High-resolution lidar from unmanned aerial vehicles for forestry applications

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1. Introduction

- Unmanned aerial vehicles (UAVs) have increased the potential for environmental monitoring
- Lidar remote sensing has improved the characterization of vegetation and topographical attributes of landscapes
- The use of unmanned aerial vehicle (UAV) with a lidar sensor onboard provides unprecedented options for many environmental and forestry applications
- Here we report on an ongoing research project using an UAV lidar acquisition

Objectives

1. Identification of tree seedling with high resolution UAV lidar (see preliminary results)
2. Improvement of fuel estimation within the wildland urban interface
3. Estimating individual tree species and forest growth

2a. Methods

Study area: Two locations on Moscow Mountain:

1. University of Idaho Experimental Forest, Flat Creek unit (**UIEF**)
2. Across a private property within the wildland urban interface (**PP**)

Field observations: 24 forest inventory plots across high, medium, and low biomass. In addition, heights, location, and crown dimensions of 40 seedlings

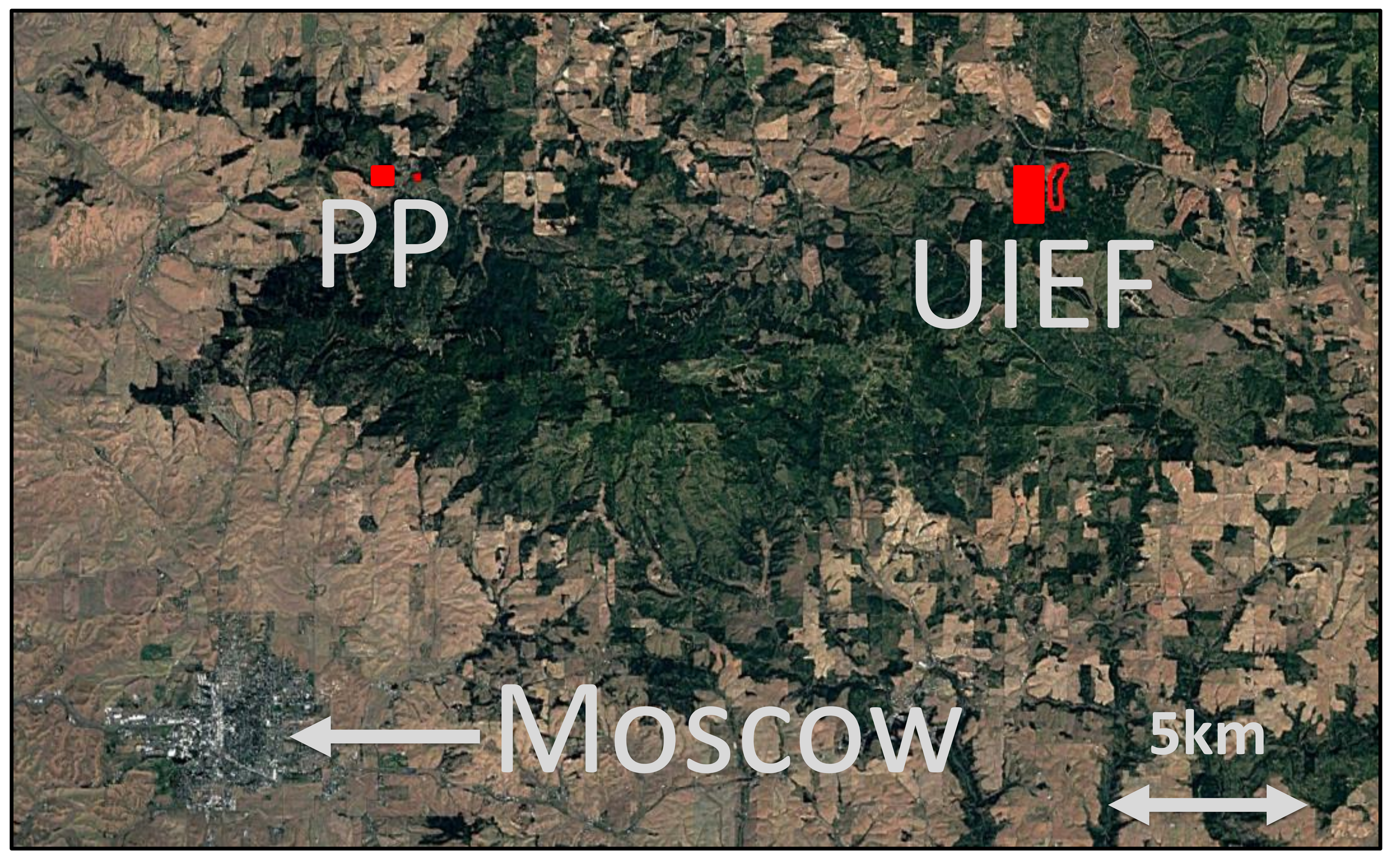

Fig. 1: Locations of UAV lidar acquisitions on Moscow Mountain, northeast of Moscow, ID.

