Efficient processing of dense point clouds in GRASS GIS

at US-IALE 2016 Annual Meeting (lab presentation at CGA)

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available at

`wenzeslaus.github.io/grass-lidar-talks`

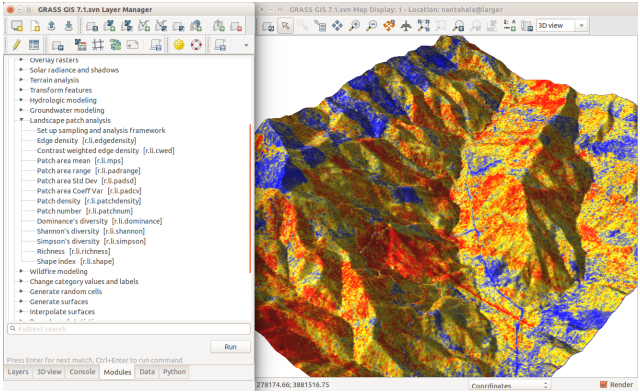
Free, libre and open source

- re-usable
- review
- usable
  - by other people
  - by future myself
- longevity
  - learn now, use forever
  - GRASS GIS over 30 years of development

Open Science Logo, Greg Emmerich, CC-BY-SA-2.0

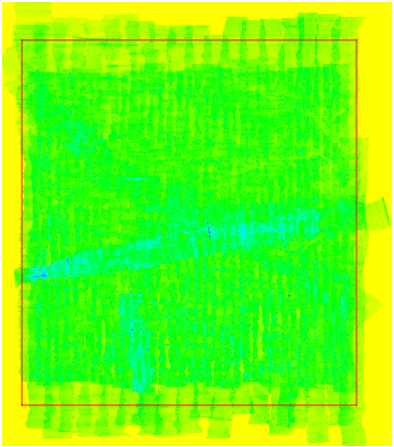
GRASS GIS

- universal scientific and processing platform
  - GUI, CLI, API
  - from small laptops to supercomputers
- lidar processing included
- data size and type challenges



Binning points to raster

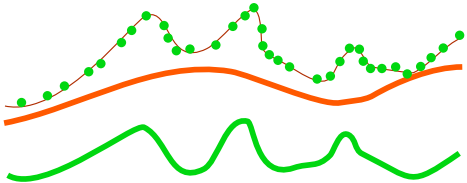
- *r.in.lidar* (import and analysis)
- statistics of point counts, height and intensity
  - n, min, max, sum
  - mean, range, skewness, ...
- filter points by
  - range of Z, return, class, ...
- multiple input files at once
- subsequent raster-based processing



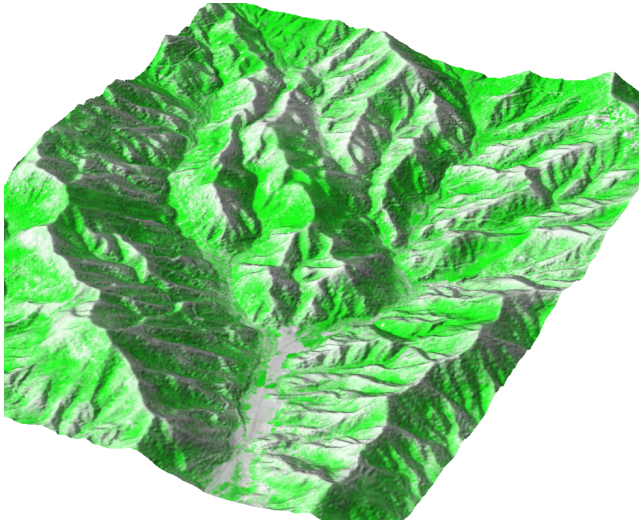
r.in.lidar, 578 million points in 90 files to 1882 × 1651 cells using 50MiB in 2 min

