An interactive mapping tool for visualizing lacunarity of laser scanned point clouds

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Lacunarity, a measure of the spatial distribution of the empty space in a certain model or real space over large spatial scales, is found to be a useful descriptive quantity in many fields using imagery, including, among others, geology, dentistry, neurology. Its application in ecology was suggested more than 20 years ago. The main problem of its application was the lack of appropriate high resolution data. Nowadays, full-waveform laser scanning, also known as FWF LiDAR, provides the tool for mapping the vegetation in unprecedented details and accuracy. Consequently, the lacunarity concept can be revitalized, in order to study the structure of the vegetation in this sense as well.

Calculation of lacunarity, even if it is done in two dimensions (2D), is still has its problems: on one hand it is a number-crunching procedure, on the other hand, it produces 4D results: at each 3D point it returns a set of data that are function of scale. These data sets are difficult to visualize, to evaluate, and to compare.

In order to solve this problem, an interactive mapping tool has been conceptualized that is designed to manipulate and visualize the data, lets the user set parameters for best visualization or comparison results.

The system is able to load large amounts of data, visualize them as lacunarity curves, or map view as horizontal slices or in 3D point clouds coloured according to the user's choice. Lacunarity maps are presented as a series of (usually) horizontal profiles, e.g. rasters, which cells contain color-mapped values of selected lacunarity of the point cloud. As lacunarity is usually analysed in a series of successive windows sizes, the tool can show a series of rasters with sequentially animated lacunarity maps calculated for various window sizes. A very fast switching of colour schemes is possible to facilitate rapid visual feedback to better understand underlying data patterns exposed by lacunarity functions. In the comparison mode, two sites (or two areas of the same site) can be visualized using the same settings.

Basic output/export operations are supported, as well as text and numerical format to utilize the calculated lacunarity values. Furthermore, the system is able to export data to standard georeferenced image and GIS formats enabling further processing and integration with other observational data, like GPS coordinates of forest damages, human influence (illegal tree cut, waste dumps), abundance of species or other ecological indicators.

The use of the system is easy to learn and, via the export functionality, it provides interoperability with most of the GIS and other software tools applied in spatial ecological applications.

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