POST WORKSHOP REPORT

Mobilizing a Consortium for Autonomous Robotic Platforms to Strengthen Wildland-Fire Ecosystem Resiliency

2023 Foundational Research in Robotics
National Robotics Initiative
Principal Investigators' Meeting

Day 1: Tuesday, May 02, 3:00 – 5:00 pm
Day 2: Wednesday, May 03, 1:30 – 3:00 pm
Submitted By: Mrinal Kumar
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Zoom Meeting: 981 4856 6111
Password: 547905

Workshop Title
Mobilizing a Consortium for Autonomous Robotic Platforms to Strengthen Wildland-Fire Ecosystem Resiliency

Chairs
Mrinal Kumar and Roger Williams, The Ohio State University
Frederica Darema, InfoSymbiotic Systems Society

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Location
Hyatt Regency Crystal City at Reagan National Airport Hotel (2799 Richmond Highway, Arlington, VA 22202), Room: Potomac III & IV

Format
The workshop was held over two days:
- **Day 1**: Tuesday, May 02, 3:00 – 5:00 pm: Stakeholder presentations, followed by discussions and breakout sessions. Breakout discussions will continue during working dinner.
- **Day 2**: Wednesday, May 03, 1:30 – 3:00 pm: Summary of breakout sessions, and a panel discussion to develop action plan for proposed consortium

Workshop Abstract

This workshop aims to develop an action plan for mobilizing a consortium on autonomous robotic platforms to strengthen our wildland fire resiliency. The consortium will create opportunity for the academe, industry, and governmental entities for collaborative work on wildland fire related practice and research on related areas which are of national importance. These include, but are not limited to wildland fire response resiliency, prescribed burning planning, assessment of post-fire ecosystem and the wildland-urban interface, and fire related atmospheric(smoke) impact and other climate science. Broadly, the consortium will provide situational resources for parties working in these areas. It will serve the following purposes:

1. A venue for timely information sharing so that interested but geographically separated parties can collaboratively participate in burn events. Teams can multiply efforts by bringing to bear their specialized equipment (such as hyperspectral imagers) for multi-modal monitoring of the various stages of a wildfire's life cycle. This way existing partnerships can be strengthened, and new ones can be formed.
2. A platform for sharing software, hardware, and data resources to improve wildfire modeling, detection, and prediction efforts. There is special emphasis on data generated-by and related to autonomous robotic platforms to forge a path towards their certification for use in fire events.
3. Create opportunities for collaborative and inter-disciplinary scholarly work by providing financial support for graduate and post-doctoral fellowships, travel grants, and experiential learning.
4. Interfaces to local wildfire responders and access to real-time and archival data collected from such events.

During the workshop, we will garner participant feedback to solidify the above goals and form additional goals. A task force will be formed to implement the action plan for the proposed consortium.

DAY 1: Presentation Schedule (All Times Eastern)

Time	Name	Topic
3:00 – 3:10	Mrinal Kumar, Frederica Darema	Why Are We Here?
3:10 – 3:20	Ralph Wachter [Program Manager: FRR & NRI: NSF]	Introduction
3:20 – 3:35	Eric Toman [Director: Lake States Fire Science Consortium: *presenting virtually*]	Risk Management
3:35 – 3:50	Haris Riris [NASA Earth Science Technology Office]	NASA Roadmap
3:50 – 4:05	Greg Guess, Roger Williams [Burn Managers, Ohio DNR and OSU]	Operations Needs
4:05 – 4:15	Natasha Neogi [Research Engineer: NASA Langley, *presenting virtually*]	System Wide Safety
4:15 – 4:30	Carrick Detweiler (*virtual*), Todd Kaeffaber, Vivek Mital	Industry Efforts
4:30 – 4:45	Marcus Johnson (*presenting virtually*) [NASA AMES]	ACERO Project
4:45 -	Open Forum Discussion: Workshop room available for as long as needed	Consortium Mission
5:30 – 6:30	Mrinal Kumar, Frederica Darema, Roger Williams, Ralph Wachter	Compose 3 problems and 3 breakout groups
7:00 – 9:00	Breakout Groups G1 – G3	Working dinner breakout discussion on assigned questions

(1/5) DAY 1: Summary (05/02/2023)

- **Attendance:** 12 in person, 18 online (Zoom)

