FIG WORKING WEEK 2017

Helsinki Finland

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How Farmer Can Utilize Drone Mapping?

National Land Survey of Finland
Finnish Geospatial Research Institute
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From digitalisation to augmented reality

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Introduction

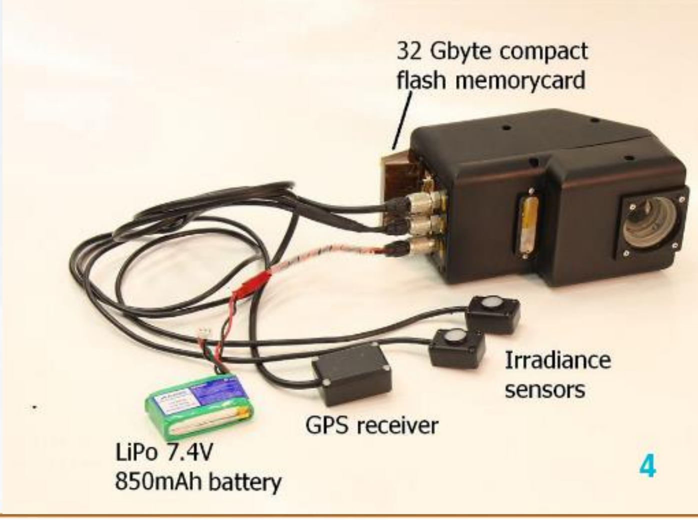
- Remote sensing based on drones (alternative terms: UAV; Unmanned Aerial Vehicle or RPAS; Remotely Piloted Aircraft System) is a rapidly developing field of technology
- Due to technological innovations lightweight and frame format hyperspectral sensors have become available which may be carried by small drones
- Drone based mapping enables to map agricultural lands with very high spatial resolution

Equipment

- Drone (UAV, RPAS)
  - Payload:3-4kg, flight time:15-30 min
  - Sensors
    - FPI based hyperspectral camera (500-900 nm)
    - Off-the-shelf RGB camera (Samsung NX500)
- Ground station

Novel FPI-Based spectral cameras – VNIR

- **1. FPI**
- Spectral range: 409-973 nm, 36 bands with 10-15 nm FWHM
  - Based on FPI technology (developed by VTT Finland)
    - Changing air gap between two mirrors determines different wavelengths
  - 1010*648 pixels, with of 11 x 11 µm pixel size, no interpolation
  - Focal lenght 9 mm, f-number 2.8
  - FOV: ±18.5° in the flight direction, ±18.5° in the cross-flight direction
  - Mass: 720 g without battery



Drone data capture summer 2016

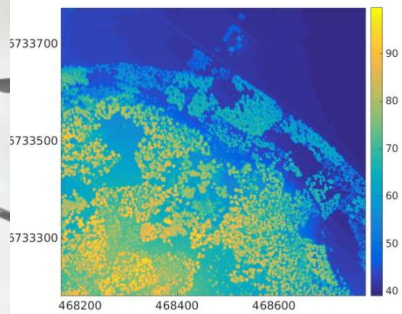
- 3 different farms
- 8 flight campaings
  - 34 different flights
  - 16 different parcels
    - (1)-3 times during growing season
- 68 data sets
- Plants
  - grass, wheat (summer and winter), barley, oat, rapeseed and pea

	Farm 1	Farm 2	Farm 3
Flying date	2016-06-02	2016-06-07	2016-06-15
N of flights	3	5	4
N of parcels	5	6	4
Flying date	2016-06-22	2016-06-21	
N of flights	4	6	
N of parcels	5	6	
Flying date	2016-07-21	2016-07-26	
N of flights	4	4	
N of parcels	5	3	
Flying date		2016-03-08	
N of flights		4	
N of parcels		2	