2b. Methods

UAV lidar collection

Equipment (Fig. 2):

- UAV:
  Matrice 600 UAV
- Lidar sensor:
  Velodyne HDL-32E
- Points per second: ~700k
- Accuracy: ± 2 cm

Dataset

- Acquisition date:
  September 2nd, 2017
- Area
  - PP: 20 ha
  - UIEF: 100 ha
- Point density
  ~522 points/m^2 (Fig. 3)

Fig. 2: The Matrice 600 UAV with the Velodyne HDL-32E LIDAR sensor.

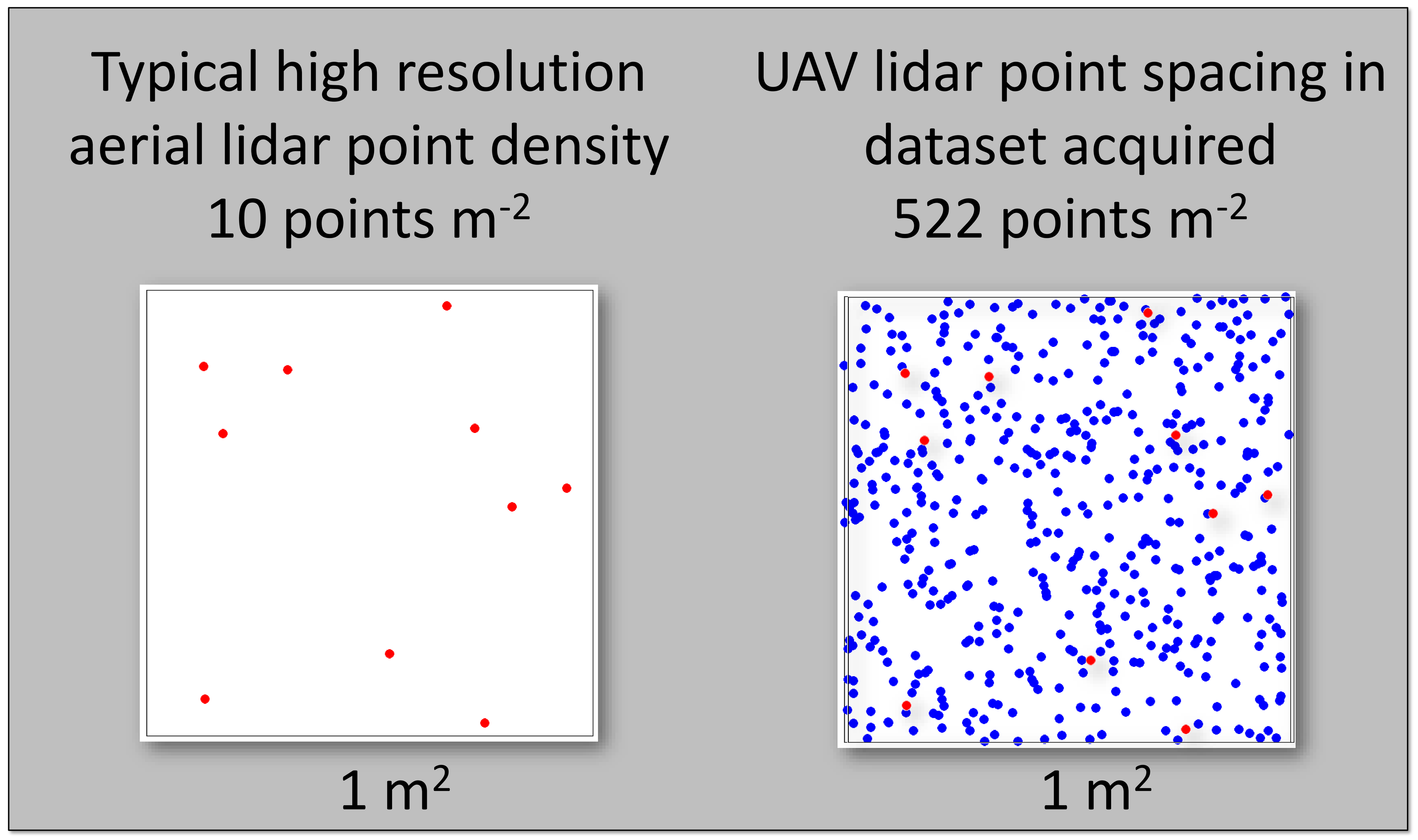

Fig. 3: Illustration of typical aerial lidar point density (left) and UAV lidar point density collected for this study.

