Proposed sub-session: 2.1 fire management systems

Fire detection, fuel model estimation and fire propagation estimation/visualization for the protection of Cultural Heritage

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FIRESENSE (Fire Detection and Management through a Multi-Sensor Network for the Protection of Cultural Heritage Areas from the Risk of Fire and Extreme Weather Conditions) is a project co-funded by EU FP7 Environment that aims to develop a multi-sensor early warning system to remotely monitor areas of archaeological and cultural interest from the risk of fire and extreme weather conditions. It will combine different sensing technologies, i.e. wireless networks of temperature/humidity sensors, optical and infrared cameras, as well as local weather stations. Pilot deployments will be made in five cultural heritage sites in Greece, Turkey, Italy and Tunisia.

Another goal is the estimation of the propagation direction and speed in order to help forest fire management. FIRESENSE will provide real-time information about the evolution of fire using wireless sensor network data and estimate the propagation of the fire based on the fuel model of the area and other important parameters such as wind speed, slope, and aspect of the ground surface.

The fire propagation data are visualized on a user-friendly 3D-GIS environment. Some of the supported features are: a) Display of sensor locations and regions of interest in the cultural sites b) Interactive selection of some parameters (e.g. ignition point, humidity parameters) c) Automatic acquisition of weather data from onsite or nearby weather stations d) 2-D or 3-D visualization of fire propagation estimation output (ignition time and flame length).

Commercial satellite images have reached a fairly high spatial resolution which allows more powerful textural analyses and more detailed description of soil surface. This improves the capacity to recognize and classify land uses, the amount and typology of vegetation and other potential sources of fuel for wildfires. It also reduced substantially the time and costs for updating vegetation and fuel distribution. Ground truth is also required especially for developing and testing of new image analysis algorithms. Measurements of the main fuel component are required and are usually destructive and costly, sometimes even unacceptable, especially if biodiversity or soil are threatened or in protected sites. Therefore, a sampling technique has been developed for single or groups of plants. Sub-volumes, which are characterized by the same type of fuel component and vegetation mix, are sampled over small known volumes. Volumetric mass densities are transformed into biomass and fuel components as mass per unit of surface.

Very-High-resolution satellite images (QuickBird) are ortho-rectified with a detailed DTM of the study area and analyzed: recognition of lines of water flux convergence, pathways, usually unrecorded on official maps, vegetation patchiness, connectivity lines for fire to spread more easily, and connectivity lines for water fluxes during rainstorms will be among the results.

Another approach that we use for vegetation classification is multi-band SVM classification approach. Each band characterizes/emphasizes a particular type of information such as textural, spatial, local and spectral information. The combination of these features improves significantly the accuracy of the results. We are currently investigating the registration between the ortho-rectified images and a ground truth map from the covered area in order to validate and improve the classification results.

It is expected that the characterization of these areas and the accumulation of temporal series of vegetation/fuel distribution will serve not just for fire prevention and management but also for soil conservation and soil erosion control.

Presentation format: poster

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