NRI: INT: Balancing Collaboration and Autonomy for Multi-Robot Multi-Human Search and Rescue

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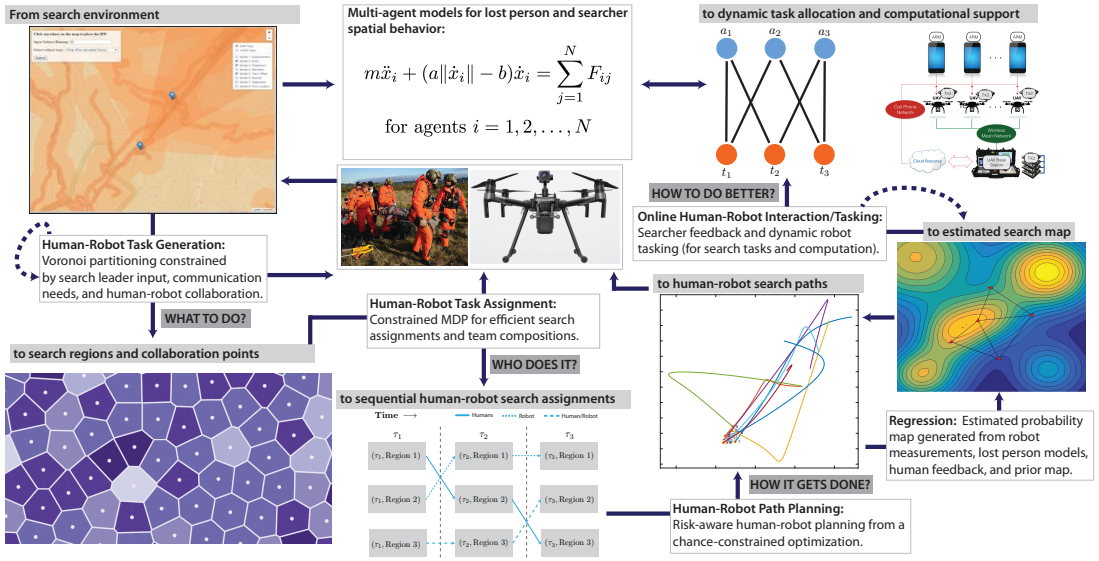
Challenge

- Enabling teams of human searchers and unmanned aerial vehicles to collaborate towards improving search outcomes and reducing human effort.

Solution

- Risk-aware human-UAV search planner.
- Agent-based lost person model.
- In-field computational backpack.
- Web-based SAR interface.



Project overview.

Scientific Impact

- Planning and control systems that autonomously gather information while adapting to uncertain human plans.

Broader Impact

- Volunteerism is in dramatic decline nationally and across Virginia, and thus UAVs could eventually supplement the lack of trained volunteers.

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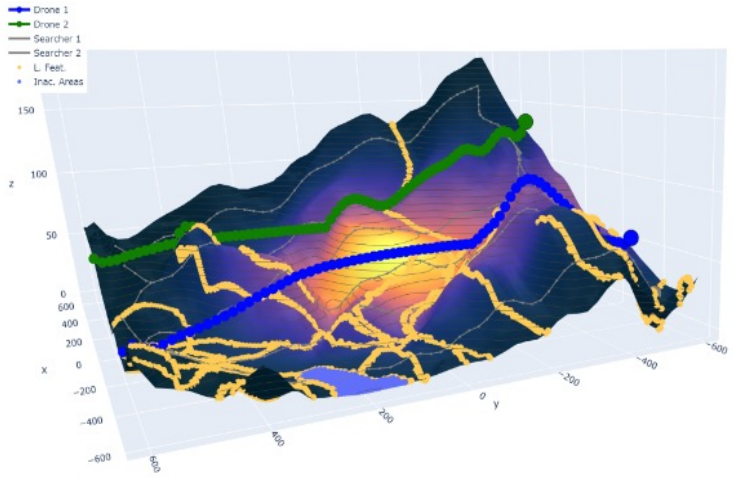
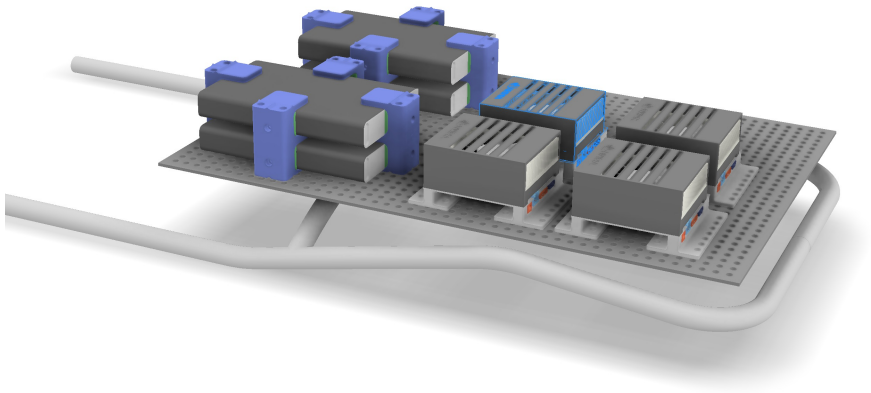
Overview of Current Results:

