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PYRSAT – PREVENTION AND RESPONSE TO WILD FIRES WITH AN INTELLIGENT EARTH OBSERVATION CUBESAT

Abstract

Forest fires are a pervasive and serious problem worldwide. Besides loss of life and extensive environmental damage, fires also result in substantial economic losses, not to mention property damage, injuries, displacements and hardships experienced by the affected citizens.

Missions such as MODIS and SPOT VEGETATION have proven multispectral and hyperspectral Earth observation to be of great use for fire-related applications, providing rich information in a wide range of the electromagnetic spectrum. At the same time, Cubesats are starting to be used in numerous low-cost Earth observation applications.

However, the usual size of hyperspectral sensors, together with the vast amount of information to be downloaded and the downlink limitations of nanosatellites normally restrict this capability to larger and more costly satellites. Furthermore, the large data volumes require high-performance antennae on ground. Highly skilled image processing experts are also required to process the images in order to extract useful information products for end users. All these requirements limit the reach of the technology to a reduced number of users.

This project proposes a hyperspectral 3U CubeSat space mission for low-cost, direct-to-ground applications. The main novelties of the proposed mission are the full use of low-cost, commercially available COTS components for the CubeSat subsystems, the use of open source tools and readily available single-board computing platforms and the on-board autonomous generation of the mission final data product. The proposed satellite can be built for under $100 000.

The hyperspectral images will be autonomously pre-processed and classified on-board using Machine Learning algorithms. The final product will be compressed and georeferenced vegetation fire risk and burnt area maps to be directly delivered to users on the ground. These maps will acquire the form of a GIS layer in order to be directly integrated with other geographic information. This can be of special interest to specific key locations such as hospitals, schools or airports, or important corridors, such as railways, major roads or power lines.

Used in combination with other services such as the European Forest Fire Information System (EFFIS) or the Advanced Fire Information System (AFIS), the system could considerably reduce the extent and consequences of forest fires.