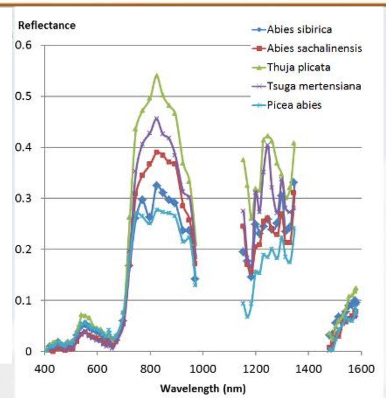
Flight parameters

- Flying height:140m
- Ground sample distance (GSD) 14 cm for FPI and 3.2 cm for RGB camera
- Flying speed: 4m/s
- Overlaps:
  - FPI: 90% forward and 65% side overlap
  - RGB 93% forward and 75% side overlap

Analysis Processing flow for Hyper-spectral UAS data



ALS DTM



Data capture → Image pre-processing → Image orientation → DSM generation → Radiometric block adjustment → Mosaic generation → Analysis

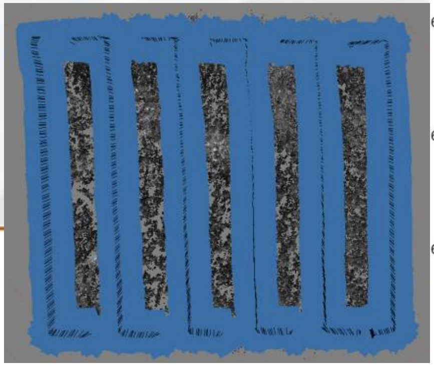
ALS DTM → Target detection

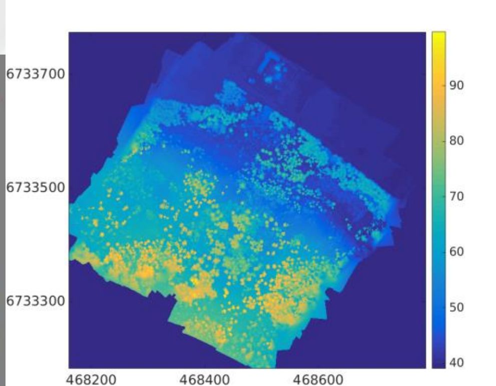
DSM generation → Target detection

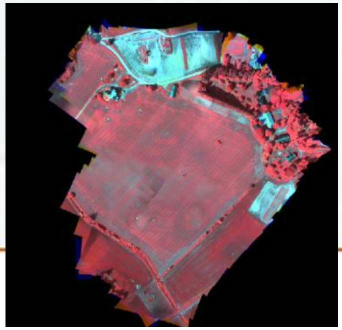
Target detection → Spectral characteristics of samples → Analysis

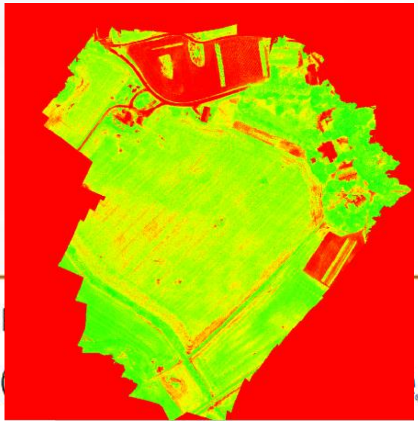
Field reflectance reference → Radiometric block adjustment