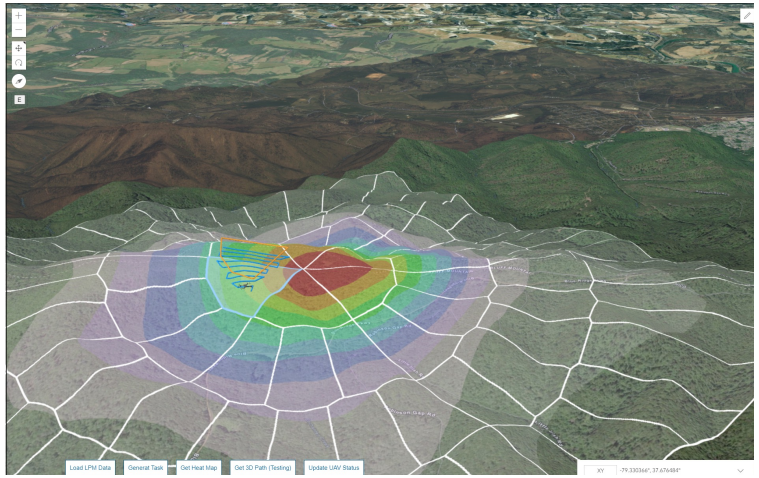


(a) H.M. State Park

Lost person modeling and human-UAV search planner pipeline.



In-field computational backpack.



Search and rescue interface with human factors studies.

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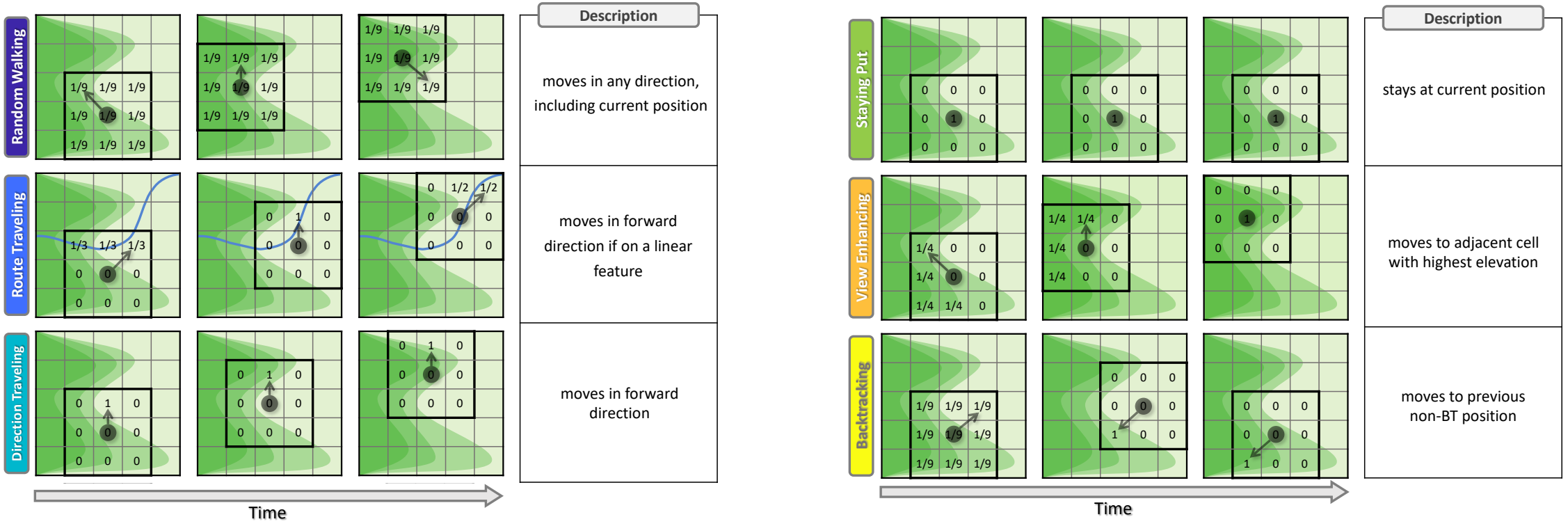
Agent-Based Lost Person Model



Lost person behaviors and agent motion.

