Spatial Disorientation in Unihabited Aerial Vehicles – A Preliminary Empirical Study

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While the Spatial Disorientation (SD) has long been recognized as an important causal factor in aviation incidents and accidents, it is only beginning to be recognized as a factor in Uninhabited Aerial Vehicles (UAVs). SD is defined as a failure to sense correctly the attitude, motion and/or position of the aircraft with respect to the surface of the earth (Benson 1999). Self, Ercoline, Olson and Tvaryanas (In press) describe a taxonomy of UAV characteristics relevant to the presence of SD – control method, visual reference and operator platform. SD is predicted to be most likely for a manually controlled UAV when operated from a mobile platform. It is likely that this predisposition towards SD will be expressed as pilot error in maintaining vehicle control.

As a first step towards better understanding the effects of control platform motion on manual UAV control, 10 rated Air Force pilots flew a simulated UAV task (MS Flight Simulator) from a motion capable control platform (General Aviation Trainer -GAT II). Participants performed two basic flight tasks: a) a constant rate climb/descent while maintaining a constant heading, and b) a constant bank turn while maintaining a constant altitude. The independent variables in this within subjects design included the relationship between control platform and UAV motion and the type of motion cues. There were three levels of visual and vestibular control platform motion cues (no motion/visual cues, motion with no outside visual display, motion with outside visual). The three types of control platform motion cues were congruent, neutral, or conflicting motion cues. Congruent and incongruent motion cures were defined as motion in the same axis and either same/different direction as the primary task (i.e., simulator turned left/right and task was a constant left hand turn). Neutral motion was defined as motion in a different axis of motion relative to the primary task (i.e., simulator motion was climb/descent and task was a constant bank turn). Dependent variables included deviations from desired heading, altitude, and vertical speed.

Preliminary results indicate that there was little effect of control platform motion on roll axis performance, i.e., bank and heading error. However, pitch axis deviations (altitude and vertical velocity) showed an effect of both control platform motion and motion type. Presence of both visual and motion cues resulted in greater pitch deviations than motion only or baseline (no motion/no visual cue) conditions. Also, direction of control platform motion had an effect; vertical velocity deviation in the constant rate climb/descent task was greatest in the presence of roll axis motion while altitude deviation in the constant bank task was greatest in the presence of pitch axis motion. These results suggest that platform motion may interfere with an operator's ability to manually control a UAV from a moving platform (a possible precursor to SD). A follow-on study is planned to collect data in an aircraft which will allow examination effects of turbulence and additional motion cues. These results have implications for planned UAV operations from both fighter and transport aircraft.