UNIVERSITI TEKNOLOGI MARA

REAL-TIME OPTIMAL TRAJECTORY CORRECTION (ROTC) FOR AUTONOMOUS QUADROTOR

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

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ABSTRACT

Attaining navigation precision for an autonomous quadrotor when it moves on the planned route in windy environment possesses huge challenge. The wind will cause the quadrotor diverges from the route and certainly affects the navigation accuracy. Integrating a trajectory correction algorithm in the navigation control can overcome this problem. However, existing algorithm seems too complicated to be applied. Since there is no technique can enable the quadrotor to implement precision navigation application, the research proposed a Real-Time Optimal Trajectory Correction (ROTC) algorithm. The algorithm works if the quadrotor undergoes a deviation, an admissible trajectory path is generated for the quadrotor rapidly return on the straight-line route. There are two stages implicated in the algorithm. First stage comprises a deviation scheme used to sense a deviation via an accelerometer and formulates a vector by applying double integration techniques fused with Kalman's Filter (KF). The second stage focuses on using the vector to generate an admissible cubic path via Hermite interpolation technique integrated with time and tangent transformation scheme. A Dead Reckoning (DR) navigation technique is employed to steer the quadrotor on the path. The scheme and algorithm are experimented in low, moderate and high categories of deviation acceleration via a customized quadrotor. The scheme performance is evaluated according to its accuracy to compute the vector compared to estimation method using Laser Range Finder (LRF) modules. As for the algorithm, the navigation system with and without it are compared to justify it workability. Parameters, specifically distance and time utilized by the quadrotor to return on the route after a deviation happened and also complete the navigation are evaluated. The results signify the deviation scheme gains more than 80% accuracy in estimating the vector in any experiment conducted. Hence, fewer distances and time are consumed by the quadrotor navigation with the algorithm to return to the route after a deviation happened as compared to it navigation without it. Consequently, the differences of distance travelled by the quadrotor between both navigation systems to complete the navigation for high, moderate and low categories of deviation acceleration are 143 centimeter (cm), 84 cm and 87 cm. As for the time, the differences are 5.5 seconds (s), 3.6 s and 2.5 s for the respective categories. Conclusively, the results show the ROTC algorithm is relevant to assist the quadrotor autonomous navigation in windy environment.

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