

Collaborative Autonomy and Safety for Teamed Human – Unmanned Aircraft Systems in Fast Evolving Wildfire Environment: Year 2 Summary

Xiaolin Hu (Georgia State University), Ming Xin (University of Missouri), Haiyang Chao (University of Kansas)



Overview: The objective of this project is to develop innovative research that can transform wildfire management by enabling operational wildfire spread prediction and situation awareness for firefighters using a team of unmanned aircraft systems (UAS).

Key Problems and Significance

- Fire sensing and wind estimation using a team of UAS.
- Advanced data assimilation to enable data-driven wildfire simulation for operational wildfire spread predictions.
- UAS coordination and path planning algorithms governing UAS autonomy.
- Support teamed human-UAS collaboration.

Scientific Impacts

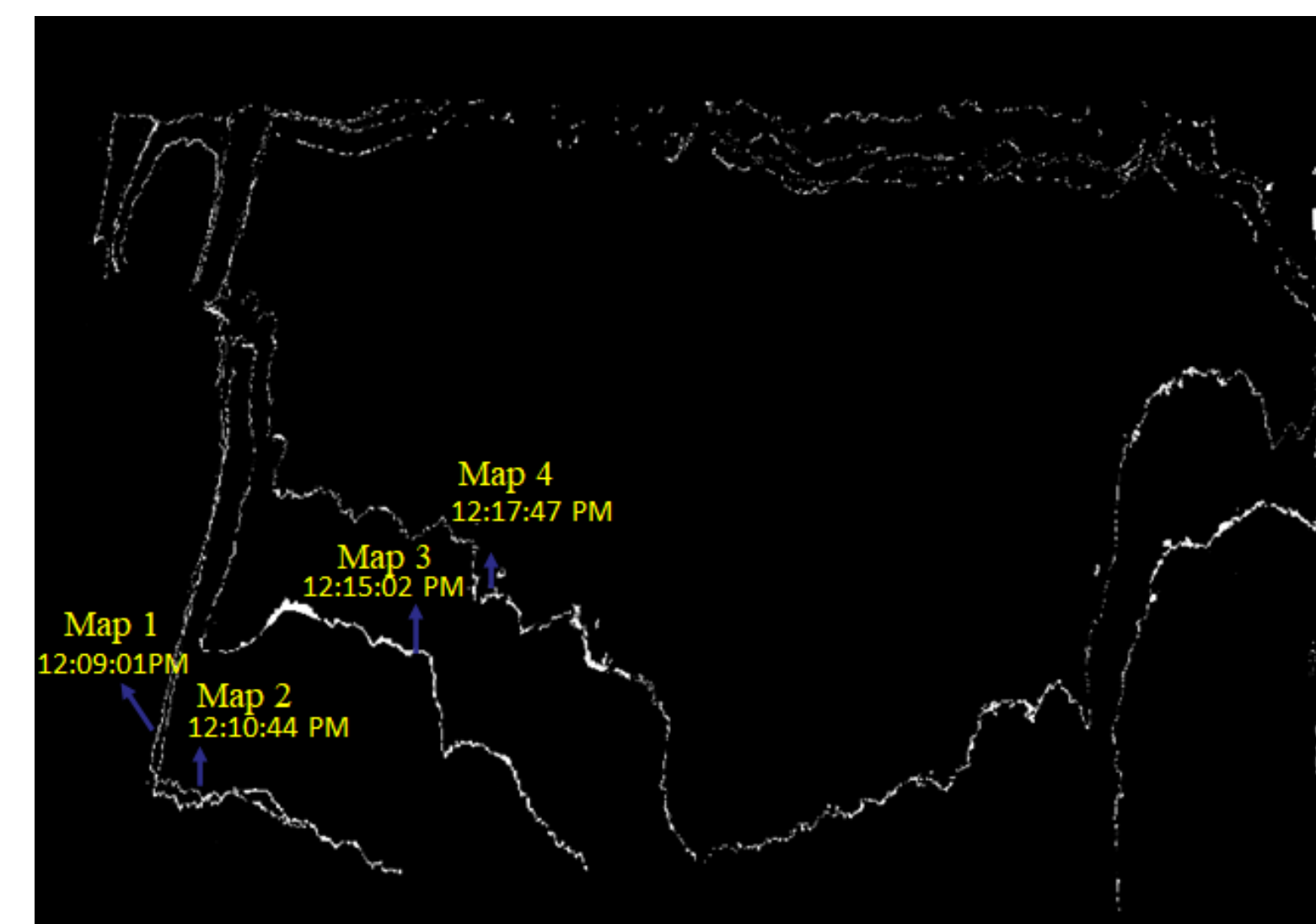
- The UAS-based fire and wind sensing fills the critical gap of real time data collection and data assimilation for operational wildfire spread prediction.
- The multi-UAS autonomy algorithms allow UAS to effectively collect the most useful information about dynamic wildfires and to ensure safety of firefighters.
- The project provides new ways for humans to direct UASs' autonomy and new approaches of using UASs to ensure human safety in challenging environments.

