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Monocular camera based trajectory tracking of 3-DOF helicopter. (English) Zbl 1302.93155

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Summary: The vision based flight control problems of unmanned Micro Aerial Vehicles (MAVs) have attracted much attention in recent years. This paper presents a new solution to the trajectory tracking problem of a 3-Degrees-Of-Freedom (3-DOF) helicopter by utilizing only an onboard monocular camera without any artificial marker. First, the Parallel Tracking And Mapping (PTAM) algorithm, which is a famous solution to the visual simultaneous localization and mapping (vSLAM) problem, is employed to estimate the attitude angles of the 3-DOF helicopter. Then the calibration puzzle of the mapping between the onboard camera and helicopter coordinate systems is turned into an optimization problem. A robust cost function is applied to get the accurate estimate of the mapping. Finally, for the purpose of alleviating the influences of nonlinearity and coupling between channels, the Feedback Linearization (FL) and the Linear Quadratic Regulation (LQR) techniques are employed to design the controller. Experimental results show that the proposed method can ensure that the helicopter hovers without drift and has good tracking performance.

MSC:

93C85 Automated systems (robots, etc.) in control theory
68T45 Machine vision and scene understanding
94A08 Image processing (compression, reconstruction, etc.) in information and communication theory
68T40 Artificial intelligence for robotics
93B18 Linearizations
49N10 Linear-quadratic optimal control problems

Keywords:

PTAM; unmanned micro aerial vehicles; trajectory tracking; linear quadratic regulation

Software:

MonoSLAM; PIXHAWK

Full Text: DOI

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