- Workshop started at 3 pm with introductory remarks by Mrinal Kumar, Frederica Darema and Ralph Wachter.
- This was followed by key stakeholder presentations, including land management officials, NASA program officers and research scientists, and industry leaders engaged in wildfire response. Note that NASA has been tapped by the President's Council of Advisors on Science and Technology (PCAST) to lead the charge on modernizing wildland firefighting ([Link to Report](#)).
- Dr. Eric Toman (Director of the Lake States Consortium on Wildfire Fire) presented details on interactions between humans and wildland fire, especially along the wildland urban interface (WUI), expanding on the list of stakeholders and risk management issues.
- Dr. Haris Riris (Program Manager of NASA's FireSense Project) presented NASA's roadmap to wildland fire management. He presented findings from a similar stakeholder focused workshop conducted by NASA ARMD, and discussed a plan for field campaigns during 2023-2028 to test sensors and platforms during various lifecycle stages of a wildland fire.

(2/5) DAY 1: Summary (05/02/2023)

- Mr. Greg Guess (Assistant Chief at Division of Forestry in the Ohio Department of Natural Resources) presented existing gaps in the current practice of prescribed burning. He discussed the need for improved modeling, and fire line and smoke management. He discussed potential UAS solutions that can help improve situational awareness during and after a controlled burn, including fire initiation, detecting spot fires and hot spots. He also presented details of the National Cohesive Strategy for Wildland Fire Management and the national prioritization for fuel management (through prescribed burns), pointing out the need to create workforce capacity multipliers.
- Dr. Natasha Neogi (ARMD Research Scientist) at NASA Langley discussed at length NASA's System-Wide Safety Project for airspace operations. She described a safety demonstrator series for operational demonstration and developing recommendations for standards necessary to monitor, assess, and mitigate risks in disaster-oriented operations. She discussed the different layers of in-time aviation safety management and tied them with demonstrator series campaigns, which will focus on wildfire operations in 2024, graduating up to urban disaster relief through 2030. She presented a framework for online data integration called ODIN-Fire that will enhance situational awareness allow various stakeholders, including fire agencies, research groups and local communities to share timely information and multimodal datasets (including those from airborne sensors and satellite data).

(3/5) DAY 1: Summary (05/02/2023)

- Mr. Greg Guess (Assistant Chief at Division of Forestry in the Ohio Department of Natural Resources) presented existing gaps in the current practice of prescribed burning. He discussed the need for improved modeling, and fire line and smoke management. He discussed potential UAS solutions that can help improve situational awareness during and after a controlled burn, including fire initiation, detecting spot fires and hot spots. He also presented details of the National Cohesive Strategy for Wildland Fire Management and the national prioritization for fuel management (through prescribed burns), pointing out the need to create workforce capacity multipliers.
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(4/5) DAY 1: Summary (05/02/2023)

- The next three speakers represent commercial interests in integration of robotics with wildland fire management. Dr. Carrick Detweiler (Drone Amplified and Professor at University of Nebraska), Mr. Todd Kaeffaber (Asymmetric Technologies) and Mr. Vivek Mital (VegaMX) discussed platforms under development for fire detection, controlled burn management, and related topics. Dr. Detewiler presented details of their IGNIS system that can be used to safely ignite controlled burns. Mr. Kaeffaber presented details of Asymmetric's secure flight controller "IronClad" and the WiGig 60 Hz Wi-Fi communications system. Mr. Mital discussed VegaMX's work in AI enabled aerospace and ground sensor grid for detection, monitoring and forecasting. He emphasized the need for integrating ground, air, and space-based resources for these tasks.

- Dr. Marcus Johnson (research scientist at NASA AMES) was the final speaker on Day 1. Dr. Johnson is associated with NASA's ACERO project (Advanced Capabilities for Emergency Response Operations). He discussed the outcomes of recent workshops conducted by NASA in collaboration with USFS to understand the state-of-the-art and opportunities to improve wildfire management. He continued the discussion on persistent wildfire monitoring and support with resources in air and space. He emphasized the role of UAS for 24-hour operations and support for prescribed burning, logistics, connectivity and suppression of wildfires. He ended with a discussion on NASA's role in leading an inter-agency CONOPS to ensure consistency of operational priorities, technology adoption and alignment with national needs.