Progress in Year 2

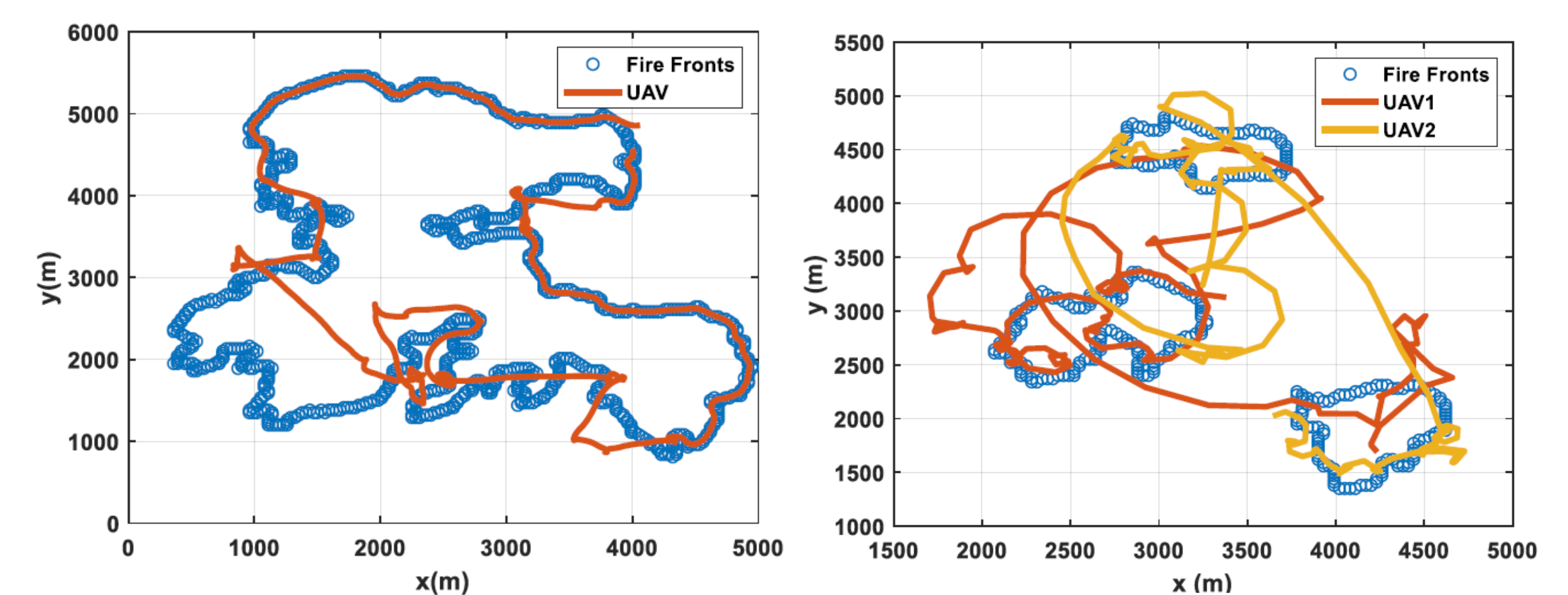
1. KHawk-55 Thermal UAS for prescribed fire sensing (tall grass field of 650 by 350 meters)



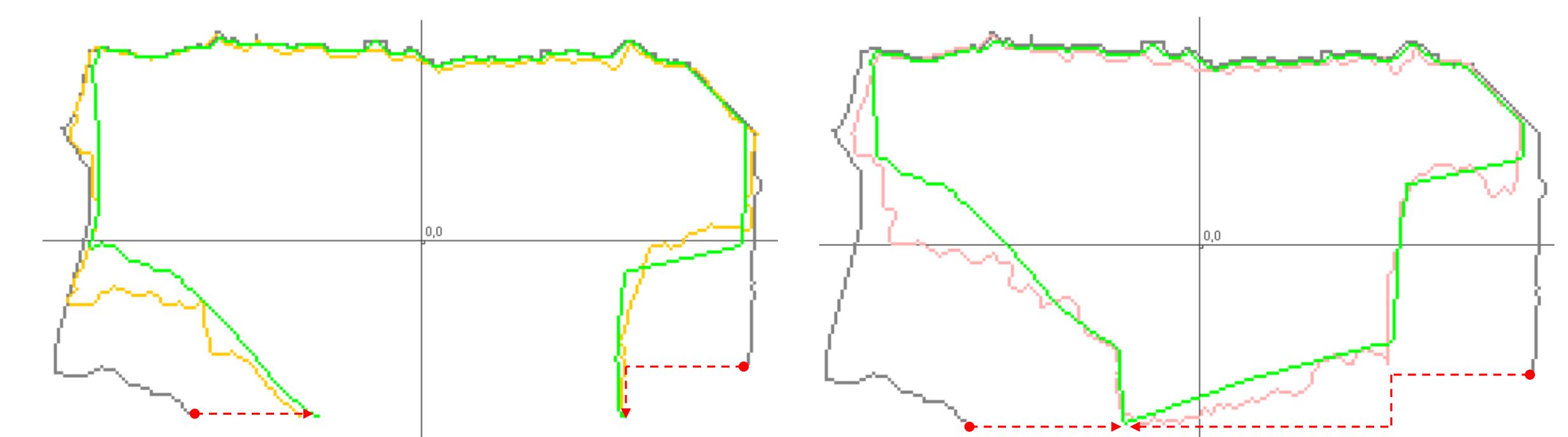
2. Time sequential UAS thermal imagery to support estimation of fire line location and rate of spread (ROS)



3. UAV path planning based on partially observable Markov decision process



4. Prescribed fire spread simulation in comparison with real fire fronts (gray: initial fire front; green: simulated fire fronts; orange & pink: real fire fronts; red: ignition routes).



Broader Impact – Impact on Society

- There is an urgent need of advanced technologies and tools for operational wildfire spread prediction and situation awareness for firefighters and people in and near wildfire areas.
- The results of this research will benefit wildfire management and other civilian and defense emergency response applications where humans and UASs increasingly work together.

Broader Impact – Education and Outreach

- Wildfire-UAS Field Trip program
- Annual outreach workshop series; UAS club events.
- New courses and learning materials.
- An open data repository hosting wildfire and UAS data and share with the research community.
- A web-based wildfire simulation portal open to the public.