FOR 474: Forest Inventory

LiDAR for DEMs
- The Main Principal
- Common Methods
- Limitations

Readings:
See Website

Lidar DEMs: Understanding the Returns

The laser pulse travel can travel through trees before hitting the ground. Secondary returns might not be from the ground.

Non ground objects could include:
- Shrubs
- Ladder Fuels
- Seedlings
- Buildings
- Wildlife
- TANKS!!!

The different vertical structure of deciduous and coniferous forests can be highlighted by the returns.
In modern lidar systems, 1-9 returns are possible depending on sensor. The returns from one pulse are not in the same horizontal or vertical location.

The Intensity is an output of all Lidar acquisitions. Intensity is an 8-bit scale (0-255) value. Adaptive Gain (values are not calibrated).

The Intensity is different for hardwood and coniferous forests.
To generate a DEM from Lidar we identify what returns are associated with the ground reflections and delete all the rest.

Source: Jeffrey Evans USFS RMRS-Moscow
Lidar DEMs: The General Principal

Many different methods exist to identify the ground from non-ground returns. They are called “filtering” methods.

The challenge in forestry is that most of those filtering methods don’t cope well with non-ground objects beneath the first returns:

Shrubs, seedlings, wildlife, ladder fuels, coarse woody debris, slash, etc, etc, etc.

Source: Campbell 2007

This process is repeated until the surface stops changing:

Source: Jeffrey Evans USFS RMRS-Moscow

Lidar DEMs: The General Principal

Source: Jeffrey Evans USFS RMRS-Moscow
Lidar DEMs: The General Principal

Lidar DEMs: The Block Minimum Method

Block Minimum:
The Lidar points are divided into grid cells and the lowest point is chosen as the ground.
• Easy to Implement
• Does not work well in high canopy cover forests

Lidar DEMs: The Block Minimum Method

Block Minimum:
When canopy cover / biomass is high there may be very few ground returns in your “bin”

You might need select lowest point in 5x5m area instead of 1x1 m areas

If the bin is too large you might miss topographic features!!!
In this case a Block Minimum 6 x 6 meter bin size was still not enough to “see” enough ground returns.

Source: Jeffrey Evans USFS RMRS-Moscow

In general, lock Minimum has problems with shrub and understory or when canopy cover is high.

From Zang et al. (2000)

Lidar DEMs: The Slope Threshold Method

**Slope Threshold:**
Starting at the 1st point, all points higher than a slope from the first point are deleted.
Then repeat at the next point.
Problems where features have abrupt edges: buildings/cliffs

Lidar DEMs: The Slope Threshold Method

Building Footprint

Problems in high canopy cover

From Vosselman, (2000)

What is a curvature?
- An aberration from the ground
- A point higher than the surrounding points
- Not an edge!!!

Curvatures

Edges

Lidar DEMs: The Progressive Curvature Filter

We have curvatures in Forestry.

This method is widely used by the USFS and other agencies (ARS, BLM, etc).

Source: Jeffrey Evans USFS RMRS-Moscow
Lidar DEMs: The Progressive Curvature Filter

We have curvatures in Forestry.

As the filter does each pass, the curvatures in the forest becomes less distinct

Source: Jeffrey Evans USFS RMRS-Moscow

Lidar DEMs: The Progressive Curvature Filter

We have curvatures in Forestry.

This method repeats until a "smooth" surface remains

Source: Jeffrey Evans USFS RMRS-Moscow

Lidar DEMs: The Progressive Curvature Filter

DEM produced in high biomass area.

Source: Jeffrey Evans USFS RMRS-Moscow
Lidar DEMs: Common Errors - Data Gaps

Data Gaps:
If too few ground returns are present the ground surface may miss "real" topographic features.
Data Gaps:

Similar problems can occur when the lowest return is from elevated vegetation.