**Research Paper Summary**

**Title:** Vision-Based Formation for UAVs

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

Section 1 - Overall Idea

* Vision based relative sensing system for leader-follower formation flight without inter-vehicle communication
* Monocular camera on follower, measured relative distance

Section 2 - Methodology

* Detect target with 3D measurement with monocular camera, machine learning approach to identify leader UAV, trained with both positive and negative images using OpenCV. Haar Wavelet based AdaBoost cascade. Combine several weak classifiers into a strong classifier via linear combination.
* Calculate relative displacement using known camera model and geometry info as well as location in image.
* Control camera to keep pointing at leader UAV, predicted under quasi steady state, and using PID control
* Discrete time model of target motion, Kalman filter to estimate estate of target in image plane, predict possible location of target in next frame.
* Fuse data with motion estimator, detector, image tracker, Kalman filter.

Diagram

Description automatically generated

Section 3 - Applications

* Formation flying for UAVs is most obvious application, but also in underwater robots too.
* Platooning in ground based mobile robots / self driving cars
* Terminal guidance - can be used in missiles, or for docking on a ship or space station.
* With the terminal missile guidance, vision can distinguish between the target and countermeasures, and it does not involve communication with the target.

Section 4 - Future Development

* Conditional leadership - suppose there are 3 drones, 2 leaders one follower. Set conditions in which the follower will follow leader 1, and in other conditions follow leader 2. Or even dynamic assignment in which a leader changes into a follower based on the robot’s operating conditions.

Section 5 - Questions

1. What is “Haar Wavelet based AdaBoost cascade”?

Section 6 - Anything Else

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