LEARNING FROM EXPERIENCE FOR RAPID GENERATION OF LOCAL CAR MANEUVERS

Piotr Kicki[1], Tomasz Gawron[1], Krzysztof Ćwian[1], Mete Ozay, and Piotr Skrzypczyński[1]

[1]Institute of Robotics and Machine Intelligence,
Poznan University of Technology, Poznań, Poland

IRIM

POZNAN UNIVERSITY OF TECHNOLOGY

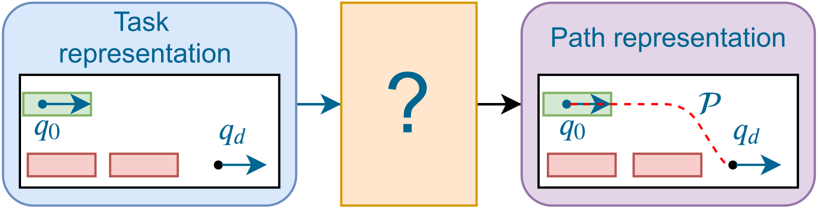

Figure: How to efficiently determine the path solving motion task?

We consider a problem of planning a feasible monotonic path from an initial state to the desired state in some environment, taking into account the vehicle kinematics, physical dimensions and its limited steering angle.

PROPOSED METHOD

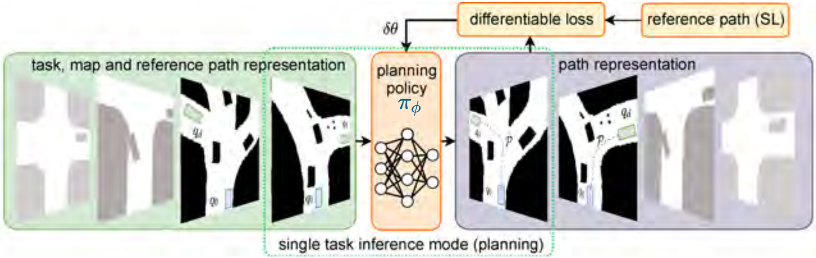

Figure: Concept of the oracle-based rapid path planning system

We propose a new approach to efficient path planning with the use of neural network trained in a weakly supervised manner. Planning function, which transforms the representation of the task into representation of the path is approximated by the neural network

PROPOSED SOLUTION

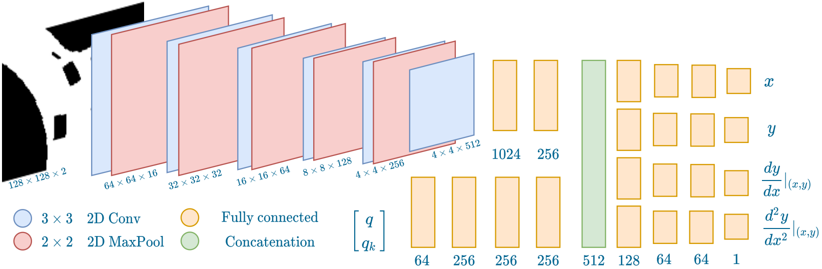

Figure: Architecture of the neural network used to generate path segments

$$\mathcal{L} = \sigma_{\text{coll}}\mathcal{L}_{\text{coll}} + \mathcal{L}_{\text{curv}} + \mathcal{L}_{\text{over}} + \mathcal{L}_{\text{nbal}} + \sigma_{\text{len}}\mathcal{L}_{\text{len}}, \quad (1)$$

Proposed neural network processes the information about environment using the Map Processing Block and about the robot initial and desired states using State Processing Block. Produced latent vectors are concatenated and used to determine the parameters of the gluing points of the spline path.

EXPERIMENTS

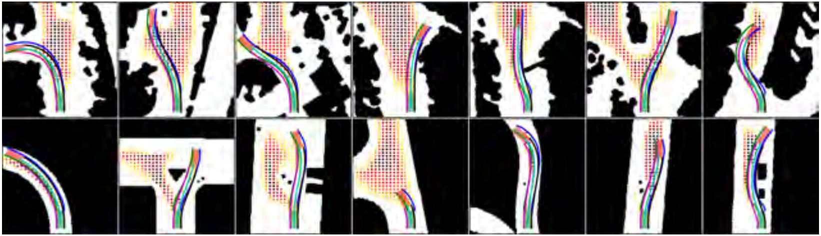

Figure: Visualization of the set of the initial states from which it is possible to plan an feasible path to the final state

Exemplary results in real and simulated environment. Maps in the first row are obtained from the test set made with real LiDAR data, whereas in the second row, we show maps which are obtained from CARLA Town04

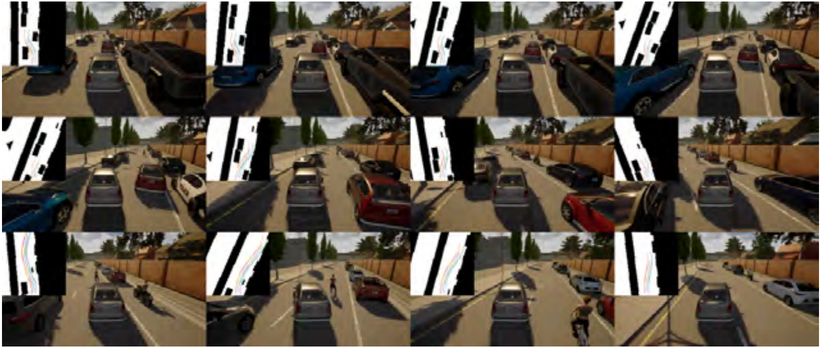

Figure: Visualization of the online re-planning process

Rapid re-planning enables the car to avoid collisions with static obstacles. Even though the planner produces a path that collides slightly with the obstacle, after a small movement, it re-plans, and the final path is feasible. The inset maps present the planned path. This sequence is also available as video: https://youtu.be/fuBXiZFYdXA?t=28

CONCLUSIONS

HIGHLIGHTS & CONTRIBUTION

- Neural network which rapidly plans paths for a car-like vehicle
- Average planning time is about 40 ms and with very low variance
- Trained in a weakly supervised manner
- Generated paths can be tracked with continuous steering angle
- Can be easily extended to more complex kinematics

Thank you for your attention

This work was partially supported by TAILOR, a project funded by EU

Horizon 2020 research and innovation program under GA No. 952215