

## Dynamic Convoy Algorithm for Intelligent Cars

Florian Zimmermann

Professor : Alcherio Martinoli

Assistant(s) : Iñaki Navarro/Milos Vasic

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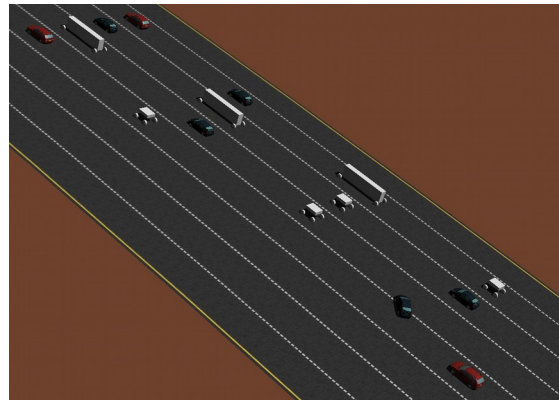
Recently there has been an increased focus on the sub-field of autonomous vehicles inside the larger field of distributed intelligent systems. In order to make reliable autonomous vehicles a reality, various problems need to be addressed, such as lane-detection, distributed convoy formation, collision avoidance and the underlying communication protocols.

During this project we've worked on devising a dynamic convoy formation algorithm in a group of heterogeneous autonomous vehicles traveling on highways having an arbitrary number of lanes with known trajectories.

We started by rewriting the previous implementation from scratch, which was necessary due to the hard-coded nature for the original code. We separated the monolithic code-base into sub-components. In order to improve simulation performance, we changed the lane-keeping from a computer vision-based method to a trajectory-based method. In order to do so, we wrote code to generate lane trajectories from a list of Webots road segment definitions.

Our first approach had several limitations and we ran into race-conditions when multiple vehicles tried to join the convoy

simultaneously. In order to overcome these issues, we radically changed our approach towards the middle of the project. Our new implementation is free of concurrency issues and can handle heterogeneous vehicles of any length.



*Figure 1: A heterogeneous convoy undergoing a lane-change operation*

Additionally, we have devised a lane-changing protocol enabling any vehicle to safely change lanes inside the convoy.

The final algorithm has been empirically validated to be robust even under severely impaired communication conditions. All elements of the current implementation (including trajectory generation) are documented in order to facilitate future extension of our work.