High-resolution lidar from unmanned aerial vehicles for forestry applications

Anthony J. Martinez1*, Arjan J.H. Meddens1, Carlos A. Silva2, Lee A. Vierling1, & Jan U.H. Eitel1

1University of Idaho, Department of Natural Resources and Society, Moscow, ID 83844, USA
2Biosciences Laboratory, NASA Goddard Space Flight Center, Greenbelt, MD 20771, USA

ajmartinez@uidaho.edu

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

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/m² (Fig. 3)

2c. 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).

3a. Preliminary results II

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

3b. Preliminary results II

• 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).

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).

Acknowledgements: This research was supported by the NASA Idaho Space Grant Consortium and the University of Idaho College of Natural Resources. We thank Alta Science & Engineering, Inc. for the data collection.