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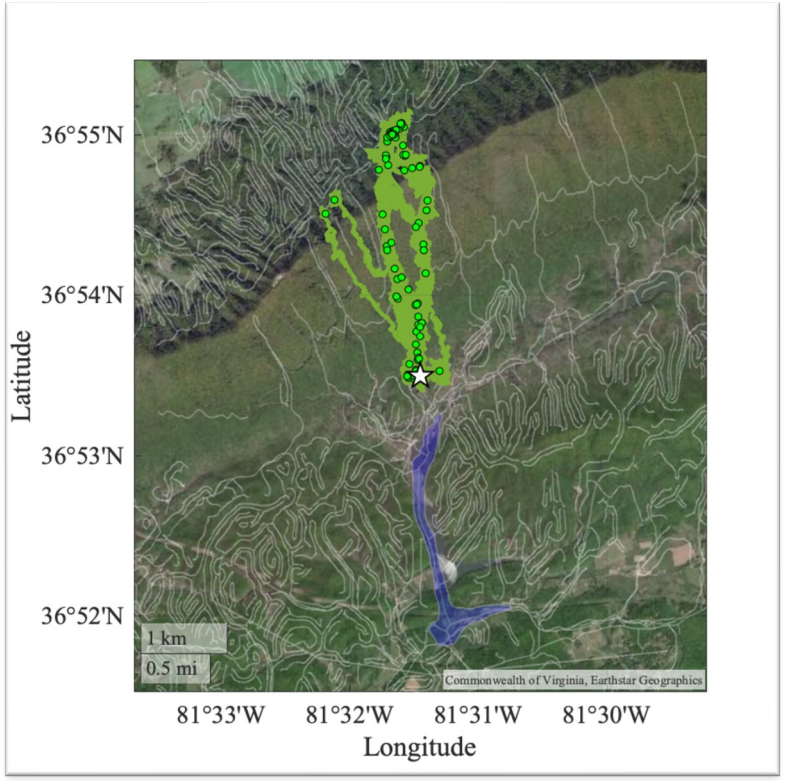
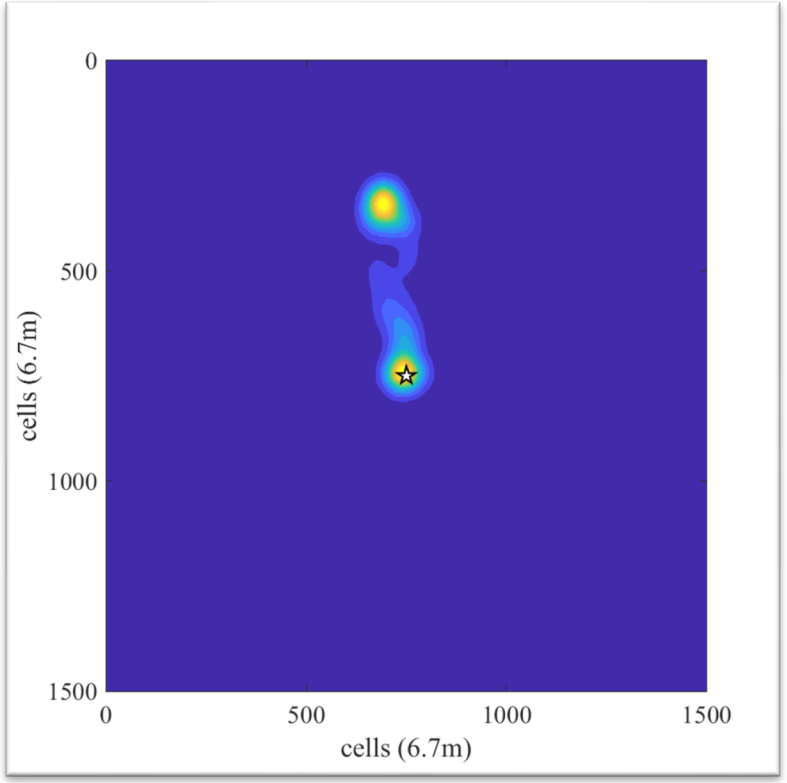
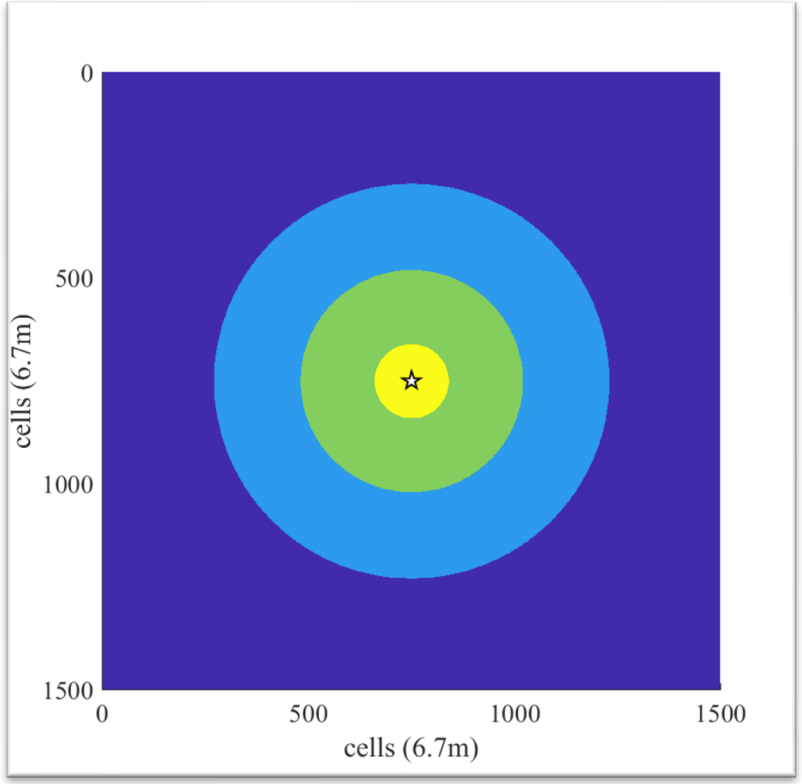
Agent-Based Lost Person Model



