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Abstract

Unmanned aerial vehicle (UAV) applications have become increasingly vital, especially when human operators have limited access to the mission such as an inspection of a deep sewerage tunnel system. The problem arises when the UAV is deployed to perform a pre–defined operation, particularly in close proximity to the environment. When the UAV flies within a few centimeters away from its surrounding environment, the ceiling effect problem might occur, which will affect the flight performance. This paper presents the utilization of a centralized predictive interaction control by leveraging an identified nonlinear model of a quadrotor UAV to mitigate the problem. In the first step, real-time data is collected for translational states of the system to identify its aerodynamic parameters. Secondly, a centralized predictive controller is applied to the system in real–time to compensate for the ceiling effect. Finally, the proposed approach is validated numerically and experimentally in free–flight and ceiling interaction phases. The results show that the optimization–based controller with a centralized algorithm is able to converge within 5 ms.

Keywords: unmanned aerial vehicles, identification, unscented Kalman filter, model predictive control, quadrotor, interaction control

1. Introduction

Inspection is one of the critical operations in the maintenance of civil infrastructure systems. Although the utilization of advanced technologies has