



Calhoun: The NPS Institutional Archive

DSpace Repository

Faculty and Researchers

Faculty and Researchers' Publications

2021

Effectiveness of Human-Autonomy Teams in UAV Operations

McGuire, Mollie R.; Monarrez, Aurelio

Monterey, California: Naval Postgraduate School

http://hdl.handle.net/10945/69801

This publication is a work of the U.S. Government as defined in Title 17, United States Code, Section 101. Copyright protection is not available for this work in the United States.

Downloaded from NPS Archive: Calhoun



Calhoun is the Naval Postgraduate School's public access digital repository for research materials and institutional publications created by the NPS community. Calhoun is named for Professor of Mathematics Guy K. Calhoun, NPS's first appointed -- and published -- scholarly author.

> Dudley Knox Library / Naval Postgraduate School 411 Dyer Road / 1 University Circle Monterey, California USA 93943

http://www.nps.edu/library

Effectiveness of Human-Autonomy Teams in UAV Operations



Background

- Human to unmanned aerial vehicle (UAV) ratio is decreasing lacksquareas autonomy increases.
- Not only is a human capable of managing multiple UAVs, but ulletin some circumstances the human's role is shifting away from controlling.
- Under conditions of higher autonomy, a human can control ulletup to twelve UAVs.
- However, when more human involvement is needed, the \bullet number goes down considerably.
- This is due to the cognitive resources needed to effectively ulletcontrol the UAV, the more the human is involved in the coordination and control of each UAV, the less cognitive resources are available to attend to other UAVs.



ScanEagle Vehicle on Launcher



ScanEagle Control Station setup for the control of four ScanEagles

Observed ScanEagle Scenarios

- Operator performs Systems Check and Takeoff of 4 simulated ScanEagle aircraft consecutively with emergencies occurring on each aircraft at separate times.
- Operator manages 4 simulated ScanEagle aircraft with lacksquareengine failures, forcing internal airspace deconfliction and prioritization of aircraft recovery.
- Operator manages 4 simulated ScanEagle aircraft, 2x engine \bullet failures & 2x uncontrolled climb, forcing prioritization of emergency procedures and prioritization between airspace violation and emergency recovery.
- Operator manages 4 simulated ScanEagle aircraft, each with a critical or catastrophic emergency, forcing prioritization of emergency procedures.

Results

- Performance of operators managing multiple ScanEagles showed five out of six operators violated airspace when managing more than one ScanEagle.
- Other performance issues included UAV collision, UAVs being left in uncleared airspace, misdiagnosed errors, and unnoticed errors.

- Operators reported difficulty multitasking with two or more simultaneous errors, and difficulty not going into tunnel vision during exception handling. This was consistent with performance showing unnoticed errors and UAV entering uncleared airspace.
- Pupil dilation measures showed increased pupil size with the addition of one or more UAVs, indicating increased lacksquarecognitive load beyond managing one UAV.

Conclusions

Operator feedback, performance assessment, and \bullet cognitive load measures indicate that ScanEagle operators are not yet prepared for a one-tomany paradigm of UAV control.

Future Work

- Examine the capability of operators to manage • multiple UxVs in a multi-domain environment.
- If the future of command and control is multi-• domain operations by one operator, then the parameters of what the operator can handle need to be assessed.



Researchers: Dr. Mollie McGuire and Mr. Aurelio Monarrez **Information Sciences** Topic Sponsor: Naval Special Warfare Command

NRP Project ID: NPS-21-N105-F

This research is supported by funding from the Naval Postgraduate School, Naval Research Program (PE 0605853N/2098). Approved for public release; distribution is unlimited.