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Title

Preliminary study of tracking vs boundary avoidance task effects on rotorcraft pilot involuntary response.

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Abstract

A The input strategies of vehicle pilot manipulation can be recognized as a trade-off between point tracking and boundary avoidance tracking [1]. The assumption is that when the tracked target is far away from critical boundaries, pilots tend to treat the point tracking task as primary; however, when the tracking target is closer to the critical boundary, pilots tend to treat the boundary avoidance task as primary, while the point tracking task becomes secondary, or is even abandoned to avoid failing the mission. The change in piloting strategy can be observed from the measurement of tracking error of the point tracking tasks and input aggression. This study used simulation tasks developed in MATLAB and Simulink to carry out both point-tracking and boundary-avoidance-tracking tasks. The tasks were designed based on simplified helicopter tracking tasks. Fourteen participants were involved in the experiment. Tasks were conducted with a laptop and a joystick connected to it. The analysis of variance (ANOVA) and regression analysis were used to analyze the effects of task conditions on the participants' tracking error and input aggression. Results demonstrated that: 1) the participants showed lower tracking error when the target was near the boundaries ($p<0.01$); 2) the input aggression was slightly higher when the tracking target was near the boundaries and had statistical significance ($p<0.05$); 3) across all participants and task runs, within a certain range, tracking error showed negative correlation with input aggression, while beyond this range, increasing aggression would not further correspond to lower tracking error. This study provides an indication of manipulators' switching input strategies under different task conditions. Ongoing research focuses on whether and how the observed changes in pilot strategies affects the pilots' biodynamics feedthrough[2]. Furthermore, more realistic helicopter dynamics models and more immersive test environments will be utilized for the simulation tasks. This study also suggests a potential way of designing simulation tasks for humans manipulating helicopters to stimulate better performance of the manipulator.

References

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