Editorial

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Biographical notes: Brian Bourgeois completed his PhD in Electrical Engineering at Tulane University in New Orleans, LA in 1991. He retired as a Captain from the US Naval Reserve in 2008, after 28 years of active and reserve service. He is presently Head of Code 7440.5 in the Naval Research Laboratory detachment located at Stennis Space Center, MS. His work there has involved the development of unmanned underwater vehicles (UUVs) and sensor systems, and underwater navigation and communication systems for UUV teams. His recent research interests have been in the development of advanced mission planning and management systems for UUV teams.

Timothy E. Busch is a Senior Engineer with the Information Systems Research Branch of the Air Force Research Laboratory. He received his PhD in Electrical Engineering from the Binghamton University in the area of Control Theory. His primary research interest is in the application of model predictive control techniques to dynamic decision problems typical in high tempo operations. He is a Research Advisor to the National Research Council and an Assistant Professor in the Electrical Engineering Department of the State University of New York Institute of Technology. He is a senior member of the IEEE and also an Associate Editor for the *IEEE Transactions on Systems, Man, and Cybernetics Part C*.

The growing use of autonomous air, surface, ground and underwater systems is continually demonstrating new military and commercial possibilities and applications. The technology for, and capabilities of, unmanned vehicles (UVs) have leapt dramatically ahead in the past two decades, going from concept to operational systems. However, relatively little progress has been seen in the development of decision support systems that help the operators prioritise, plan, schedule and adapt these vehicles for a wide variety of functions and environments.

Typical mission planning systems do little more than show data to us, as opposed to displaying the impact of that data on a proposed mission or further to provide a systematic framework for the exploration, creation and evaluation of potential mission plans that meet specified objectives. UVs, particularly those with high levels of autonomy inferring infrequent human control, are unique in that much more planning is needed ahead of time than for manned missions. These vehicles have neither the sensors nor the decision-making sophistication required to assess the environment and its impact on the mission, so many of the eventualities must be planned for prior to a mission using the best knowledge available.

Today, this task is typically managed in an *ad hoc* fashion with little support from computers tailored to provide analytical analysis, and often requires significant expertise and manpower to successfully field these systems. To make the deployment of UVs more manageable and less expensive, advances need to be made in decision support software systems that can provide a consistent and systematic approach to the analysis of the myriad of considerations for the generation of plans to meet stated objective and subjective mission goals.

The objective of this special issue is to bring focus on this specific technology gap and present recent research that is addressing these issues.

'Global vs. local decision support for multiple independent UAV schedule management' by Cummings and Brzezinski closely examines human-machine interface issues for the time-critical task of managing multiple unmanned aerial vehicles (UAVs) on targeting missions. They introduce MAUVE, a multi-aerial vehicle experiment test bed and present the StarVis configural display that displays multiple variables related to the UAV management task in a single geometric display. Additionally, StarVis incorporates a projective feature that advises the operator of potentially adverse future consequences based on proposed decisions. Experimentation with operators contrasted three approaches:

1. the display of information using simple timelines for each UAV
2. the use of local StarVis that focuses on only one vehicle at a time
3. the use of Q-Global StarVis that allows exploration of consequences to multiple schedule problems simultaneously.

The results revealed that Local StarVis yielded superior performance, reduced workload and enabled higher situational awareness for the operators.

'Robust team decision-making under uncertainty' by Gulpinar, Canakoglu and Thoms looks at decision-making problems that arise in mission planning for multi-agent teams. Specifically, the authors focus on robustness when contending with data uncertainty, and consider a stochastic programming approach for the task allocation problem and extend it to a worst-case analysis. They investigate the impact of data uncertainty on team performance and develop models for team decision-making and robust optimisation to contend with it. Their simulation results show a clear trade-off between robustness and performance.

'Design of genetic algorithms for topology control of unmanned vehicles' by Sahin, Urrea, Uyar, Conner, Bertoli and Pizzo presents a decentralised distributed approach for multiple unmanned ground vehicles (UGVs). The objective of this effort is the development of approaches to disperse a group of vehicles uniformly within an assigned area using only local UGV to UGV communications and their sensors, eliminating the need for a centralised controller with full network connectivity between all UGV nodes. They present a force-based genetic algorithm approach that effectively responds to multiple criteria including the size of the area, the number of vehicles, physical obstacles and communication range, and adapts as these conditions change. Simulation results demonstrate the effectiveness of the approach, even when there are insufficient vehicles to provide full coverage of the area.

'A simulation model for the analysis of end-to-end support of unmanned aerial vehicles' by Amouzegar, Drew and Tripp examines how logistic requirements impact the operational readiness of a group of UAVs. In this paper, they present a simulation model that includes both operational and maintenance processes, implemented as a closed loop network of multiple servers/queues with both sequential and parallel processes. The model can be used for assessment of complex trade-offs inherent in UAV operations, and provides capabilities for the user to set data parameters, accommodate dynamic metrics, flexibly set the time dimensions for analysis, and variably set repair modes. An example is presented showing how the model can be used to simulate changes in fielding, operations, and support, and translate those changes into an operational metric, i.e., the ability to provide a desired coverage of a target area.