Terrain map with linear features and agent trajectories.



Heatmap of the simulated trajectories.



Ring model, how real searches are modeled.

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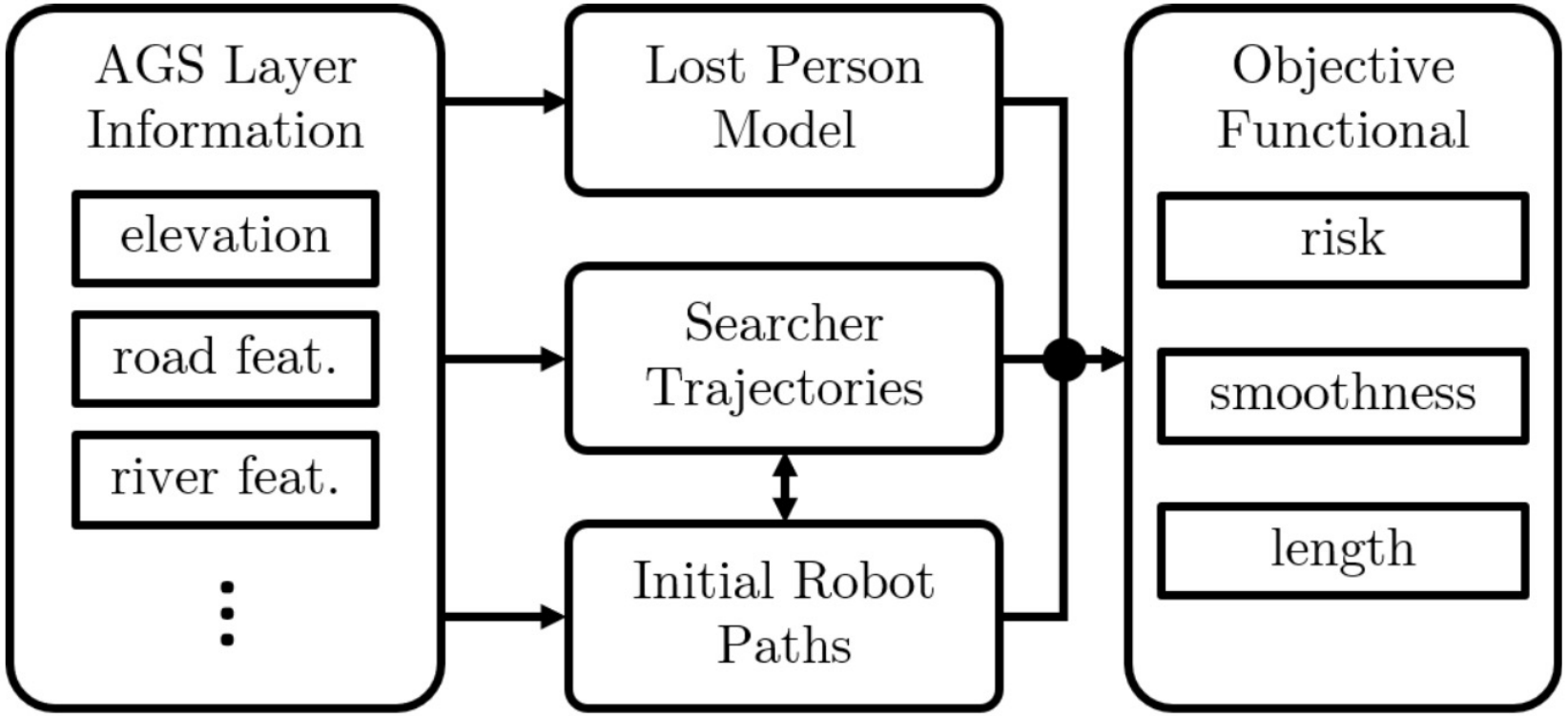
Risk-Aware Multi-UAV Planning with Lost Person Model



