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Simulation and Control Design of a Midrange WPT Charging System for In-Flight Drones
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Abstract
Drones, or unmanned aerial vehicles (UAVs), have emerged as an indispensable tool across numerous industries due to their remarkable versatility, efficiency, and capabilities. Notwithstanding all these traits, drones are still limited by battery life. In this paper, we propose a genuine in-flight charging method without landing. The charging system consists of three orthogonal coils, among which the receiving coil is connected to the drone. The development of the model for wireless dynamic charging systems is achieved by integrating the receiver trajectory and velocity in the model. Furthermore, the model is significantly enhanced by introducing the concept of the positioning mutual coupling function for the receiver trajectory; thus, it is possible to simulate a genuine continuous trajectory for UAVs and link it to the systems' total input power consumption. The developed control algorithm can direct the magnetic field resultant to track the exact trajectory of the drone. The real-time simulation of the multiparameter discrete extremum-seeking control (ESC) algorithm on the (DSP) F28379D hardware shows that the input power is maximized up to 12 W in a response time of 2 ms for a drone-hovering velocity of 8 m/s without any feedback. © 2023 by the authors.

Author Keywords
controlled omnidirectional WPT; dynamic charging; in-flight charging; magnetic tracking; multiparameter ESC; UAVs; wireless power transfer

Index Keywords
Aircraft detection, Antennas, Charging (batteries), Control theory, Drones, Energy transfer, Flight simulators, Inductive power transmission; Aerial vehicle, Charging systems, Controled omnidirectional WPT, Dynamic charging, Extremum seeking control, In-flight charging, Magnetic tracking, Multiparameter extrema-seeking control, Multiparameters, Unmanned aerial vehicle; Trajectories

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