3a. Preliminary results I

- Automated detection of seedlings/saplings (trees < 1.2m) from the digital surface model using a local maxima detection algorithm was moderately successful (40% or 16 out of 40 seedlings were correctly identified; figs. 4 & 5).

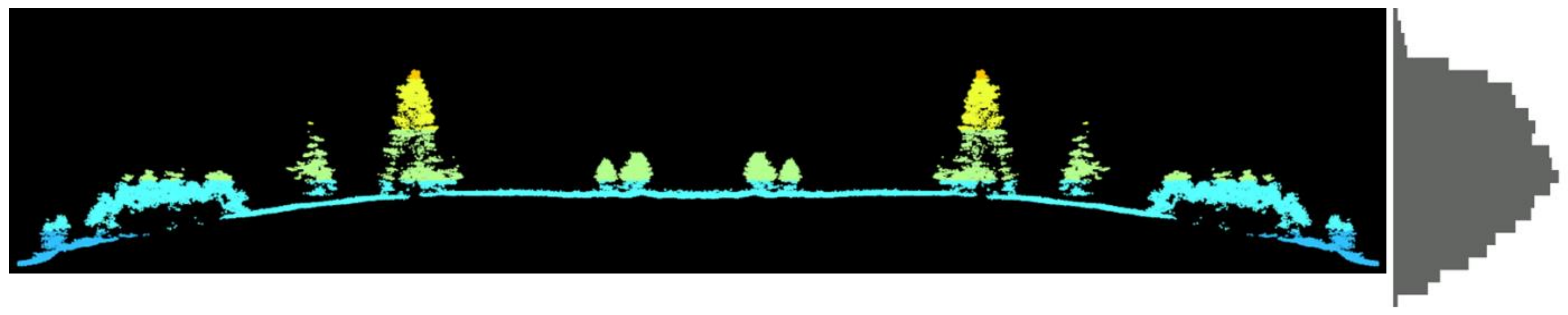

Fig. 4: Example of point cloud profile and histogram from UAV lidar.

3b. Preliminary results II

- The difference in height between the correctly predicted seedlings and their sampled counterparts was ~30cm.

