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Data-Driven Insights for Intelligent Transport Systems: From Vehicle Perception to Human Interaction

Pre-defense report

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Co-Supervisor: Prof. Dr. Jonas Sjöberg

Abstract Space for your (short) abstract.

Space for your revision block, acknowledgements, etc.

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Contents

Abstract

Space for your abstract.

1. Introduction

A single-column 4 page report has to be submitted to the chair of PhD affairs (Prof. Josef Küng for candidates in Computer Science and Prof. Johannes Fürnkranz for candidates in Artificial Intelligence) two weeks before the pre-defense in order for the chair and examiner to prepare questions. They will get the report before the pre-defense starts and should prepare one or two questions each.

The report should contain 3 parts: scientific part (maximum 2 pages, 11pt font, standard margins) - motivation (for the general audience) - approach, results, future work progress part (maximum 1 page, 11pt font, standard margins) - published/submitted/planned papers or other output (including talks, SW, systems, stay abroad, organized events, awards etc) - description of the candidate's contributions, impact references (1 page, but actually without page limit)

2. Scientific Part

2.1 motivation

The pursuit of fully autonomous vehicles (AVs) represents one of the most ambitious technological challenges in modern transportation. A key stepping stone toward achieving this vision is the gradual development and deployment of Advanced Driver Assistance Systems (ADAS). ADAS technologies, while currently limited in their capabilities, serve as a critical intermediary, bridging the gap between manually driven vehicles and fully autonomous systems. By incrementally enhancing the level of autonomy through increasingly sophisticated ADAS, these systems allow vehicles to perform specific tasks in controlled operational design domains (ODDs). This approach not only enhances road safety but also provides a framework for the eventual realization of fully autonomous vehicles.

This dissertation explores critical aspects of automated driving systems (ADS), ranging from the fundamental challenges of road marking (RM) visibility to the complexities of real-world vehicle and pedestrian interactions. Initial research focused on the impact of RM materials on their visibility for machine vision, demonstrating that different RM types exhibit varying performance under diverse conditions, including dry, wet, day, night, and glare. The study quantified how these visibility variations affect the performance of camera-based ADAS, revealing failure points in lane detection and trajectory planning. This foundational work highlights the crucial role of road infrastructure quality in enabling reliable autonomous navigation. Additionally, the research extended to the use of LiDAR sensors in RM detection, demonstrating that reflectivity data provides superior results compared to intensity data alone when segmenting RMs from point clouds.

Building on the sensor-level understanding, the research then examined how to extract meaningful information about the behavior of road users. Applying the IEEE Standard 2846-2022 methodology, the work explored how to extract kinematic data from real-world scenarios, and determine safety-relevant assumptions about road user behavior. This involved analyzing realistic driving data to establish kinematic boundaries for other road users, offering a basis for ADS to make informed decisions. In addition, a novel dataset was created that integrates multi-modal sensor data, including direct access to the vehicle bus, providing a comprehensive view of diverse traffic scenarios in Germany. This IAMCV dataset includes data from highways, country roads, roundabouts, and intersections, which is crucial for the training and validation of ADS algorithms.

Finally, the dissertation addresses the complexities of vehicle-to-pedestrian (V2P) interactions, evaluating the effectiveness of different warning systems for distracted pedestrians. This research provided empirical evidence that V2P technology can significantly improve pedestrian safety, specifically through a comparative study with traditional auditory warning systems. The experimental results highlighted how pedestrian behavior changes in response to visual or auditory alerts, accounting for varying levels of distraction. These findings contribute valuable insights into the development of effective alerts for vulnerable road users within the context of shared urban environments. Overall, the interconnected research threads emphasize that the safety and reliability of ADS are determined by the complex interactions between infrastructure, sensors, and all road users.

2.2 Approach

2.3 Results

2.4 Future work

3. Progress

4. Example

This is an example for another section in your thesis. It should primarily show you some basic LaTeX tricks. For instance, 1 references to your introduction. You can also embed figures, tables, etc. in your work. 1 is an example for a figure (i.e. photos, diagrams, and other artwork). Note that figures (just like tables, see) are floating elements. They are either placed at the top or bottom of a page (or sometimes stand on their own page), but not in between your text. You can influence their placement with the placement modifiers “t”, “b”, and “p”. Bottom placement (“b”) is sometimes more tricky, as LaTeX does not consider this nice in some situations. You can convince LaTeX to honor your placement expectation with “!b” then. Since you do not place figures/tables in between your running text, you always need to reference them by their label (e.g. 1).

[6] [8] [4] [5] [7]

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5. Conclusion

Space for your summary, central conclusions, and an outlook on potential future work.

References

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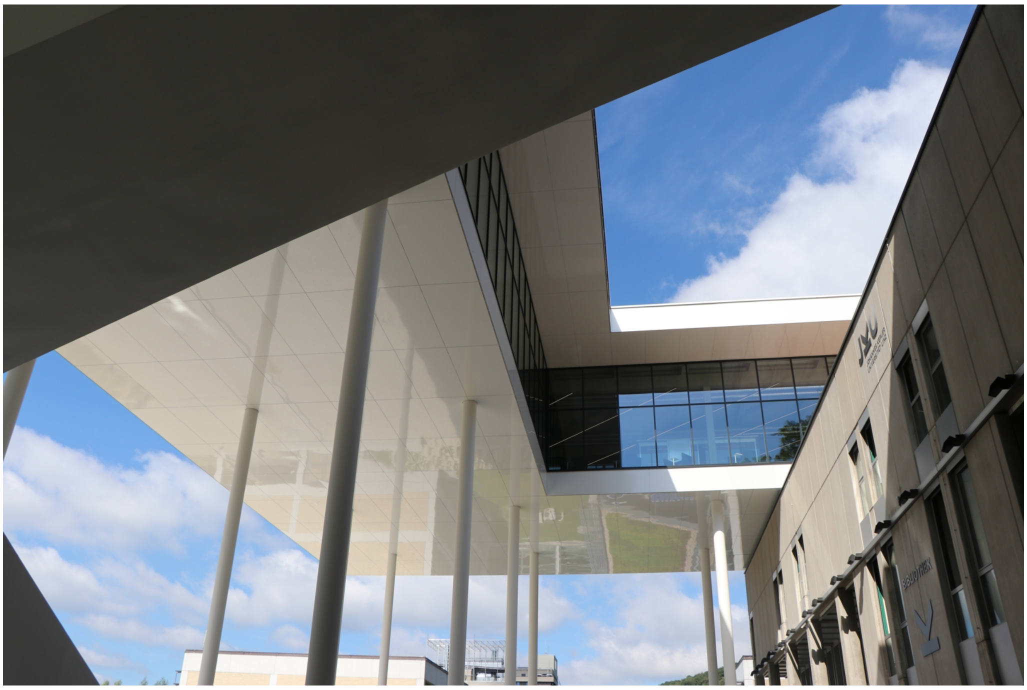

Figure 1: A figure. Be aware that figures have their caption below the artwork

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Appendix A. An Appendix

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