cdbb

Centre for Digital Built Britain

Co-Evolving Built Environments and Mobile Autonomy for Future Transport and Mobility

Benefits to: city planners, developers, governmental policy makers.

"What would an autonomous vehicle's dream city look like?"

Summary

Autonomous navigation and automated mobility are hard problem that are compounded by the unpredictability and dynamics of urban environment. As we re-think and re-design our built environments, we have the unique opportunity to transform them so that automated mobility systems a can perform efficiently and robustly. The main idea behind this project is to tackle the challenges of autonomous navigation and automated mobility by explicitly considering the coupling of the autonomous vehicles with the environments that they operate in.

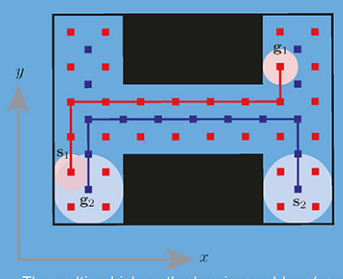
Outline

Our approach is to pose the built environment as a design variable, and to jointly optimize mobile autonomy. Our goal is to support mobile autonomy through re-designs of the built environment; in particular, we are interested in how its morphology, topography, and technological enhancement aid us in this endeavor.

Key Findings

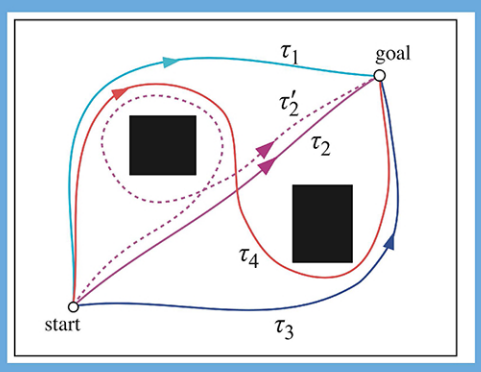
Our research highlights include the following insights:

1. We were able to expose the tight coupling between a vehicle's mobility constrains and the topography of the built environment. Also, we showed that by explicitly considering this relationship, we are able to improve navigation performance. This is a milestone result that provides a fundamental new understanding of navigation in cluttered environments [1].



The multi-vehicle path planning problem (a red vehicle and a blue vehicle both compete for the narrow corridor space)

2. We were able to show that exploiting redundancy in transport networks is an effective approach to reducing waiting times in mobility systems. Importantly, our results also indicate an interesting connection between robustness and diversity: the paths selected by our mobility assignment algorithm tend to be more diverse, and correlate with better performance. This insight can be applied to the design of transport networks, where measures must be taken to provide redundant and diverse travel paths that connect same start and goal locations, in order to increase transport efficiency. This is a milestone result that provides guidance towards the planning, design and routing of road networks [2].



Research Acknowledgements

Research collaborators:Jiayi Zhao, Subhrajit Bhattacharya, Wenying Wu

References

[1] W. Wu, S. Bhattacharya, A. Prorok, "Multi-Robot Path Deconfliction through Prioritization by Path Prospects", IEEE Robotics and Automation Letters (R-AL), under review

[2] A. Prorok, "Resilient Assignment Using Redundant Robots on Transport Networks with Uncertain Travel Time", IEEE Transactions on Automation Science and Engineering, under review.

Impact and next steps:

Our ultimate aim is to provide actionable recommendations for city planners. Towards this vision, we are developing metrics that quantify how 'difficult' a given built environment is, from the point of view of trajectory planning and mobile autonomy. We are also developing methods that actively propose the modifications that a built environment needs to undergo.

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