Height above a surface

- new feature in *r.in.lidar*



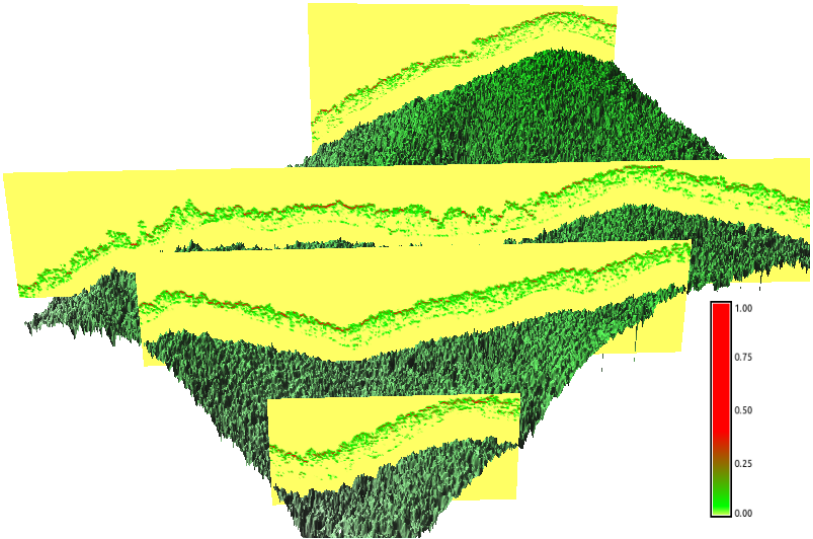
9 min, 480 MiB RAM, 2.7 GHz, SSD, Ubuntu
578 million points in 90 files



Binning points to 3D raster

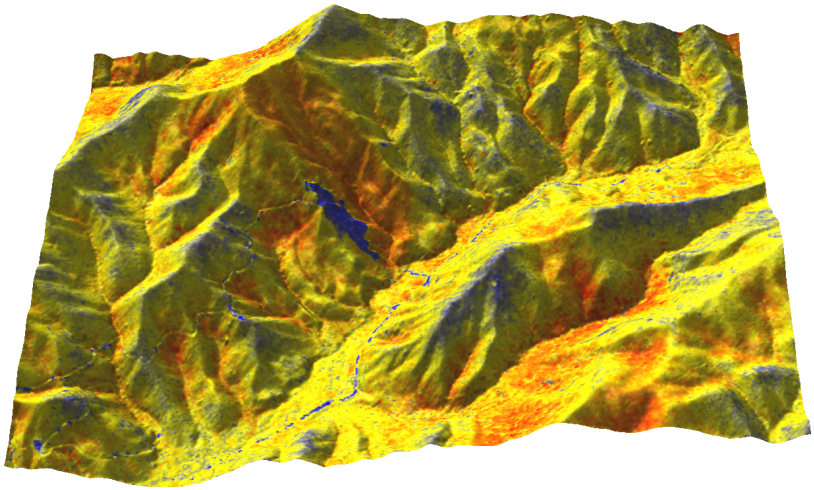
- *r3.in.lidar*
- proportional count
  - count per 3D cell relative to the count per vertical column
- intensity can be used instead of count

under development



Decimation, interpolation

- *v.in.lidar*
- filtering same as in *r.in.lidar*
- followed by interpolation (costly)
- decimation
  - fast count-based as effective as more advanced decimation



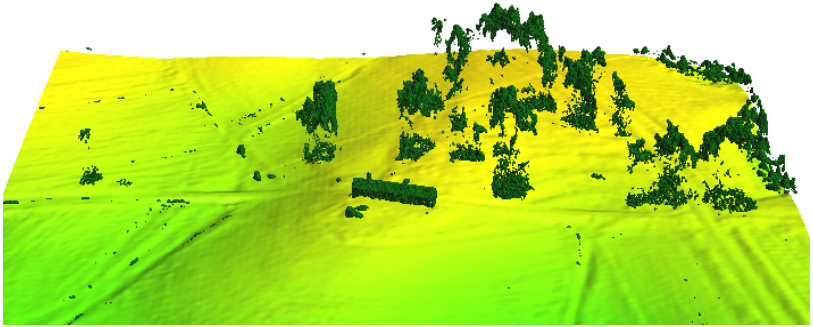
range from *r.in.lidar* on ground obtained from *v.in.lidar* followed by *v.surf.rst*

Large point clouds

- trade-offs: a lot of memory (RAM) or slow
- 64bit version
- point cloud specific optimizations
  - no IDs stored
  - no attribute table
  - no topology created

