Simultaneous colour visualizations of multiple ALS point cloud attributes for land cover and vegetation analysis

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This poster participates in OSP Outstanding Student Poster Contest

The state of the art

Point clouds can be viewed usind 3D rendering in planar, profile or 3D perspective. However, viewing software typically only allow visualization by attributes directly obtained during the measurement (elevation, amplitude, echo number) or standard point classification. Creating "photorealistic" point clouds by assigning colour values to each point from imagery works in an urban context but not in vegetation: Canopy points all get very similar colours (green) and sub-canopy points don´t get any colour assigned from aerial images at all.

The problem

Points belonging to a wide range of different objects would have exactly the same colour if they are similar in one particular LIDAR variable. If most of the points have the same colour, screen clutter limits the size of the scene that can be loaded and the perspective of the view is difficult to see. Different point classes are hardly possible to detect in context if only a very small area can be viewed at a time. Point cloud attribute interpretation is not intuitive: only very experienced users can identify objects or discriminate between different kinds of vegetation.

The objective

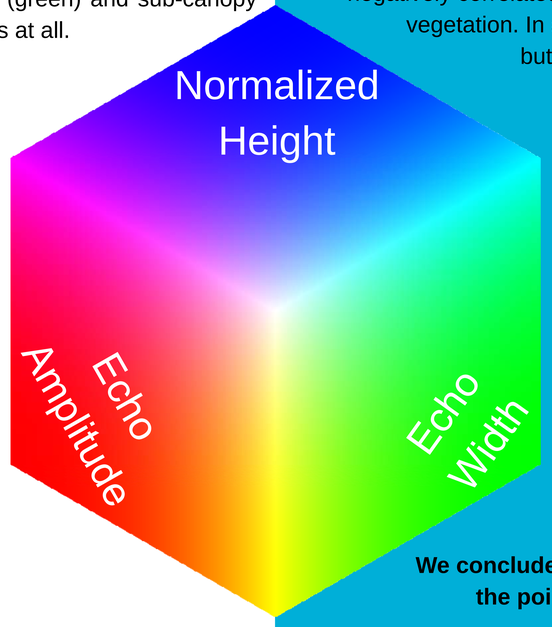
Intuitive point cloud visualization for multiple attributes

It should be able to

- Work with any point attribute defined by the user
- Show as many attributes as possible simultaneously
- Remain independent from the viewing software
- Keep input values and rely on straightforward and transferable calculations.
- Colours should be intuitive to understand and easy to discriminate
- Colours should support perception of height and depth.

The solution

Instead of a single colourmap for one attribute, any combination of three point attributes can be mapped to each of the three primary colours. The ASPRS .las format is used, and a Python script of Opals software modules rescales the attribute values to the full range of the .las format Red, Green and Blue channels.



Results

This visualization scheme exploits our intuitive understanding of the RGB colour scheme for dealing with three arbitrary attributes simultaneously. Input attribute values are not modified and the colour parameters are written to the file, conserving independence from viewing software. Colour scaling is linear, with the option of histogram equalization. In case of the scheme we used, the variables are are often negatively correlated, resulting in a wide range of colours, with green mainly for vegetation. In a perspective view, vegetation points overlap terrain points, but they can be discriminated based on their colour, creating a sense of depth. High points with respect to the terrain are more blue, creating an intuitive sense of elevation.

Object	Amplitude	Echo Width	Normalized Height	Resulting Colour
Asphalt	Low	Low	Low	Black or brown
Bare Soil Mown grass	High	Low	Low	Red
Tall grass, Shrubs	Low	High	Low	Green
Coniferous trees (leaf off)	High	Medium	High	Purple
Deciduous trees (leaf off)	Low	High	High	Blue-Green
Power Lines	Low	Low	High	Blue

We conclude that RGB visualization of ALS point attributes makes the point cloud human readable for vegetation analysis