State Estimation of Forest condition in the Event of Fire, Based on Satellite Image Processing

Shepeliev Oleksandr[0000-0002-6258-3446], Bilova Mariia[0000-0001-7002-4698]

National Technical University «Kharkiv Polytechnic Institute»,
Pushkinska str., 79/2, Kharkiv, Ukraine
zirgus1@gmail.com, missalchem@gmail.com

Abstract. The relevancy of the work connected with the need to improve existing software designed to assess the condition of the forest in the event of a fire. The task of responding quickly and assessing the state of forests in recent years has become a very important factor, since the economic and environmental impacts of forests can cause irreparable damage to the state and the planet. Geoinformation systems (GIS) can be used to achieve this goal.
Most Earth observation applications involve converting multi-channel image data into thematic maps using classification procedures. This research is an attempt to automate the process of extracting feature boundaries from satellite imagery.

Keywords: Computer vision, GIS, Feature, Extraction, Imagery, Segmentation

One of the problems occurred with state estimation of forest condition in the event of fire is connected with the fact that existing GIS do not foresee or have only a partial integration of satellite image processing systems to assess the state of the forest. Such systems should provide statistics on the fire, and give an opportunity to calculate a group of estimates for a detailed justification of the strategy of forest fires. In this case a computer vision (CV) can be used. CV is the transformation of data from a photo or video format into a solution to a task or a new presentation. A new view may mean converting a color image to an image in grayscale, or removing camera movement from the image sequence.

Satellite image processing requires converting data into thematic maps. In this case edge detection produces global edges in an image. This means that there is no object definition attached to the edges. Therefore, it is required to somehow define the objects first and then obtain edges from them. This can be achieved by using image segmentation [1]. The main goal of image segmentation is to divide an image into parts that have a strong correlation with objects or areas of the real world depicted in the initial image. Thus, image segmentation divides the whole image into homogeneous regions based on the color information. The regions can be loosely defined as representatives of objects present in the image. Feature space analysis is used extensively in image understanding tasks [2]. Comaniciu and Meer [3] provide

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an efficient segmentation algorithm that is based on feature space analysis and relies on the mean-shift algorithm to robustly determine the cluster means. A feature space is a space of feature vectors. These features can be object descriptors or patterns in case of an image.

One of the methods is crust extraction from the Delaunay triangulation. The vertices of the Voronoi diagram approximate the medial axis of a set points sampled along the boundary of an object. In this research, vertices of the Voronoi diagram of the sample points were inserted into the original set of sample points and a new Delaunay triangulation was computed. The circumcircles of this new triangulation approximate empty circles between the original boundary of the object and its skeleton. Thus, any Delaunay edge is connecting a pair of the original sample points in the new triangulation is a part of the border.

Further, Gold's study [4] leads to a One-step border (crust) extraction algorithm. In a Delaunay triangulation, each Delaunay edge is adjacent to two triangles and the circumcircles of these triangles are the Voronoi vertices. A Voronoi edge connecting these two circumcenters is the dual edge to the Delaunay edge considered here. According to Gold [4], a Delaunay edge is a part of the border if it has a circle passing through its extremities that does not contain any Voronoi vertex in its interior.

To summarize, analysed methods showed a promising machinery to extract meaningful features from remote sensing image data. Advantage of Delaunay triangulation method is that the results are not just a series of connected pixels or sets of line segments, rather they offer spatial information and connectivity for free. Solution allows to read colour images and perform segmentation on them. Identified features can be sampled for boundary that is used to compute the Voronoi and Delaunay graph. The boundary and skeleton extraction algorithm then extract the required features.

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