Reference plots → Analysis







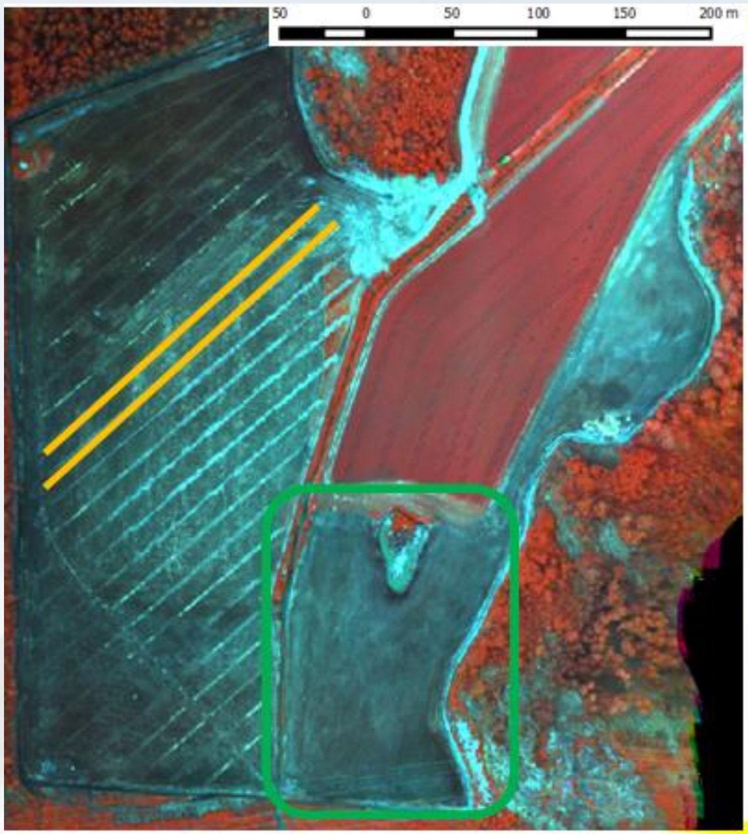


Examples of RGB mosaic data

Parts of orthomosaics where farmer can identify weeds

Parts of orthomosaics where the farmer can identify areas of ice encasements (left) and old sub-surface drainages (right)

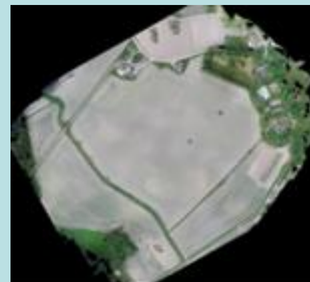
Documentation of sub-surface drainages



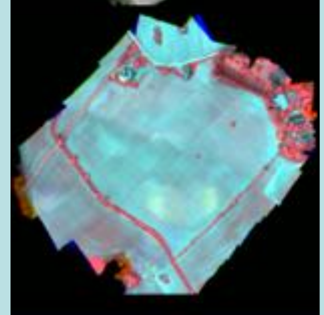
Drone data from pea parcel

- Pea field
- Time serie collection during growing season
- Anomalies visible espacially in last data set
  - Rain and topography

