



Article

## Model, Control, and Realistic Visual 3D Simulation of VTOL Fixed-Wing Transition Flight Considering Ground Effect

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**Abstract:** The research topic of VTOL (vertical take-off and landing) fixed wing (VFW) is gaining significant attention, particularly in the transition phase from VTOL to fixed wing and vice versa. One of the latest and most challenging transition strategies is the bird take-off mode, where vertical and horizontal take-off is carried out simultaneously, mimicking the behavior of birds. The condition that is rarely considered when taking off is the ground effect. Under natural conditions, a ground effect is bound to occur, which can significantly impact the stability of the transition when the VFW is close to the ground. This paper addresses this issue by proposing a model and control strategy and conducting realistic visual 3D simulations of the VFW transition that incorporates ground effect using full complex aerodynamic parameters. This research represents a novel approach, using the robot operating system (ROS) and Gazebo to conduct realistic visual 3D simulations for VFW transition. The linear quadratic regulator (LQR) control method is used to manage the transitions and compensate for any disturbances. The flight tests demonstrate the effectiveness of the proposed model and controller in executing flight missions using the bird take-off mode transition. Moreover,

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