Multi-UAV planning pipeline.

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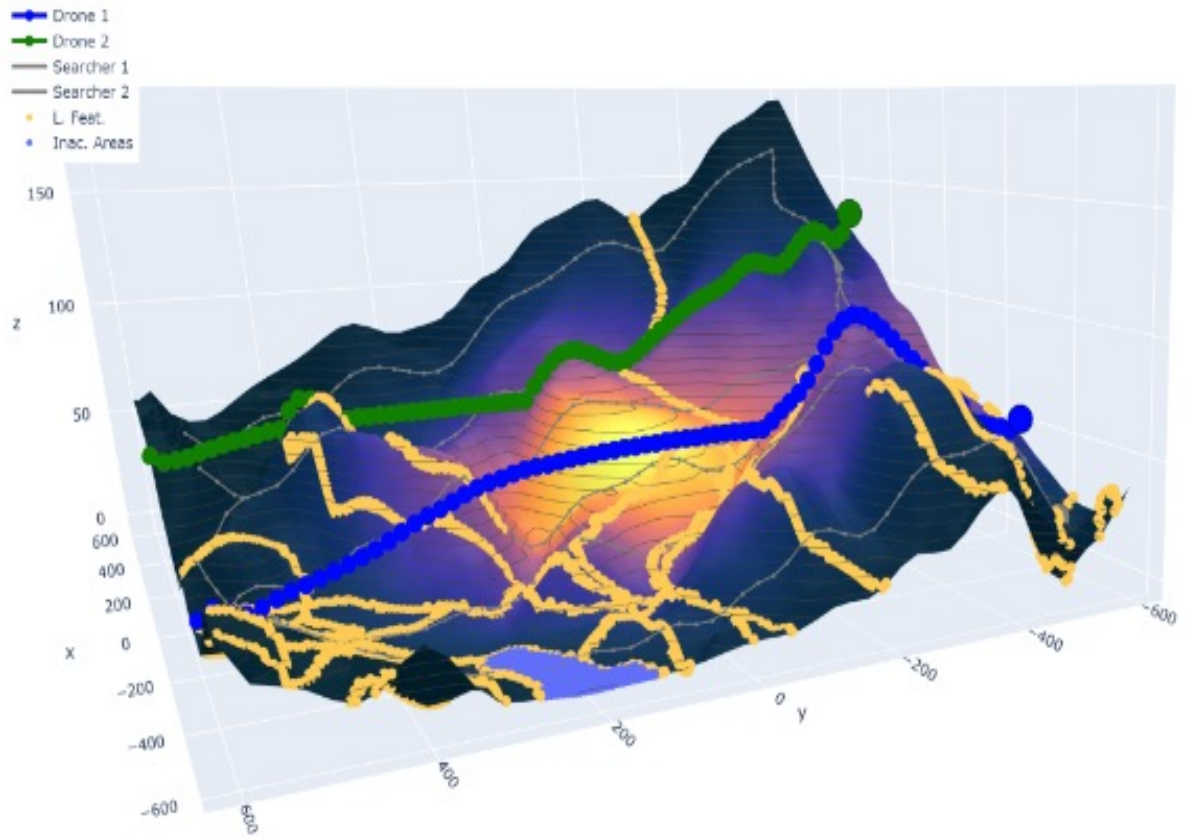
Risk-Aware Multi-UAV Planning with Lost Person Model



