Graduate Research Assistantship (M.S.), Unmanned Aerial Systems Applications in Fire Management, School of Forestry, Northern Arizona University

An M.S. graduate assistantship is available in the School of Forestry at Northern Arizona University (NAU), in Flagstaff AZ. The position will provide up to 2.5 years of support in the project "Wildland Fire Observation, Management, and Evacuation using Intelligent Collaborative Flying and Ground Systems." This research is a collaboration between Dr. Fatemeh Afghah and Dr. Abolfazl Razi, (School of informatics, Computing and Cyber Systems, NAU) and Dr. Peter Fulé (School of Forestry, NAU), as well as other graduate students and scientists at collaborating institutions. The project is described in detail on the next page. The M.S. position is in Forestry, advised by Dr. Fulé. Funding will include a graduate research stipend, tuition waiver, and health benefits. The successful candidate will gain expertise in the fields of fire management, UAS technology, and artificial intelligence applications for forest management.

Minimum Qualifications:

- B.S. in forestry, geography, environmental science or a related field and experience and interest in fire management.
- Must have current or recent red card, ability to renew red card.
- Experience with wildland fire (describe qualifications).
- Ability to communicate effectively with project partners and fire managers to coordinate field tests, follow safety protocols, and collect accurate data.
- Availability to start by August 15, 2021.

Preferred Qualifications:

- Experience with Geographical Information Systems and/or Remote Sensing
- Experience using R, Python, or other programming language

If you are interested, please send the following by **March 23, 2021** to Pete.Fule@nau.edu:

- A one-page letter describing how your career goals, qualifications and experience make you interested and qualified for this project.
- Resume
- Unofficial transcripts
- Names, phone numbers, and e-mail addresses of three references.

If invited to apply, the application deadline for the graduate program in the School of Forestry at NAU is somewhat flexible but quick action will be needed. For more information, contact Dr. Fulé at Pete.Fule@nau.edu.

Wildland Fire Observation, Management, and Evacuation using Intelligent Collaborative Flying and Ground Systems

Overview: Wildfire is one of the costliest and deadliest natural disasters, especially in the US southwest, causing damage to millions of hectares of forest resources, evacuation of thousands of people, burning of homes and residential infrastructure, and most importantly, threatening the lives of people. The rapidly increasing risk of fire, due to the recent widespread extreme drought conditions and climate change, calls for new national strategies to prevent and manage wildfires The great potentials of unmanned aerial systems (UASs) have not yet been fully utilized in this domain due to the lack of holistic, resilient, flexible, and cost-effective monitoring protocols.

In this project, we develop human-in-the-loop UAS-based fire management strategies to utilize unmanned aerial vehicles (UAVs) in the best and safest way to assist the first responders during the fire detection, management and evacuation stages. The objective of this proposal is to develop scientific and engineering methods for utilization of a network of low-cost and small unmanned vehicles along with ground vehicles during different stages of fire management operations including (i) early detection of fire in remote and forest areas using autonomous UAVs, (ii) fast active geo-mapping of fire heat map on flying drones, (iii) real-time video streaming of fire spread, (iv) finding optimal evacuation paths using autonomous UAVs to guide the ground vehicles and firefighters for fast and safe evacuation, and v) damage assessment of the impacted areas.

The team is uniquely positioned to carry out this project from both technical and experimental aspects. Noting the high incidence rate of wildfires in the Southwest, forest fire management is a critical concern in this region. The NAU team has established an ongoing collaboration with the US Forest Service in Arizona and performed multiple field tests during the prescribed fires to collect multiple datasets. We have made agreements to continue these tests during prescribed fires and managed wild-fires at several sites in NAU Centennial Forest, Kaibab National Forest, and Coconino National Forest. PI Watts is the UAS coordinator for the DoD's Wildland Fire Science Initiative Incident Resource Management Team and also the UAS lead of the Fire and Smoke Model Evaluation Experiment (FASMEE), which is the largest-of-its-kind nationwide campaign to conduct coordinated research on large prescribed fires. These fires will be utilized to test and evaluate the performance of our developed techniques. We also collaborate with Tall Timbers Research Station and Land Conservancy ('TTRS') to perform UAS-based tests during their fires.

Intellectual Merit: This project advances the frontier of wildfire management by: (i) Investigating and developing an innovative drone-based forest fire detection and monitoring technology for rapid intervention in hard-to-access areas and minimal human involvement to protect fire fighter lives; (ii) Developing new onboard low computation fire modeling techniques to offer a fast fire mapping using drones, (iii) developing a human-in-the-loop task allocation and coordination mechanism to optimize the operation of UAV networks based on the human feedback, and (iv) developing a reasoning-based path planning mechanism where the UAVs identify the fastest and safest evacuation roads for firefighters and fire-trucks in a highly dynamic and uncertain dangerous zone.

Team members:

Dr. Fatemeh Afghah, Associate Professor, School of informatics, Computing and Cyber Systems, NAU
Dr. Abolfazl Razi, Assistant Professor, School of informatics, Computing and Cyber Systems, NAU
Dr. Peter Fulé, Professor, School of Forestry, NAU
Dr. Kyriakos Vamvoudakis, Associate Professor, School of Aerospace Engineering, Georgia Institute of Technology
Dr. Janice Coen, Project Scientist, National Center for Atmospheric Research
Dr. Adam Watts, Associate Research Professor, Desert Research Institute