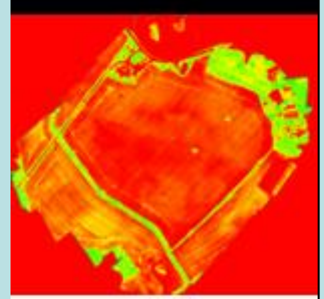
RGB mosaic



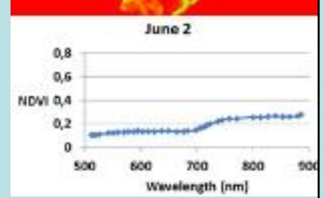
FPI Spectral mosaic

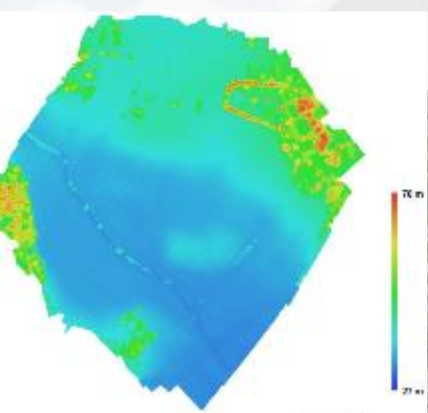


NDVI map



Average spectra

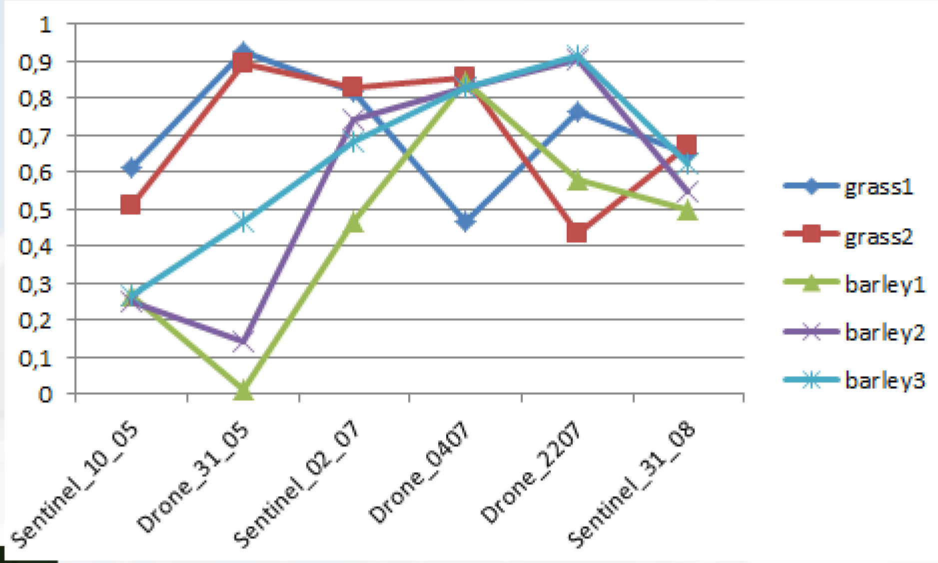




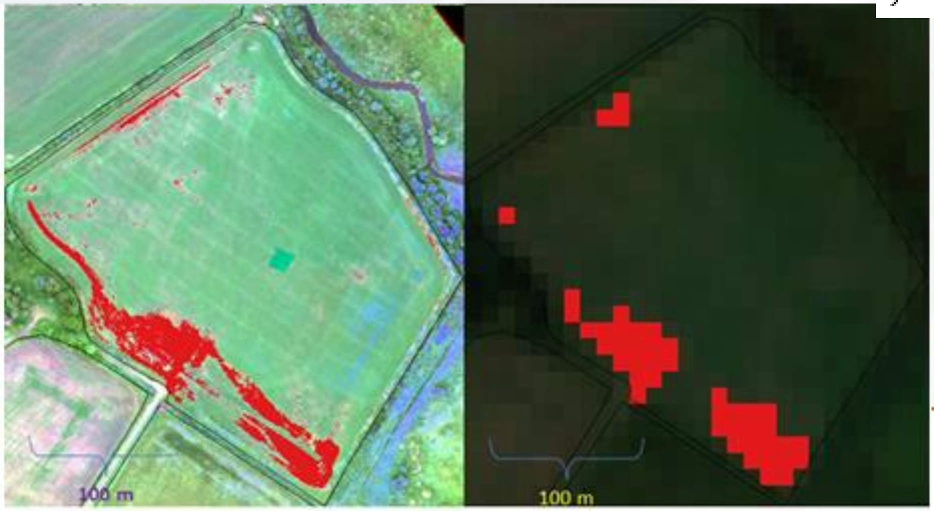
Comparison to satellite data

- Sentinel-2 data were collected from same area
  - GSD 10m (drones 0.03-0.20m)

NDVI time serie was calculated
-parcel based statistics are compatible



Drone **Satellite**



Anomaly detection:
-Detected areas are quite similar

Conclusion and outlook

- Visual analysis of drone based orthomosaics can already provide valuable information for farmers
- Computational analyses are independent of human knowledge and necessary for automatic methods
- The rapidly evolving drone remote sensing tools provides new possibilities to automate and accelerate the remote sensing procedures for precision agriculture
- In the future, even near real-time response is expected
- Novel systems have a great potential to support optimization of land use and farming practices

More information

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