Multi-UAV planning pipeline output.

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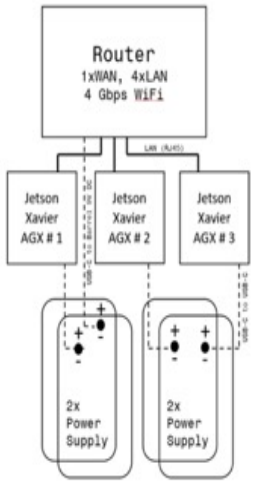
Distributed Computing for Multi-UAV SAR

WASP

Components

NVIDIA Jetson **AGX Xavier**
512 Core Volta GPU @1377 MHz
8 Core Carmel CPU @ 2.26 GHz
16 GB DDR4 (137 GB/sec)
30 W | 32 AI TOPS
105 x 105 x 105 mm | 0.28 kgs

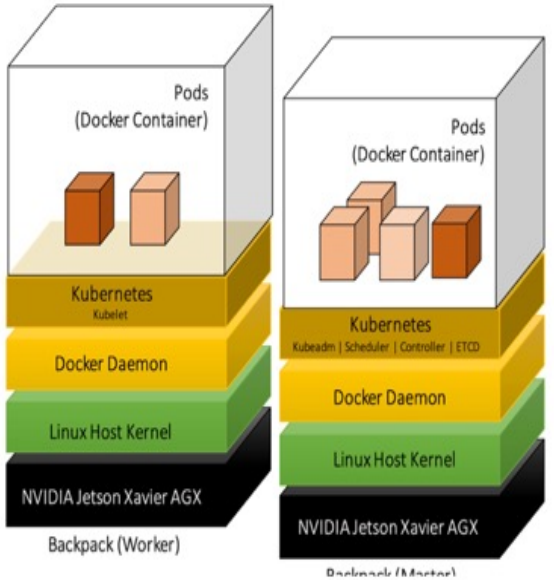


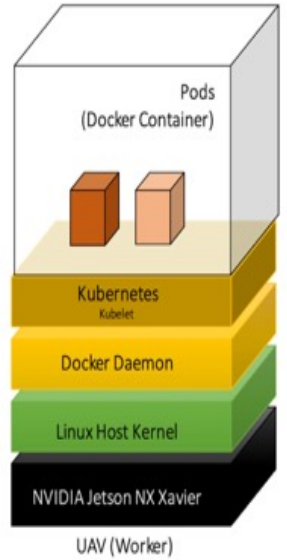
Netgear Nighthawk **XS6 AC4000**
Tri-band w/ Load Balancer
5 GHz @ 1.625 Gbps
2.4 GHz @ 750 Mbps
295.5 x 226.8 x 54.5 mm | 1.1 Kg
Implicit Beamforming

Mophie **Powerstation AC**
24,000 mAh Li-Po
100 W AC @ 110 V
30 W DC (20/15/9/5 V) USB-C
12 W DR (5V) USB-A
190 x 114 x 28 mm | 0.756 kg

WASP

Software Infrastructure





Kubernetes Architecture

Hardware/software stack.