(5/5) DAY 1: Summary (05/02/2023)

- Following stakeholder presentations (ending at 5:30 pm), Darema, Kumar, and Williams gathered to formulate questions for all workshop attendees. The following questions were sent by email, to prep discussions for Day 2:

CONTEXT: Consider the broad context of the consortium's mission statement (see bottom of slide).

1. What efforts/projects are you involved in, or plan? How do you see your efforts contributing to the Consortium?

2. What do you expect to leverage from the Consortium?

CONSORTIUM MISSION STATEMENT:

Create opportunities for sharing resources for collaborative efforts across academe, industry, federal agencies, land managers and first responders. Resources include, but are not limited to data, models, instrumentation (sensors, platforms), and professional training. In the present time, there exist no guidelines for robotic agents to participate alongside humans in either fighting a wildfire or conducting a controlled fire. A key goal of the consortium is to forge a path to the certification of ground, aerial and space robots to participate in these events in pre-determined ways.

(1/3) DAY 2: Summary (05/03/2023)

- **Attendance:** 21 in person, 12 online (Zoom)

- Day 2 of workshop started at 1:30 pm. Kumar summarized the presentations from Day 1 and presented four topics for discussion by the attendees. These topics are included below:

DISCUSSION TOPIC I

CONSORTIUM MISSION STATEMENT
Create opportunities for sharing resources for collaborative efforts across academe, industry, federal agencies, land managers and first responders. Resources include, but are not limited to data, models, instrumentation (sensors, platforms), and professional training. In the present time, there exist no guidelines for robotic agents to participate alongside humans in either fighting a wildfire or conducting a controlled fire. A key goal of the consortium is to forge a path to the certification of ground, aerial and space robots to participate in these events in pre-determined ways.

(2/3) DAY 2: Summary (05/03/2023)

Discussion Topic II

CONTEXT: Consider the broad context of the consortium's mission statement.

1. What efforts/projects are you involved in, or plan? How do you see your efforts contributing to the Consortium?

2. What do you expect to leverage from the Consortium?

Discussion Topic III

CONTEXT: Fighting Fire with Fire (aka prescribed burn, aka controlled burns). Haris Riris described three lifecycle stages of a controlled burn:
- Pre-fire: determining burn objectives, fuel load mapping, etc.
- Active fire: situational awareness, forecasting (fire and environment)
- Post-fire: tracking burn objective and regeneration.

Consider the NASA/USFS Utah Field Campaign set in Fall 2023. *Define representative mission(s) for each lifecycle stage that would help us establish the merits of pooling resources (data, models, instrumentation, platforms).*

(3/3) DAY 2: Summary (05/03/2023)

> ## Discussion Topic IV
>
> How do you see federal agencies, such as NASA, NSF, USFS, DoD (ARMY, especially), State agencies, etc. developing a joint vision to address topics in wildfire research, practice, and integration.

- Workshop format on Day 2 was an open discussion on the above topics.
- Participants took turns sharing their vision for the consortium, in terms of tools, platforms, data sharing and experiential opportunities.
- The overwhelming consensus was that establishing a coalition is a good idea.
- The first step is for the organizing committee to put together a working group (volunteers during the workshop). The working group will develop a mission statement for the consortium and prepare for the first field campaign to pool resources. A potential opportunity presents in Fall 2023, during the NASA/USFS prescribed burn planned at Fishlake National Forest, UT (Fig.1).
- A website will be set up to organize content and initiate communications.
- The IUCRC program was proposed by Dr. Darema as an opportunity to generate funding for the consortium.

- **Objectives** in 2023:
  - Test technologies and collect data to help fire modeling community
  - Targeted FireSense use cases:
- **Dates**: October 15 - November 22, 2023
  - Burn plan: prescribed burn window (1 to 2 days)
- **Prescribed Location**: Monroe Peak , Fishlake National Forest, UT
- **Basing locations**:
  - Palmdale, CA (outside of prescribe burn)
  - Richfield Municipal Airport (one week, surrounding prescribe burn)
- **Plan**: 6-week deployment window. While waiting for prescribe burn, will fly targets of opportunities
- **Coordination** with U.S. Forest Service
  - Land managers, Burn Boss, Aviation Management services

Fig. 1: <u>Taken from Dr. Haris Riris' presentation at the workshop, Day 1</u>. Field opportunity for deployment of sensors and platforms.