2021

Effectiveness of Human-Autonomy Teams in UAV Operations

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

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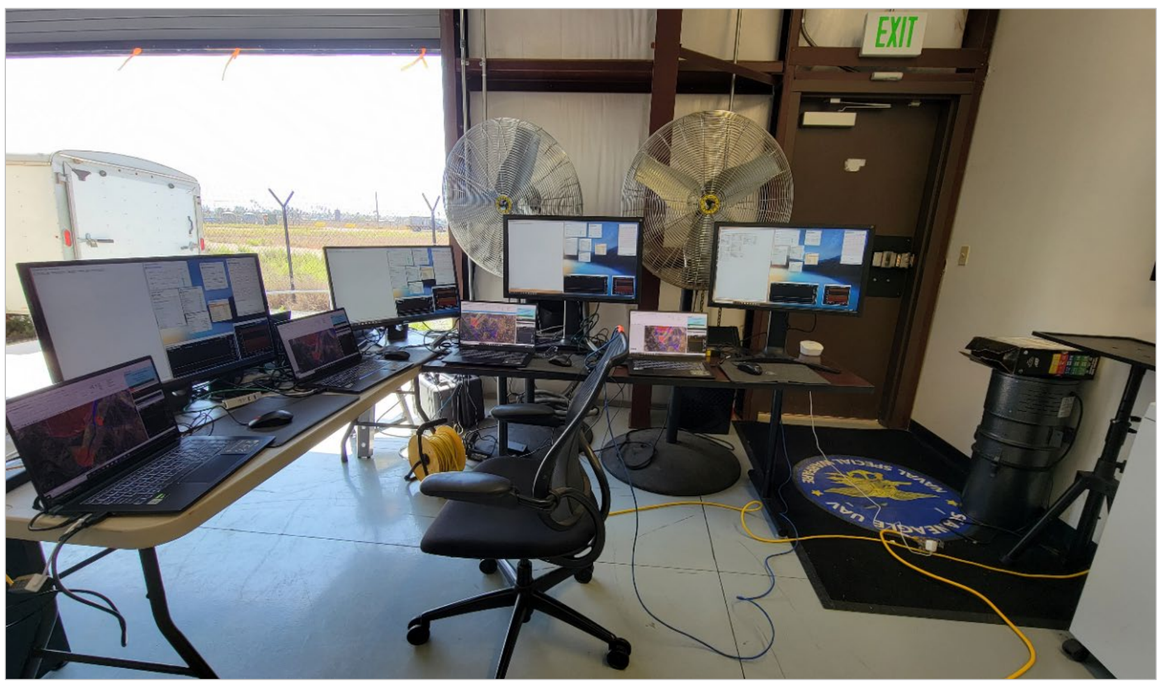
Background

- Human to unmanned aerial vehicle (UAV) ratio is decreasing as autonomy increases.
- Not only is a human capable of managing multiple UAVs, but in some circumstances the human's role is shifting away from controlling.
- Under conditions of higher autonomy, a human can control up to twelve UAVs.
- However, when more human involvement is needed, the number goes down considerably.
- This is due to the cognitive resources needed to effectively control 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 engine failures, forcing internal airspace deconfliction and prioritization of aircraft recovery.
- Operator manages 4 simulated ScanEagle aircraft, 2x engine 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 cognitive load beyond managing one UAV.

Conclusions

- Operator feedback, performance assessment, and cognitive load measures indicate that ScanEagle operators are not yet prepared for a one-to-many 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.

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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.