Effects Of Retinal Eccentricity on Human Manual Control Behavior

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ABSTRACT

When required to manually operate an aircraft, for example during stall recovery, pilots often scan a large visual area of the cockpit, while at the same time performing a manual control task. In these situations, it is very likely that pilots will observe the aircraft's attitude on the primary flight display with their peripheral vision. The goal of this study is to investigate how human manual control is affected when the control task is viewed peripherally. In a manual control task, humans integrate information from both the velocity and the position of perceived variables in order to achieve stable control. Previous research showed that velocity is underestimated when a moving target is not observed foveally, this effect becoming stronger with increased eccentricity. Furthermore, length and distance are also underestimated under these conditions.

Most previous research aimed at understanding the neuro-mechanisms behind peripheral vision used stimuli with a constant length moving at a constant speed during trials. In the proposed research an active manual control task is performed where velocity and distance of the moving target change constantly. Our aim is to investigate the effect of viewing the control task display peripherally from a cybernetics point of view by modeling human manual control behavior. This allows us to determine how manual control performance and the use of position and velocity information changes as a function of eccentricity and elevation from foveal vision.

Subjects will perform a manual pitch tracking task while viewing a simplified primary flight display at different eccentricities and elevations from their foveal vision, while fixating on a marker in the center of the screen. In the baseline condition, the primary flight display will be presented foveally. In order to vary the amount of lead that will be generated by the subjects, which is directly linked to velocity perception, the controlled dynamics will be either velocity or acceleration control. The subjects will maintain a fixed distance from the display by using a chin and head rest. In order to ensure that subjects fixate on the marker in front of them such that they see the primary flight displays peripherally, an eye tracker will be used to check their gaze during the trials.

BIO

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Alexandru Popovici obtained his Bachelor and Master degrees in Aerospace Engineering with a specialization in Control and Simulation, from Delft University of Technology in the Netherlands. His thesis work investigated the relation between eye activity and human manual control. He is currently a research scholar at NASA Ames Research Center, where his main focus is the identification of time-varying human manual control behavior. His interests include biosignal processing, human-machine interaction, human-centered automation, simulations.