Magnetic Sensor-Based Drone Charging Station: High Efficient and Robust to Landing Errors

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Abstract. This paper introduces a magnetic sensor-based charging station for drones, addressing challenges such as low efficiency, the need for precise landings, and reliance on actuators. The station consists of modules with magnetic sensors. The drone carries a magnet on its positive pole, and upon landing, the module set positive voltage where the magnet is detected and set ground where it is not. Experiment results show robustness of proposed charing station against landing position and orientation errors and a power transfer efficiency (PTE) of 99.5%.

Keywords: drone charging station, UAV, drones

1 Introduction

As autonomous drones gain popularity in various industries, the demand for charging stations has grown. Wireless charging stations can accommodate landing errors, but they suffer from low PTE and AC to DC conversion losses. In contrast, contact-based charging stations using direct current (DC) avoid these issues but require connecting corrects polarities. Rectifier circuits correct polarity but cause power losses[2]. Other methods involve complex mechanisms like actuators[6] or funnel-shaped surfaces[3] that demand high accuracy. Current measurement methods[5] suffer from low efficiency. To address these limitations, we propose a high-efficiency magnetic sensor-based charging station robust against landing position and orientation error.

2 Implementation of charging station and experiment

The charging station implemented with 16 modules equipped with magnetic sensors and MOSFETs, controlled by an Arduino Uno as shown in Fig.1. The module remain grounded if the magnetic field is not detected. Once a magnetic field is detected, it connects to the positive voltage source. In the experiment, the drone, DJI M600 Pro, modified for external charging, landed on the station after hovering. PTE was measured consistent with previous studies.[4]. The charging station successfully charged the drone's batteries regardless of landing position or orientation in all 30 trials. PTE was measured as 99.5%, outperforming previous studies, 91%[1] and 88.42%[4].

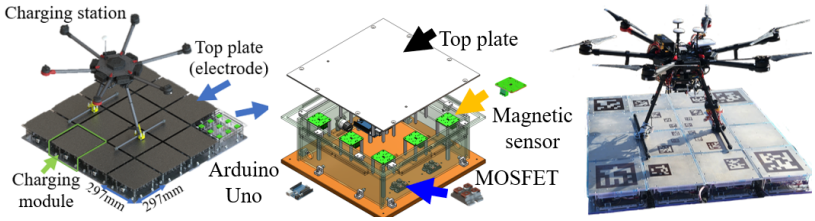

Fig. 1: Design and implementation proposed charging station

3 Conclusion

In this study, a magnetic sensor-based drone charging station was proposed, which demonstrated robustness against landing position and orientation errors and a high PTE of 99.5%

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