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A Technical Roadmap for Autonomy for Marine Future Vertical Lift (FVL)

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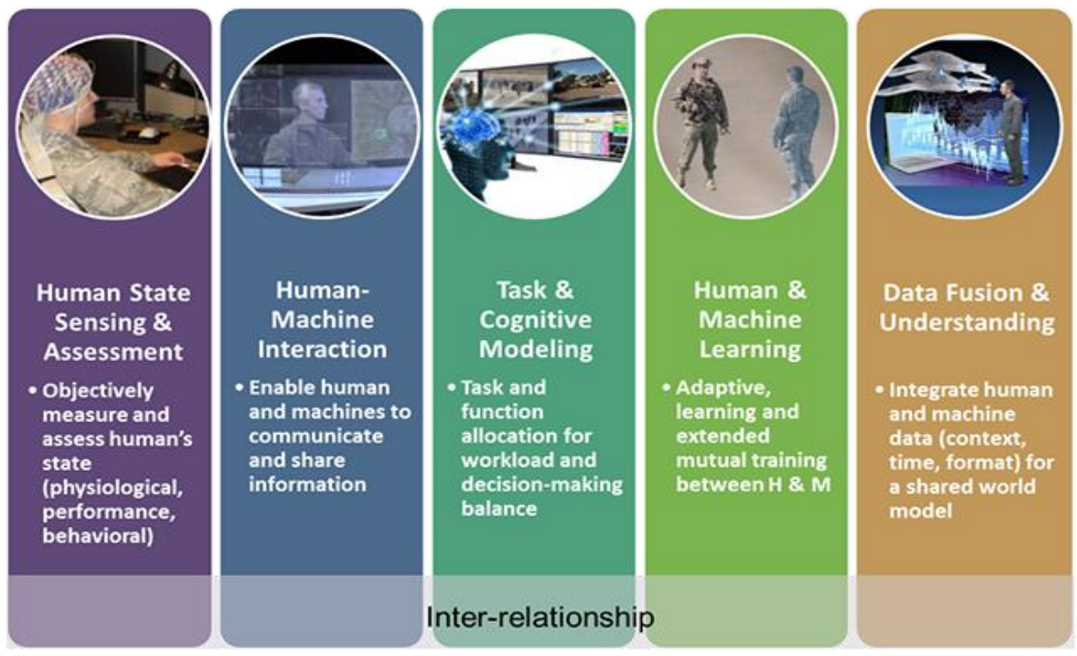
Future Vertical Lift – Human Machine Teaming for Aerial Reconnaissance Operations

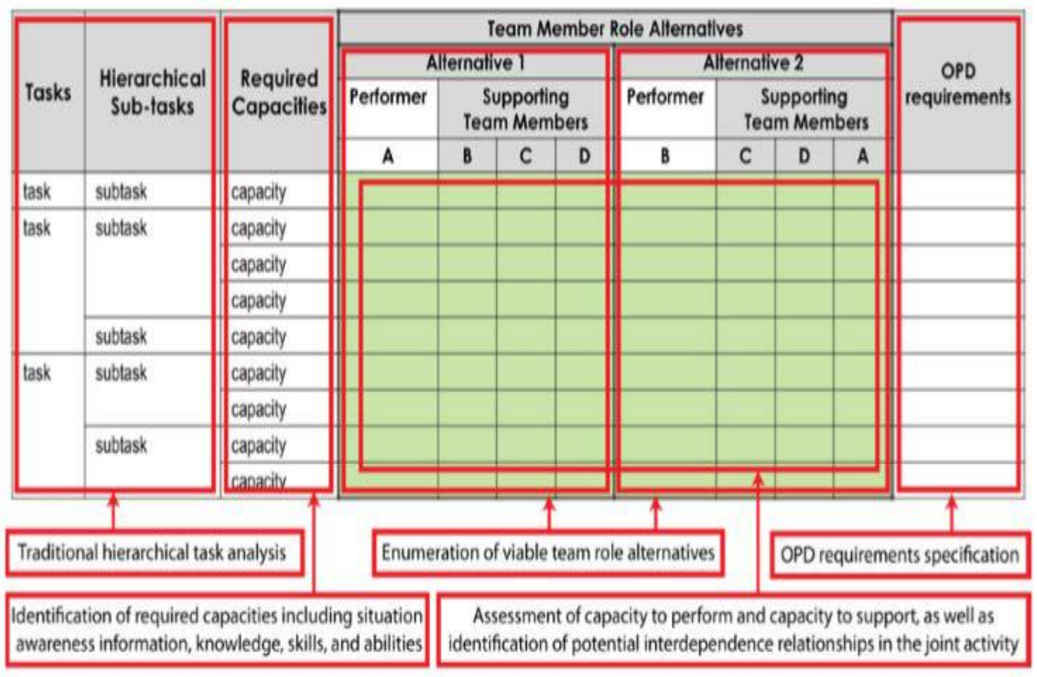
Naval Postgraduate School

Project Description

- Goal – derive human-machine teaming requirements necessary to support Marine aerial reconnaissance operations utilizing Future Vertical Lift and an Unmanned Aerial Systems.
- Approach – use independence analysis techniques to produce above requirements, then design a replicable simulation scenario to assist assessing proposed human-machine teaming concepts.
- Product – proof-of-concept experiment using MOVES' FVL Living Lab, demonstrating the feasibility and value of human-machine teaming between future vertical lift platforms and unmanned aerial reconnaissance systems.



Human-Machine interdependencies fuse automated systems with human cognitive control through reciprocal and continuous feedback loops



Independence Analysis Table (Johnson, 2014)

Independence Analysis (IA) Tool

- IA Tool was derived to graphically depict the interdependencies that exist within a system to assist design and allocation processes.
- The IA Tool enables the design of interdependence by allowing soft constraints, task dependency, capacity to perform, capacity to support, role permutations, and participant representation. It also produces reliability and resiliency considerations, and assists with prioritizing design requirements.
- Scenarios (participants, tasks, subtasks, capacity) were analyzed to form an initial operational concept across the human-machine team.

Living Lab for Design Experimentation

- A Living Lab of networked training devices, simulators and augmented/virtual reality capabilities being prototyped in support of design experimentation.
- Leverages Army's Combat Air Brigade Autonomy and Integration Lab (CABAIL) in Huntsville, AL
- Research team designing tactical experiment for evaluating HMT performance for FVL with air deployed recon UAV
- Using IA, researchers generated system inputs (tasks) required to execute manned-unmanned teaming operations in support of forward reconnaissance operations. The task performances are automatically analyzed across the manned-unmanned participants to determine interdependence performance.
- Simulation scenarios were executed using various participant and operational parameters in accordance with USMC future aerial reconnaissance mission tasks.

NPS students used the MOVES simulation environment to support their research

Results and Recommendations for Future Work

- Combining system and operational analyses with the Co-Active Design process established human machine interdependencies and enabled rapid experimentation for future USMC warfighting capabilities, and is worthy of consideration for all USMC future human unmanned system initiatives
- An HMT must have a redundant primary, alternative, contingency, and emergency communication plan to support mission planning and execution
- HMT related UAVs need a high level of autonomy, natural language processing, and a common digital infrastructure

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