Methods for the analysis and design of human-in-the-loop systems must account for interactions between the automation, the human, and the environment. We consider two problems: 1) user interface design, and 2) reachability-based navigation in dynamic, uncertain environments. The user interface, which provides information to the user about the underlying automation, and allows the user to issue input commands to the system, is key for enabling situational awareness and trust of the automation, yet is often designed in an ad-hoc fashion. We use sensor placement techniques to determine the optimal elements for display in the user interface, and exploit submodularity properties to facilitate solution of the resulting combinatorial optimization problem. We additionally consider the problem of collaborative navigation in dynamic, uncertain environments. We use Fourier transforms to compute the forward stochastic reachable set probability measure efficiently, and extend it to underapproximate stochastic reach-avoid sets in a real-time compatible manner.

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