



Experiments with unsupervised analysis of lacunarity curves of LiDAR point clouds in forested areas

Adam Kania^{1,3} and Balázs Székely²

¹definity Adam Kania, Wrocław, Poland (kania@definity.pl)

²Department of Geophysics and Space Science, ELTE Eötvös Loránd University, Budapest, Hungary (balazs.szekely@ttk.elte.hu)

³definity sp. z o.o., Wrocław, Poland

Calculation of lacunarity of voxelized point clouds has been proven to be an effective characterization of the structure of empty spaces in a feature space. The natural and planted forests show various horizontal and mosaic structures in terms of distribution of void spaces; illumination, wind characteristics, predator-prey visibility, and other ecological conditions are influenced by the spatial distribution of features and intercalated volumes.

The lacunarity functions however define a 4-D dataset even if the input voxels are considered as layers of pixels. Furthermore, the large orders of magnitudes that the lacunarity values may vary in, causes difficulties in the evaluation. To overcome these problems, effective user-friendly methods are required.

The input point cloud is voxelized/rasterized, and the raster data (set of 2D rasters or volumetric 3D raster) are the intermediate preprocessed input data. The calculation of the lacunarity functions is done using sets of defined window sizes and steps (step is a shift of the calculation windows over the raster in x-y direction). The results are available as a set of raster layers that can be viewed and analysed directly: in this project we use an interactive tool to calculate and present results on an interactive map viewer.

As the lacunarity calculation is very time-consuming, special attention has been paid to optimize the computation, speeding up the generation of the output by orders of magnitudes. The intermediate multivariate dataset is then stored for further processing or visualization. Selected raw lacunarity values/curves or extracted components can be used for classification/regression using provided forestry-related reference data. The user can run a number of dimensionality-reduction algorithms to extract significant components of the lacunarity curves (PCA, non-negative factorization, SVD, ICA) and analyse resulting components (overlaid on a raster map). These derivatives of lacunarity values and components are visualized by mapping to RGB channels, applying a color-palette, or rendered using mixtures of colors from multiple-color palettes. The user can also generate a short animated video are generated on-the-fly and can be viewed interactively. A web browser connection is also in development.

