Augmentations for Enhancing UAV Video Display Utility

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The US Air Force Research Laboratory's Human Effectiveness Directorate supports research addressing human factors associated with Unmanned Aerial Vehicle (UAV) control. This presentation will provide an overview of three ongoing research areas exploring how to improve UAV operator utility of video imagery presented in ground control stations. The overall objective of these program elements is to determine the value of combining synthetic vision data with live camera video presented on a UAV control station display. With this technology, spatial information is constructed from databases (e.g., terrain, pre-mission plan, etc.) and overlaid conformal onto the dynamic camera image display presented to operators.

The first research area to be described is evaluating the utility of computer-generated video overlays for four different types of operator video-imagery tasks: controlling the camera to locate specific ground landmarks in the 360-degree area surrounding the loitering UAV, designating multiple ground targets marked with synthetic symbology, tracing a synthetically highlighted ground route with the UAV camera boresight, and recording text from synthetic overlaid symbology. UAV telemetry update rate was manipulated from 0.5 Hz to 24 Hz. The results indicated the potential of synthetic symbology overlay for enhancing situation awareness, reducing workload, and improving the designation of points of interest, at nearly all the update rates evaluated and for all four task types. However, data across the task types indicate that update rates larger than 2-4 Hz generally result in improved objective performance and subjective impressions of utility.

A second research area focuses on a picture-in-picture (PIP) concept (where video imagery is surrounded by synthetic-generated terrain imagery, increasing the operator's instantaneous field-of-view). Experimental data shows that the PIP presentation helps mitigate the "soda-straw effect", reducing landmark search time and enhancing operator situation awareness. In an evaluation examining the impact of PIP display size and symbology overlay registration error, results indicate that performance on a landmark search task is particularly better with the more compressed video imagery, reducing average designation time by 60%. Also, the registration error between the virtual flags and landmarks was less critical with the PIP capability enabled. Participant comments suggest that the ideal size of the PIP display may be a function of the degree to which the real camera view is cluttered and the specific task step involved (search versus designate). Therefore, it is recommended that more than one size be available in augmenting the camera display with PIP.

Finally, a third area is our new research exploring a novel task transition tool that is designed to rapidly build operator situation awareness and minimize negative transfer effects when switching between missions and associated camera views for multi-UAV control. Rather than discretely switching between camera views, this "Get-in-the-Zone" tool provides a semi-continuous zoom-out/zoom-in capability utilizing synthetic visual technology. In a recent experiment, participants performed multiple tasks while periodically switching missions in a multi-UAV control simulation environment. Participants rated the transition tool favorably and realized performance benefits for some measures. For other measures, the value of the transition format was not demonstrated. Several potential tool enhancements were identified.