**Research Paper Summary**

**Title:** Accurate Platoon Control of Urban Vehicles, Based solely on Monocular Vision

**Author(s):** P. Avanzini, B. Thuilot, P. Martinet

**Date:** 2010-10

**Link to paper:** <https://github.com/albud187/ELG5163_project/blob/main/literature%20review/finished_reading/Accurate_platoon_control_of_urban_vehicles_based_solely_on_monocular_vision.pdf>

Section 1 - Overall Idea

* Global decentralized control strategy + nonlinear control techniques + inter-vehicle communication to avoid inter-distance oscillatons within platoon
* Vehicle localization in absolute frame derived from monocular vision.
* Vision data corrected with nonlinear observer with odometer data.
* Platooning can be done with local strategy (controlled exclusively by info it can acquire) or globally (data shared between all vehicles). Also see “virtual structure approach”

Section 2 - Methodology

* Trajectory based strategy with nonlinear controls, decoupled lateral and longitudinal controls
* Tricycle model for vehicle dynamics, state space model for vehicle configuration. Platooning objective described as ensuring convergence and maintaining gap.
* Exact linearization + chained form, steering control + tracking performance with RTK GPS sensor. ith vehicle regulates arc-length longitudinal error. Global error and local error considered.
* 2 step localization - 3D reconstruction of environment from monocular video sequence + real time localization by point of interest detection and feature matching in 3D reconstruction. Infers pose, vehicle state vector and curvature in control laws.
* Distortions between virtual vision world and actual metric world lead to intervehicle distance evaluation (poor longitudal performance). Corrected with estimated local scale factor. This local scale factor is combined with the state space model to express its state in the virtual vision world via observer relation.

Section 3 - Applications

* This method can be applied for UAVs in formation and convoys. In convoys, it can be used to maintain cohesion, control distance.
* Autonomous trucking. 2 people control a platoon of 5 trucks. Need to consider supply networks and logistics.

Section 4 - Future Development

* For aircraft / UAVs, visual data and odometry data can be combined with radar data, as well as whatever other sensors are on the aircraft.
* Variable distance with different platoon / convoy elements. For example, v1 is lead vehicle; v2 maintains 5m spacing from v1; v3 maintains 10m spacing from v4.
* Convoy separation drills. Convoy passes thru intersection ; v1 to v3 drive thru, but v4 to v6 stopped at red light and have to catch up. Does the convoy / platoon drive thru light, pull over and wait?

Section 5 - Questions

1. how does the monocular video sequence generate a 3D reconstruction of the environment?
2. Can other sensors be used such as LiDAR to provide more information to the system?
3. What is the field of view of the monocular vision? For example, is it always looking in front of the vehicle?

Section 6 - Anything Else

Regarding turning a video sequence into a 3D reconstruction. It mentions “motion techniques”, “computation of reconstruction done off-line with a method relying on bundle adjustment” and “vision algorithms” This is then is compared to odometer to scale it?

Not sure if this is a clear explanation of the process, though, perhaps that part isn’t the main focus of the paper, and is more concerned with applying it and developing control laws with it.