Towards Reducing Human Supervision in Fielded Multi-Agent Systems

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Motivation

The DARPA Subterranean challenge (SubT) [5] was a three year long effort designed to spark innovation in the technical areas of autonomy, perception, networking and mobility for mobile robot exploration. The challenge was modeled within the context of search and rescue and **teams of robots and a human supervisor** needed to explore unknown underground environments while searching for objects that would indicate human presence.

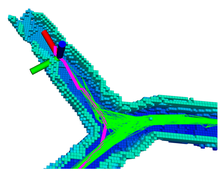
Key Finding #1:
The mission management system [2, 4] enabled exploration with minimal human intervention.

Key Finding #2:
Two critical interventions which lasted for 14 minutes of the 60 minute prize run led to a significant increase in exploration area.

Key Finding #3:
Better mechanism are needed to assess risk from semantic information in multi-agent systems.

Narrow Cave

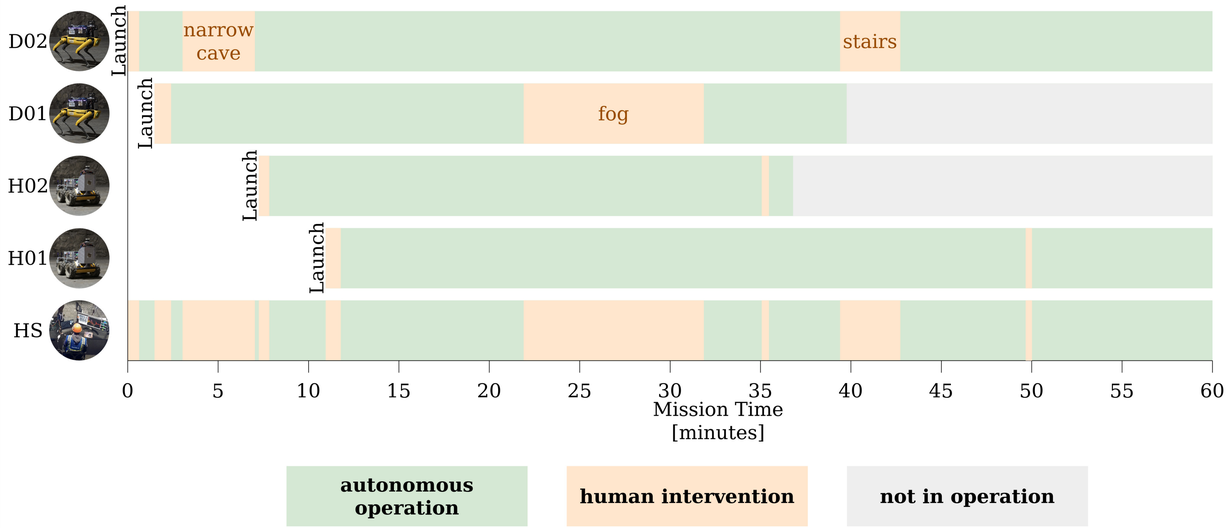
The first critical intervention occurred when the human supervisor navigated the robot through a **narrow cave**.



This decision was made based on the supervisor's **risk assessment** of the topology present in the environment. The autonomy system did not make this decision because of the higher risk of a mobility failure in a narrow environment.

Mission Timeline

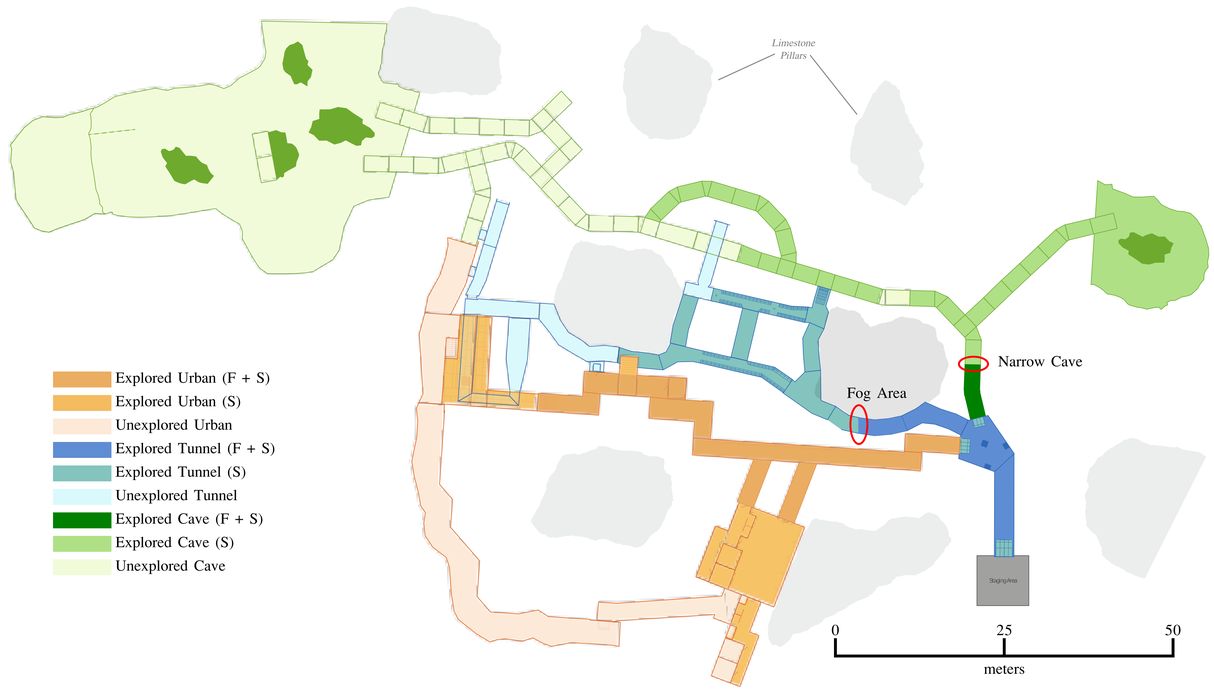
Timeline showing the autonomous operation of the four robots at the DARPA SubT final run. The human supervisors two key interventions happened at **3 minutes** and **22 minutes**. During the remaining time all decisions were made by the mission management system [2].



Traditional decision frameworks such as finite state machines [3] or behavior trees [1, 6] do not have sufficient mechanisms to reason over risk based on the context of the mission and unique environmental elements.

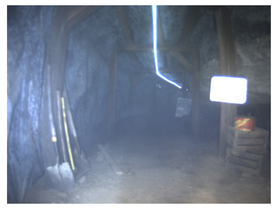
Course Map

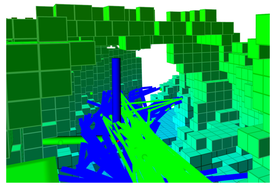
Map of the final course which shows the total explored area across the four robot fleet. Key areas where the human supervisor **made strategic decisions** are highlighted in red.



Fog Area

The second intervention occurred when the human supervisor navigated the robot through a **foggy area** based on the potential for a larger exploration area beyond the occluded area.





In this case semantic information indicating the presence of fog could have assisted the autonomy system in traversing the fog filled passage.

Full Paper

References

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