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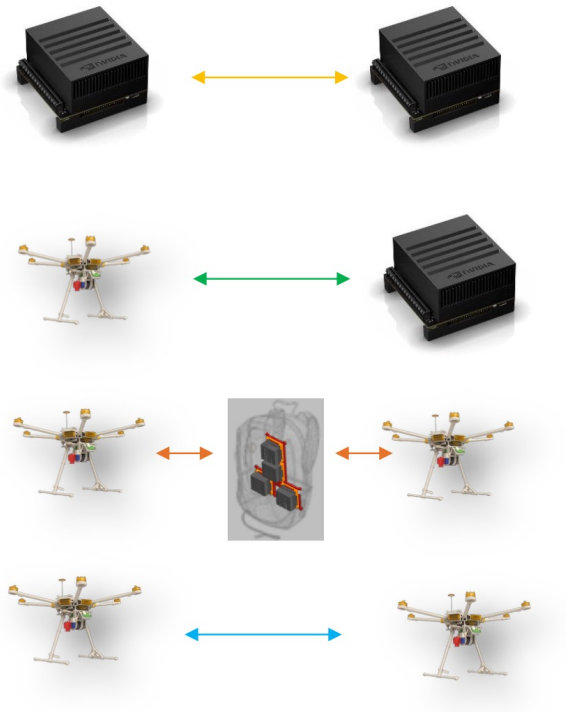
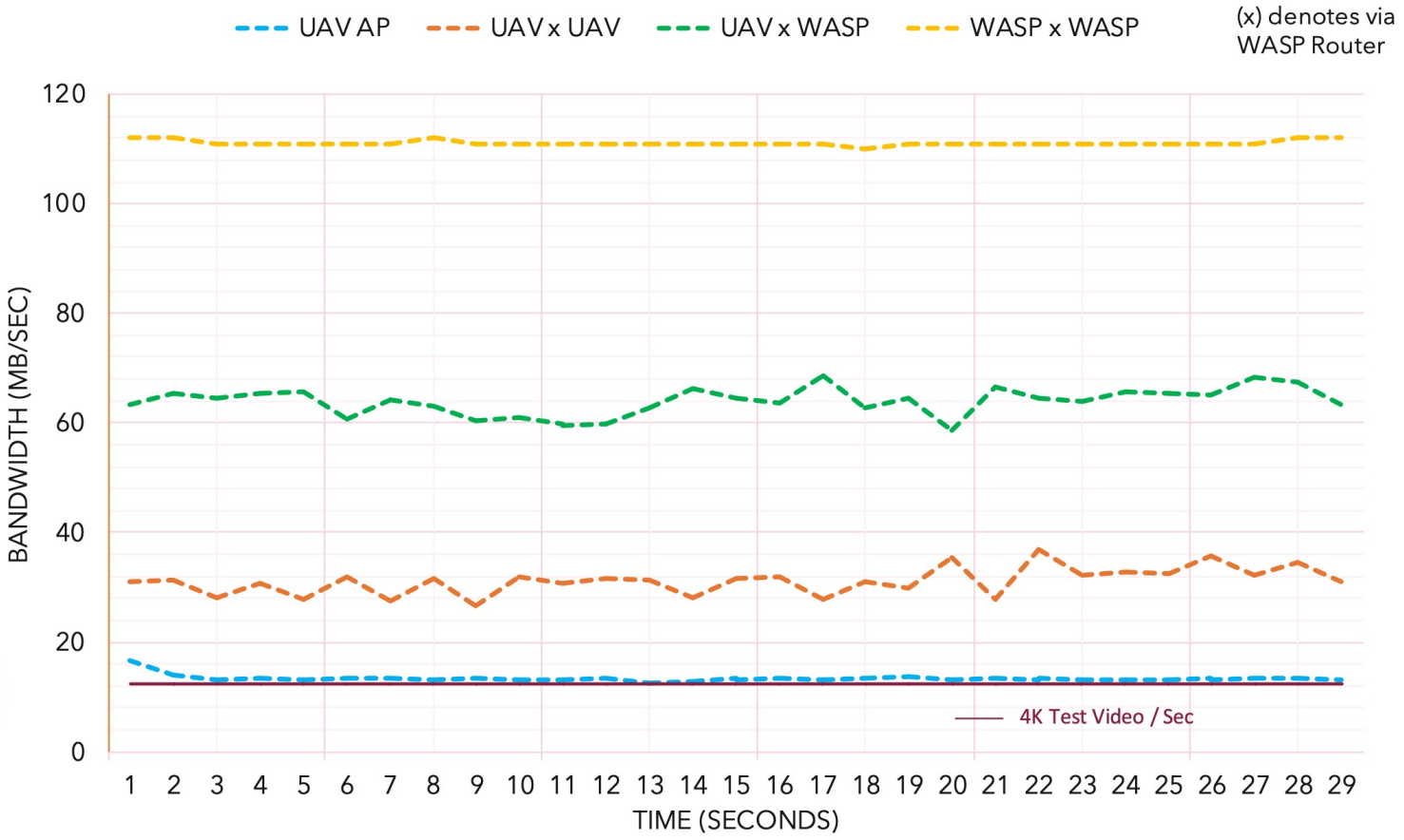
Distributed Computing for Multi-UAV SAR





