warning
  - priority traffic out of reach and static objects shall be ignored, however a safety distance shall be maintained
  - a well founded sensor range must be chosen
  - vehicles driving ahead must not be mistakenly detected as relevant traffic objects
  - develop a strategy for situations with potential priority traffic hidden behind preceding vehicles

- the intersection assistant must be able to cooperate with an active ACC system
- consider at least city and country road scenarios (choose the car and traffic speeds accordingly)
- consider orthogonal as well as non orthogonal crossings
- you can assume that traffic always follows the road rules
- Develop a scenario and sufficient test cases (with different traffic situations) using CarMaker
- Run and analyze your tests
- Document your project in a LaTeX report, filling 10-15 pages (for more details see below)
- Present your project in a 45 minutes presentation (for more details see below)

## Project Report

Please hand in a report about your project in German (or English) language. The report has to use the Latex Template given in the “Template\_AuPra\_Report” directory. It should be between 10 and 15 pages long and contain the following information:

1. Abstract: Give a clear, complete and informative summary
2. Introduction: Briefly explain your ideas and motivate your approach
3. Related Work: Give a survey on other scientific work used in your project or closely related to your approach
4. Model: Describe in detail how you implemented the system and why this way.
5. Tests: Which scenarios and tests did you develop, why those?
6. Results: What did you find out while testing? Which improvements had to be made?
7. Conclusion and Outlook: Summarize the strengths and weaknesses of your work and give an outlook on future work.
8. References: List of references

## Project Presentation

The structure of your presentation can follow the one of your report, but you can also modify this if you want to. Please plan your presentation to take about 45 minutes, including a live demo of your results, for example a suitable CarMaker test-run that helps to understand your implementation.

**We expect, that every team member does a fair part of the presentation.**

Your project presentation will be in front of the other participants of the Automotive Practical Course and other interested people from the Institute.

We will set up one of the computers from the automotive laboratory as a presentation computer. Your team's git repository will be available on that computer.

## References

- [1] C. Shooter and J. Reeve, INTERSAFE-2 architecture and specification in Intelligent Computer Communication and Processing, 2009. ICCP 2009. IEEE 5th International Conference on. IEEE. 2009, S. 379–386.
- [2] D. Westhoff und B. Roessler, INTERSAFE-2: Intersection reconstruction for on-board intersection safety systems in Intelligent Computer Communication and Processing (ICCP), 2010 IEEE International Conference on. IEEE. 2010, S. 387–392.
- [3] BMW Group, The left turn assistant – turning left safely by looking out for oncoming traffic, <https://www.press.bmwgroup.com/global/article/detail/T0108975EN/the-left-turn-assistant-\T1\textendash-turning-left-safely-by-looking-out-for-oncoming-traffic?language=en>, accessed February 2018]
- [4] S. K. Gehrig, S. Wagner and U. Franke, System architecture for an intersection assistant fusing image, map, and GPS information in IEEE IV2003 Intelligent Vehicles Symposium. Proceedings, pp. 144-149, 2003.
- [5] A. Benmimoun, J. Chen and T. Suzuki, Design and Practical Evaluation of an Intersection Assistant in Real World Tests in IEEE Intelligent Vehicles Symposium, pp. 606-611, 2007.
- [6] J. M. Scanlon, R. Sherony and H. C. Gabler, Earliest Sensor Detection Opportunity for Left Turn Across Path Opposite Direction Crashes in IEEE Transactions on Intelligent Vehicles, vol. 2, no. 1, pp 62-77, 2017.
- [7] M. Heckmann et al., Development of a Personalised Intersection Assistant, ATZ worldwide, 2017