Title of the work with no acronyms

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Autonomous driving technology has rapidly become essential for the future of transportation, particularly on highways. These roads offer the perfect conditions for autonomous vehicles (AVs) due to steady traffic and minimal interruptions from pedestrians or cyclists. Implementing autonomous driving on highways enhances road safety, improves traffic flow, and reduces environmental impacts. It also transforms long-distance travel and commercial logistics. As this technology advances, optimizing how AVs perceive and navigate these environments becomes increasingly critical.

The use of real-world data is essential for accurately simulating and analyzing the behavior of autonomous vehicles on highways. In this study, waypoint coordinates are gathered from OpenStreetMap and HERE Maps to build detailed road models. These waypoints are assumed to be linked by clothoid segments, which are common in highway design due to their smooth changes in curvature, suitable for high-speed travel. Depending on the specific characteristics of each segment, these are represented either as arc-splines or straight lines to ensure the road geometry is accurately portrayed with minimal data. When multiple segments of same type are consecutive, the possibility of merging them is assessed by evaluating the differences in their angles and positions. After approximating and merging the segments, an imaginary vehicle is placed near the trajectory, intentionally offset by errors — for example, 20 centimeters away from the centerline and with a 3.5-degree heading error. These settings are used to generate potential trajectories using Beziér curves and arc-splines, modeling possible paths for autonomous vehicles under typical highway conditions.

This research demonstrates that it is feasible to represent extensive road networks with minimal yet powerful data that includes essential geometric and dynamic properties such as position, heading, and curvature at every point along a trajectory. This efficient representation not only reduces the computational burden but also enhances the precision and flexibility of autonomous vehicle navigation systems.

The trajectory planning technique used employs Beziér curves, which are particularly well-suited for this form of road representation. Beziér curves use initial and final poses—comprising position, heading, and curvature—to generate a range of candidate trajectories. This method allows for the selection of the optimal path by evaluating various conditions, ensuring that the most suitable trajectory is chosen for navigation. Ultimately, this approach highlights the potential for advanced trajectory planning algorithms to significantly improve the efficiency and safety of autonomous driving on highways.