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A Collaborative Fusion and Tracking Algorithm based on a Sequential Monte Carlo Probability Hypothesis Density Filter

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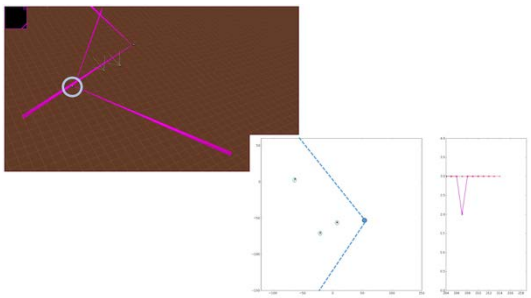
The advent of intelligent vehicles equipped with advanced sensors and trends in information technology have gradually pushed for vehicles to be able to communicate and collaborate with each other to improve the safety of driving as a whole. This builds the case for a collaborative tracking of multiple targets.



This project explored a different approach to a collaborative multiple-target tracking addressed previously with a Gaussian Mixture Probability Hypothesis Density (GM-PHD) filter by using a Sequential Monte Carlo (SMC) implementation of the PHD filter for multiple tracking. We use Exponential Mixture Distribution (EMD) based approach for the fusion of information where the field of view of collaborating agents overlap and a elegant heuristic for incorporating information outside of the ego agent's field of view. SMC methods in this case also resolves some limitations that the GM-PHD intrinsically possesses.

The SMC-PHD filter was implemented on Python and tested on both a Python-based simulation and on the Webots simulation program. The Python-based simulation developed in the scope of this project was done with reusability in mind and allows users to test tracking algorithms with ease and customizability. With regards to the SMC-PHD filter as a whole, we observed significant improvements in tracking precision using the EMD-based collaboration and presented a good foundation for tracking targets outside of the ego agent's field of view and note a considerably seamless tracking even as targets move between different fields of view.

Possibilities of future developments on this approach are numerous owing to the initial positive findings yielded from the collaborative SMC-PHD filter. We aim to test the current implementation on more realistic scenarios modelled on the Webots platform to investigate the applicability of this approach in the concrete field of multiple vehicle tracking by intelligent vehicles.