Urine patch detection using LiDAR and RPAS/UAV produced photogrammetry

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Introduction

In grazed dairy pastures the largest N source for both nitrate leaching and nitrous oxide emissions is urine-N excreted by the animals. Additional application of N on urine patches as fertilizer may increase these losses so adapting N-fertilisation in these areas is necessary. The objective of this study was to examine the use of a tractor mounted LiDAR system to accurately identify and quantify areas affected by excess N, such as urine. Synthetic urine was randomly spot-applied within two 20 m x 20 m blocks. Weekly LiDAR scans were taken for 5 weeks and flights were taken with a remotely piloted aircraft system (RPAS/UAV) for aerial footage of the trial. Mosaics of RGB and NIR images were used to create photogrammetric contour maps. Both approaches (LiDAR & photogrammetry) show no significant difference in the identification and sizing of urine patch cluster.

Experimental System

SICK LMS-511 PRO-HD uses a 905 nm, class 1 laser. Scanning frequency of 25 Hz was selected to provide 0.167° angular resolution. 16 m sampling swatch width. Tractor with the LiDAR unit (A), RTK-GPS (B), and ruggedized laptop (C).

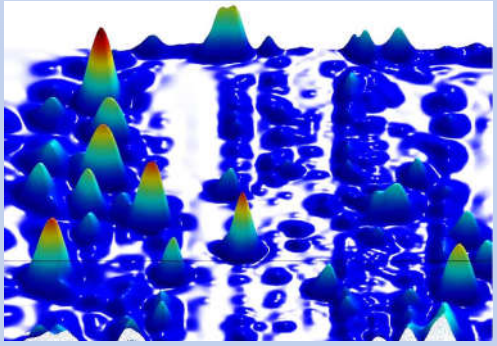
LIDAR

Tractor with LIDAR, GPS, and ruggedized laptop

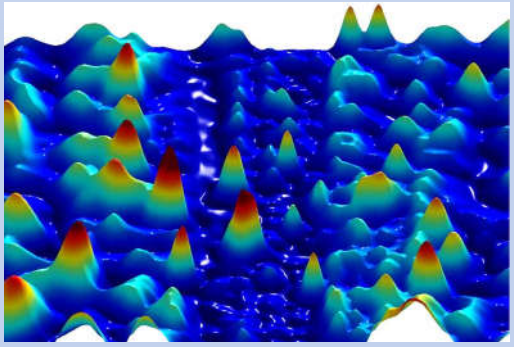
Results

LiDAR based contour maps of the pasture canopy were shown to accurately detect the asymmetric urine patches as well as calculate a percent area of urine based high N as early as one week after a simulated grazing event The proof-of-concept trial showed it was possible to detect a single urine patch using the height map from the LiDAR measurements up to 10 m away.

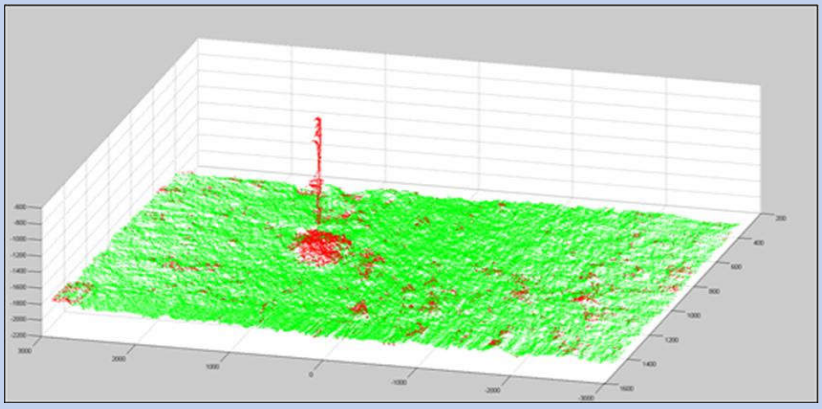
UAV photo ID of urine patches



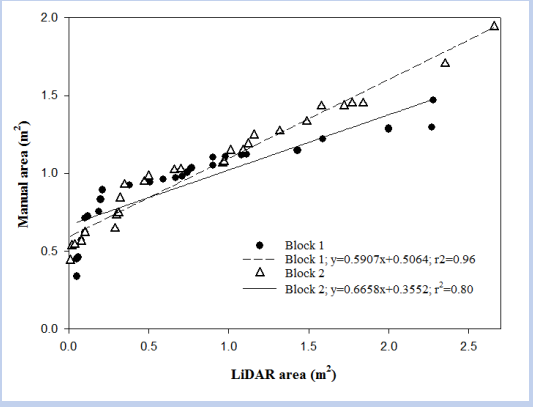
LIDAR contour map 1 week after grazing



3 weeks after grazing



LIDAR Point cloud with reference pole



Correlation of image based and LiDAR derived area measurements

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