Scalable Autonomous Teams for Disaster Management

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Kincade Fire

54,298 Acres
Vegetation

Active
Active for 3 days

5%

Contained
Estimated 2,715 acres contained

1 County
Sonoma

Location Information
John Kincade Road and Burned Mountain Road, northeast of Geyserville

Lat/Long
38.792458, -122.780053

Administrative Unit
CAL FIRE Sonoma-Lake-Napa Unit

Cause
Under Investigation

Last Updated
10/27/19 7:10 PM

Date Started
10/23/19 9:27 PM

Damages and Losses
Confirmed Damage to Property, Injuries, and Fatalities

17 Structures Damaged
Residential, Commercial and Other

94 Structures Destroyed
Residential, Commercial and Other

Cooperators & Personnel
CAL FIRE often partners with other agencies during extended emergency incidents.

1 Agency
Partner Federal, State and Local Agencies

3,441 Personnel
Total Fire Personnel Assigned

76 Crews
Number of Crews Assigned
Modeling

Healthy

On Fire

Burnt
Modeling

Graph-based Markov model
Our Work

Markov model
- Constrained resource allocation
- Fast online filtering

Markov model + aerial vehicles
- Wildfire suppression
- Persistent monitoring
Persistent Monitoring

Downward facing IR Cameras
Short range communication
Challenges

Robust communication networks are not typically available
Forest wildfires occur over very large areas and spread quickly
Large trajectory planning problem with partial observability

We build a scalable framework to coordinate a team of aerial vehicles
Main Idea

Robots schedule meetings to ensure information is shared

A meeting is a \{ group, time, location \}
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Planning - Pair of robots in a meeting
Algorithm

1: Deploy robots
2: for each time step do
3:     if a meeting occurs then
4:         Merge robots’ beliefs
5:         Schedule next meeting
6:         Perform joint path planning and save paths
7:     for each robot do
8:         Move to first location of planned path
9:         Take image and update belief
10:    Update wildfire process every $\rho$ time steps
Future Directions

Dynamic groups and meeting times

Combined tracking and control

Other physical models