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Using unmanned aerial vehicles to assist prescribed fires and detect rekindles in wildfire management

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Abstract

Forests are increasingly susceptible to wildfires due to land abandonment, fragmentation, lack of forest management, and agricultural burns. The impacts of climate change, with longer heat waves and the extension of the summer season, creates the conditions for catastrophic wildfire seasons in many countries. The drivers that increase wildfire risk are simultaneously related to vegetation, meteorology, and population (Mateus & Fernandes, 2014; Rego & Colaço, 2013). Improving tools and methods within the fire management cycle will reduce potential upcoming consequences. FoCor project focuses on the prevention, detection and mop-up phases of this cycle. Our main goal is to develop an automatic UAV based system to support prescribed fires (prevention), and detection of rekindles in the mop-up of forest fires. For both missions, we will have UAVs able to carry different cameras with different wavelengths, and/or an ignition gun to ignite fire. The mission control software will enable operators to choose the different operating modes, to delimit the area of operation, and to configure and control the mission. For prescribed fires, area coverage and analysis, ignition, and fire surveillance will be enabled. FoCor proposes a pipeline for processing RGB images to detect presence of hotspots/flame using a deep learning algorithm. The developed detector is based on a Mask R-CNN implementation that showed good accuracy with a precision of 0.92 and a recall of 0.60, for the real aerial images. While the precision value is very positive the of recall was affected by a few false negatives, such as images with a lot of smoke and with small-sized fires. The detector was run at 3.5 frames per second that showed to be enough for the desired application. We are currently expanding the dataset with multispectral images to test what are the better spectral ranges for fire detection. The UAV together with the mission control software becomes a fundamental tool to help prescribed fire personnel to successfully manage the fire during its full life cycle, preventing and alerting for possible fire projections. Simultaneously the detection of hotspots during mop-up activities, particularly in large wildfire perimeters, will allow a more efficient rekindle detection, giving support to the manual crews decreasing their physical fatigue and the number of suppression resources.

Keywords: Wildfires; UAV; Rekindles

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