Decision Support for Workload Mitigation in Supervisory Control of Multiple UAVs

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As UAVs become increasingly autonomous, the multiple personnel currently required to operate a single UAV may eventually be superseded by a single operator concurrently managing multiple UAVs. Instead of the lower-level tasks performed by today's UAV teams, the sole operator would focus on high-level supervisory control tasks such as monitoring mission timelines, altering navigation flight paths, and reacting to emergent mission events.

A key challenge in the design of such single-operator systems will be the need to minimize periods of excessive workload that could arise when critical mission stages of several UAVs occur simultaneously. It is possible, to a certain extent, to predict and mitigate such periods in advance. However, actions that mitigate a particular period of high workload in the short term may create long term episodes of high workload that were previously non-existent. Thus some kind of decision support is needed that allows operators the ability to evaluate action alternatives for managing a mission schedule in real-time.

This paper describes two decision support visualizations for the supervisory control of four UAVs performing a time-critical targeting mission. A configural display common to both visualizations was designed to highlight potential periods of high workload corresponding to the current mission timeline, as well as "what if" projections of possible high workload periods based upon possible decision alternatives. The first visualization is locally focused, allowing the operator to compare different high workload mitigation decision alternatives for individual UAVs. The second visualization is globally focused, indicating the combined effects of multiple high workload mitigation decisions on the timeline. The main advantage of the locally-based visualization is that decision alternatives can be compared; however, the possible effects of these alternatives are only for the individual UAV primarily affected by the decision. For the globally-based visualization, different decisions can be combined to show possible effects on the system propagated across all UAVs, but the different alternatives of a single decision cannot be directly compared.

The two visualizations will be tested in time-critical targeting missions of varying difficulty. Their effectiveness on human and system performance will be compared using several metrics such as a mission performance score and specific system wait times.