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Optical and gravito-inertial contributions to the perception and control of height in a simulated Low-Altitude Flight context

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Abstract

Low-Altitude Flight (LAF) is a flight formation consisting of rapid close ground flight. Perception and control of self-motion, allowing for optimal information collection and rapid adaptation, are of fundamental importance during LAF, but remain largely unexplored. This study aimed to analyse the impact of visuo-vestibular stimuli on the monitoring of height in a motion-based simulated LAF context. Thirteen non-pilots were tested in different environmental conditions, in which optical and gravito-inertial (GI) information were manipulated. The visual environment, displayed with a VR headset, was a low-textured landscape with identical and equally spaced trees throughout the trials. The GI environment was designed thanks to a motion-based simulator. Results showed that participants had better performances in a visuo-vestibular environment than in a visual-only setting, indicating that multi-sensory information was picked-up faster than a mono-sensory structure. Additionally, we found differences in the contribution of vestibular inputs depending on the kind of task. **Practitioner summary:** Low-Altitude-Flight (LAF) manoeuvres require delicate aircraft control. Two experiments using a large flight simulator investigated how visual and vestibular stimulation contribute to LAF perception and control. Results suggest that both sources of stimulation need to be combined for accurate performance, with consequences for simulator-based training scenarios. **Abbreviations:** LAF: low altitude flight; GI: gravito-inertial; 1/2/3D: 1/2/3 dimensions; VR: virtual reality; Mvt: movement; GVE: good visual environment; DVE: degraded visual environment; SSQ: simulator motion sickness questionnary; RT: reaction time; DIMSS: dynamic interface modelling and simulation system metric; corrAcf: maximum correlation coefficient; corrLag: maximum correlation lag; DFT: deviation from target; StdJ: standard deviation of the joytick value; NCR: number of control reversal.

Keywords: Aeronautics; Low-Altitude Flight; control; motion simulator; perception.

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