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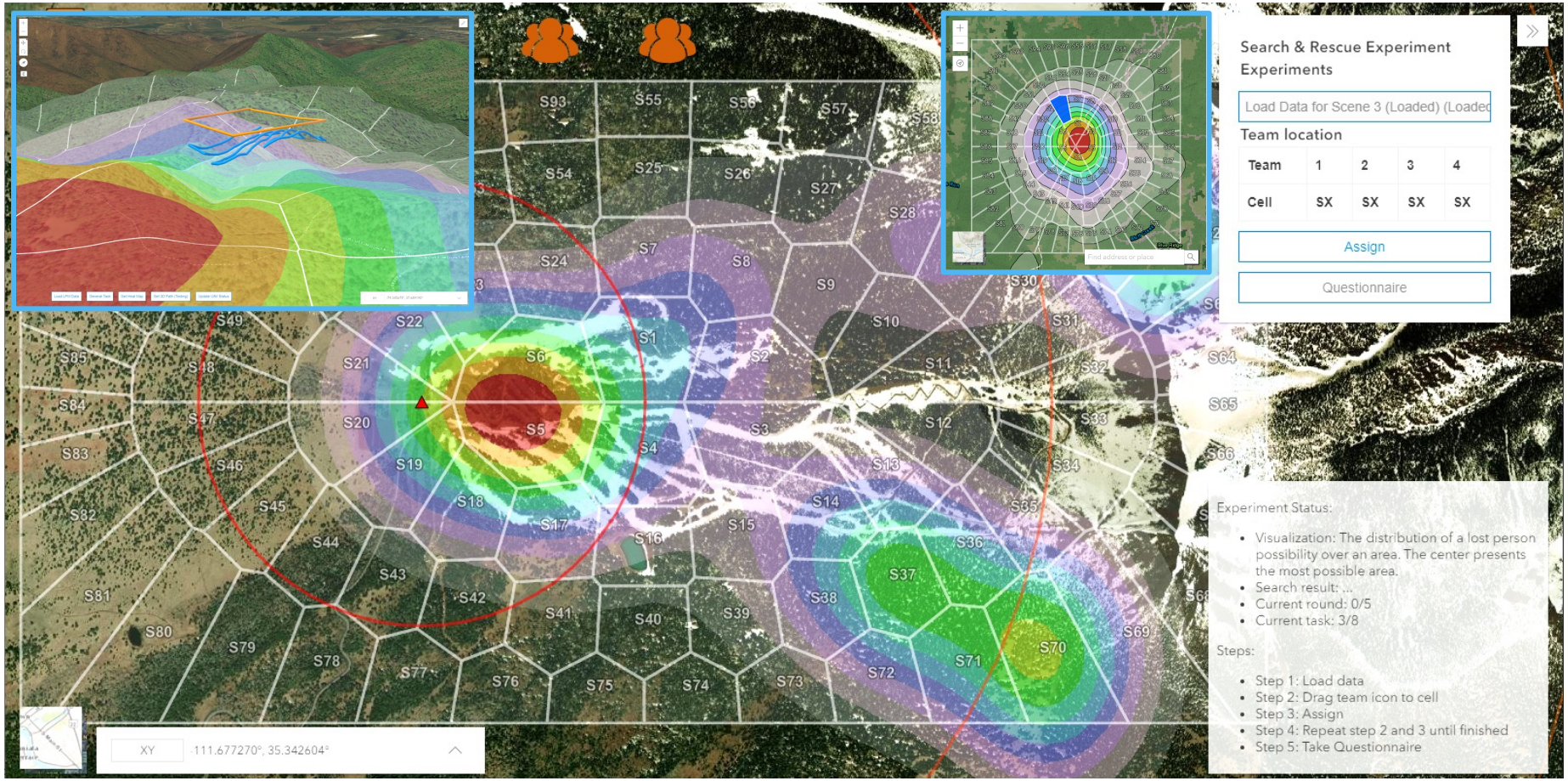
Real-Time Interface for Human-Robot SAR



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Ongoing Efforts: Field Work!

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What's Next: Trust in Aerial Search