Ground detection

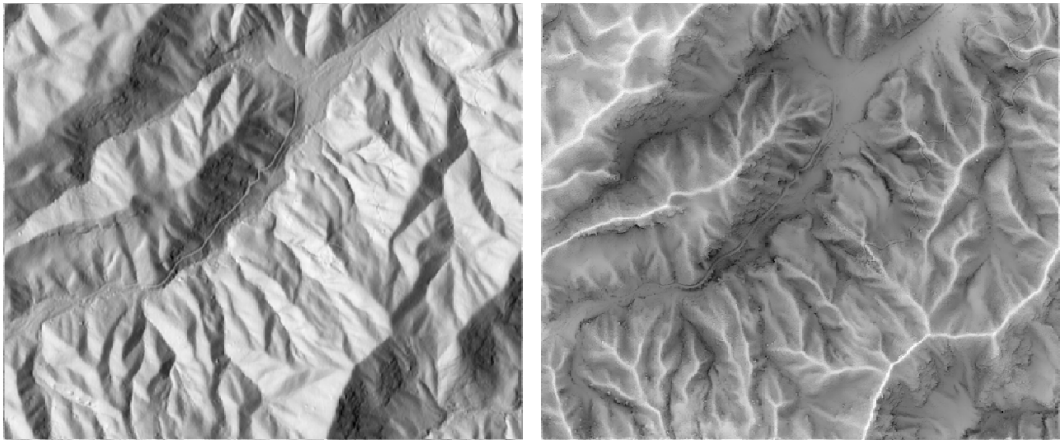
- *v.lidar.edgedetection*, *v.lidar.growing*, *v.lidar.correction*
  - uses returns
- *v.lidar.mcc*
  - multiscale curvature based classification algorithm[1]



[1] Evans, J. S. & Hudak, A. T. 2007: A Multiscale Curvature Algorithm for Classifying Discrete Return LiDAR in Forested Environments.

Sky-view factor

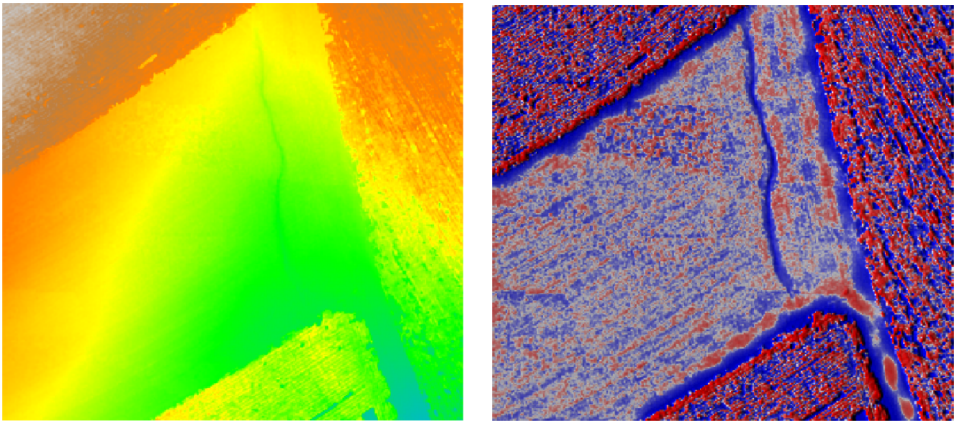
- *r.skyview* (percentage of visible sky)



comparison of shaded relief and sky-view factor

Local relief model (LRM)

- *r.local.relief* (micro-topography, features other than trend)

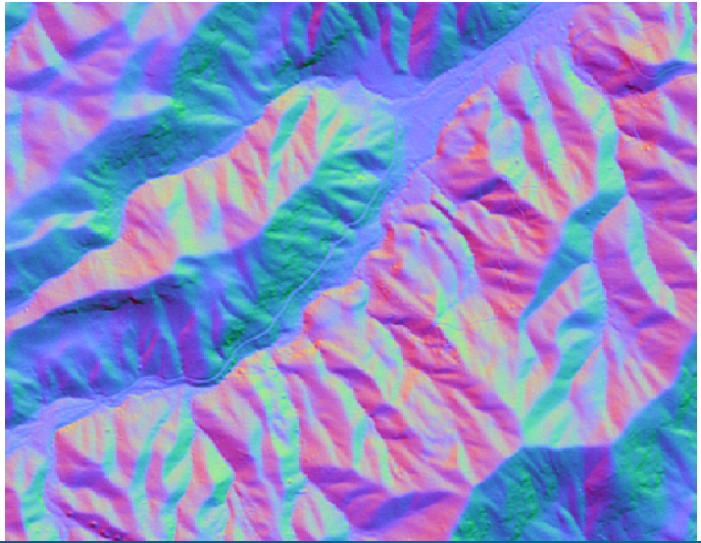


30-60cm wide, 30cm deep, 60m long gully (resolution 30cm)

