

Altitude Estimation for Autonomous Vehicles through Wide-Field-Integration of Optic Flow

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Keyword : Optic Flow, Altitude Estimation, Motion Estimation

This study proposes an altitude estimation method for autonomous vehicles by using on-board camera images through Wide-Field-Integration (WFI) of optic flow. WFI of optic flow is a motion estimation method inspired by a biological research on the visual processing systems of flying insects' compound eyes. The most important feature of WFI of optic flow is that robust estimation of vehicle's velocity variables is possible even for unknown environment with a light-weight image sensor and small computational cost.

In this study, altitude information of a vehicle is estimated as well as its velocity variables. To make the estimation of altitude information possible, two camera images are used; one ("camera-o") is placed near the mass center of the vehicle, and another ("camera-R") is placed with R (see Fig.1). When the vehicle has an angular velocity ω , the two cameras obtain different optic flow due to the distances from the mass center. Applying WFI of optic flow algorithms to the two camera images separately, the altitude of the vehicle can be estimated.

This paper describes the estimation theory for the altitude and velocity variables. Then, the validity of the theory is verified in numerical simulations. In the simulations, some sensor noises are included. Figure 2 is a typical result for the altitude estimation.

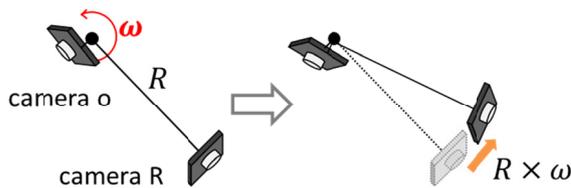


Fig.1 Translational motion induced on a camera-R due to angular velocity ω .

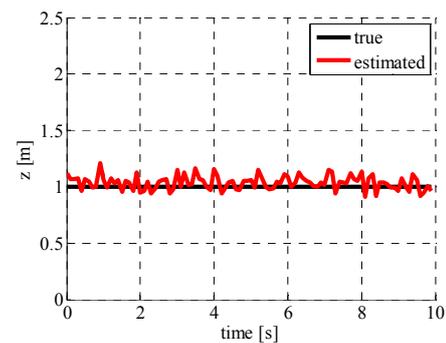


Fig.2 Typical estimation result for altitude information of a vehicle.