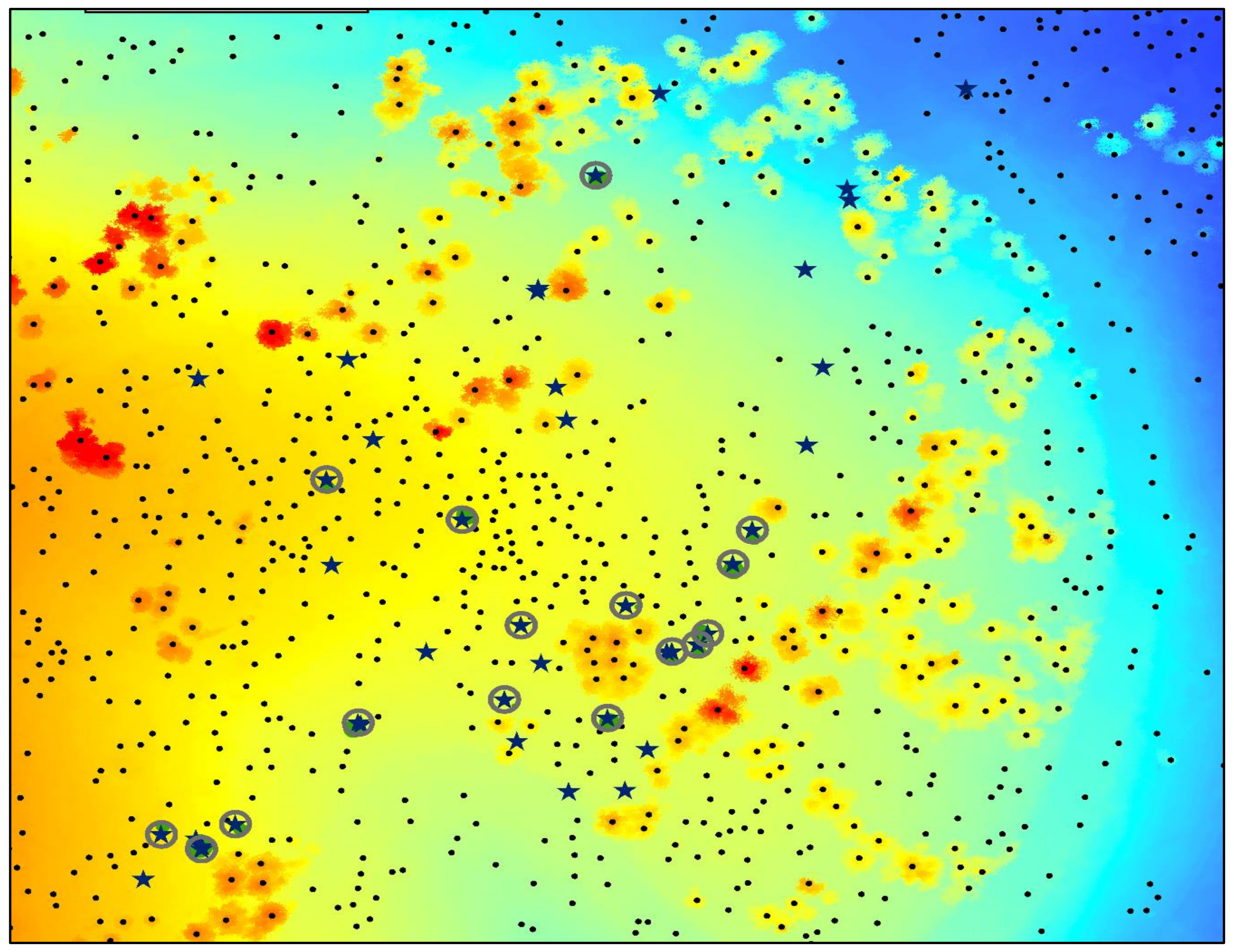

Fig. 5: Comparison of predicted tree locations and sampled tree locations on top of the digital surface model. Field sampled seedling locations are indicated with a star and correctly identified locations with a circle.

4. Next steps

- Run local maxima algorithm on the canopy height model to improve seedling detection rate
- Use the UAV lidar dataset for precise quantification of fuel loads within the UIEF and PP.
- Detection of forest growth and tree species classification (Fig. 6).

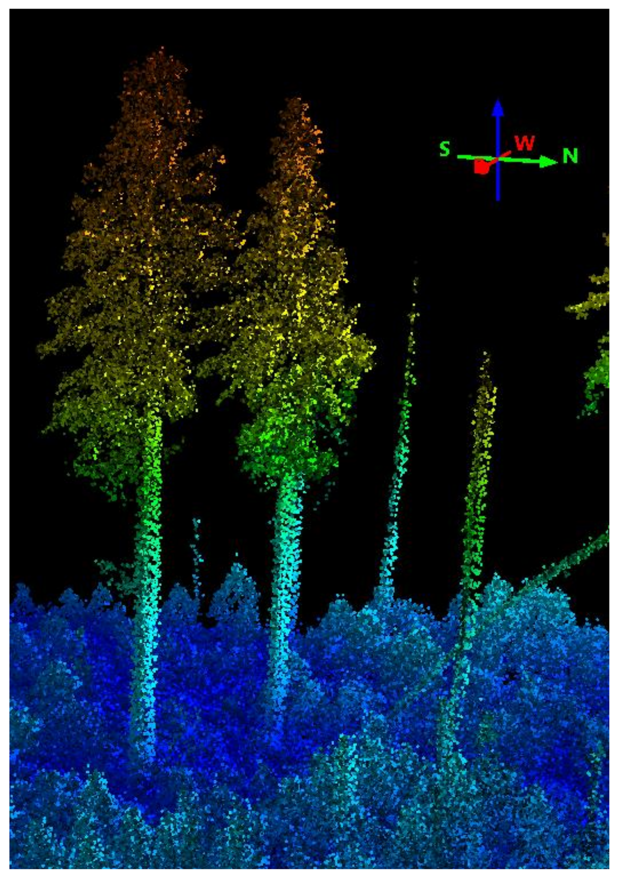

Fig. 6: Illustration of the UAV lidar point cloud.

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