Analytical shading

- *r.shaded.pca*
- relief shades from various directions
- PCA of shades
- combined into RGB composition

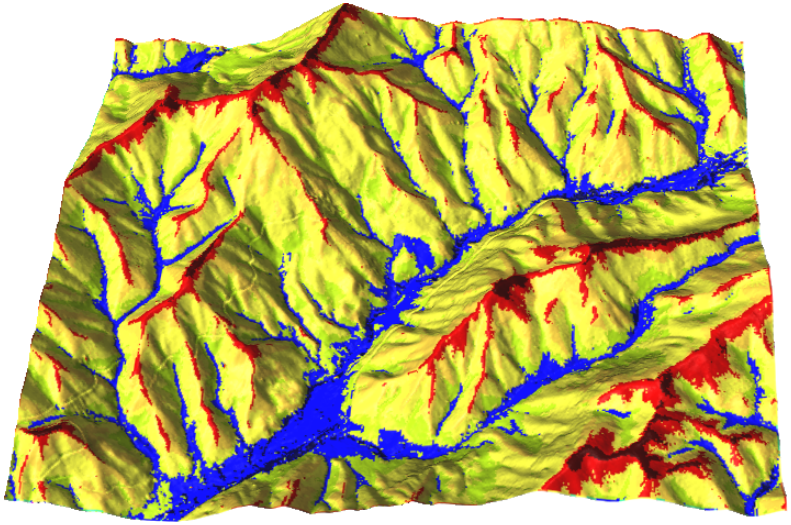
Devereux, B. J., Amable, G. S., & Crow, P. P. (2008). Visualisation of LiDAR terrain models for archaeological feature detection. Antiquity, 82(316), 470-479.



Landforms

- *r.geomorphon*
- geomorphons - a new approach to classification of landform[1]

[1] Jasiewicz, J., Stepinski, T., 2013, Geomorphons - a pattern recognition approach to classification and mapping of landforms, Geomorphology



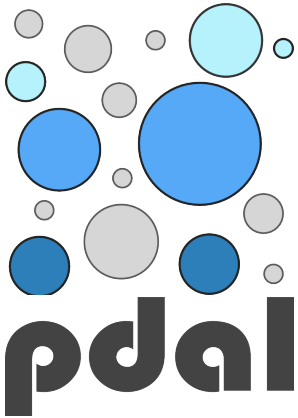
Integration with PDAL

PDAL

- formats besides LAS/LAZ
- algorithms, filters, decimations

Experimental integration

- *v.in.pdal*
- reprojection during import
- ground filter
- compute height as a difference from ground



Acknowledgements

Software: GRASS GIS

Presented functionality is work done by Vaclav Petras, Markus Metz, and the GRASS development team. Thanks to users for feedback and testing, especially to Doug Newcomb, Markus Neteler, Laura Belica, and William Hargrove.

Datasets

Data for GIS595/MEA792: UAV/lidar Data Analytics course

Nantahala NF, NC: Forest Leaf Structure, Terrain and Hydrophysiology: Lidar data acquisition and processing completed by the National Center for Airborne Laser Mapping (NCALM). NCALM funding provided by NSF's Division of Earth Sciences, Instrumentation and Facilities Program. EAR-1043051. Obtained from OpenTopography. `http://dx.doi.org/10.5069/G9HT2M76`

Summary

- rasterize early
- make use of existing methods for raster and vector processing
- 3D rasters, PDAL integration
- the plan for next 30 years driven by users – grass-user mailing list

Get GRASS GIS 7.1 development version at
`grass.osgeo.org/download`

Slides available at
`wenzeslaus.github.io/grass-lidar-talks`