Impact of Forest Management Activities on Forest Aesthetics Using Photogrammetric Point Clouds

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Background

- 1970s - public increasingly involved in clearcuttings.
- National Environmental Protection Act (1970)
- National Forest Management Act (1976)
Landscape Aesthetics

- A philosophical concept
- Socrates and Plato
- Baumgarten -1750 coined the term aesthetics
- “Our desire to see, live in, and visit beautiful places” (Gobster et al. 2007)
Research Question and Objectives

How does forest aesthetics vary with the harvest layout?

Objectives

1. Assess the utility of photogrammetric point clouds created with UAS to visually model timber harvests.
2. Evaluate the impact of harvest strategies on the forest aesthetic.
Study area

- Oregon State University College of Forestry Research Forest
  - stand A: 31.8 ha (78.6 ac)
  - stand B: 3.5 ha (8.5 ac)
- DJI Mavic 2 Pro
  - 20 MP camera
- 634 photos of high-resolution imagery
  - 520 images for stand A
  - 114 images for stand B
- Metashape Photoscan
- Point cloud
  - Stand A: 112,610,309 points
  - Stand B: 41,462,149 points
Harvest layouts

- 15 harvest layouts
- Layouts
  - strips
  - islands
  - contoured cuts
  - clumped and grouped
  - gridded
Points to grids

Ensure true obstruction
Visibility analysis

5 points inside the opening areas
Metrics and Analysis

Variables

- Number of trees
- Area harvested
- Average heights
- Volume (Omule et al. 1987)
- Distribution of matter:
  - 25, 50, 75, 95 quantiles number of points
  - Ratio of quartiles after/before
- Connectivity
- Area visible
  - Critical Area Low
  - Critical Area High

Analysis

Canonical discriminant analysis
Results

- 7063 trees delineated in Stand A and 498 in Stand B
Results

Harvested volume \([m^3]\) in respect with connectivity
Residual height

- Ratio between the height after and before
Distribution of matter

Ratio of quartiles after and before
Global Impact of harvest level: with cc

- Matter (ratio of quartiles)
- Dimensions (height, area, # trees, volume)
- Visibility (low and high)
Global Impact of harvest level: without cc
Global Impact of harvest level

- Canonical variate:
  - Similar for analysis with and without clear cut
    - For stand A without cc only the 1st eigenvector was significant (99% variation)
  - The first canonical variate: >85% variation
  - Second canonical variate: >10% variation
- Matter: 25 and 95, followed by 75 percentile
- Visibility: not significant (high or low)
- Dimensional variables: not significant
Implications

- Evaluating harvest strategies before hand
- Planned harvest layout solve visualization issues: even @90% harvest
- Key into how harvest patterns influence the scenic landscape.
- Moving forward with advancements in technology to visualize active management forestry.
- Public stakeholders
- Social license to operate
Conclusions

- Cost effective UAS point cloud flights
- Forest visualizations with high quality point clouds
- Manipulating point clouds to simulate future management activities.
- Planned harvests ensure maintenance of perceived forest aesthetics


Thank you for your time!