UPOV
International Union for the Protection of New Varieties of Plants

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Technical Working Party for Agricultural Crops

TWA/51/6

Fifty-First Session
Cambridge, United Kingdom, May 23 to 27, 2022

Original: English
Date: April 21, 2022

NEW TECHNOLOGIES IN DUS EXAMINATION

Document prepared by an expert from Denmark

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The annex to this document contains a copy of a presentation “Estimation of plant length in winter wheat by drone imaging”, to be made by an expert from Denmark, at the fifty-first session of the TWA.

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Estimation of plant length in winter wheat by drone imaging

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INNOVAR

THIS PROJECT HAS RECEIVED FUNDING FROM THE EUROPEAN UNION' HORIZON 2020 RESEARCH AND INNOVATION PROGRAMME UNDER GRANT AGREEMENT N. 818144

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InnoVar will

Use winter wheat as a test crop to devise and demonstrate improved and more efficient methods of

- Integrating new science into **DUS** and VCU testing processes
  - Genome Wide Association Studies
  - **Sensor based phenotyping**
  - Machine learning technology
- Combining DUS and VCU characters, and
- Incorporating variety information into descision-making on-farm
  - Varieties categorised into 'fit-for-purpose-groups' of High Performance Low Risk (HPLR - novel branding developed by *InnoVar*)

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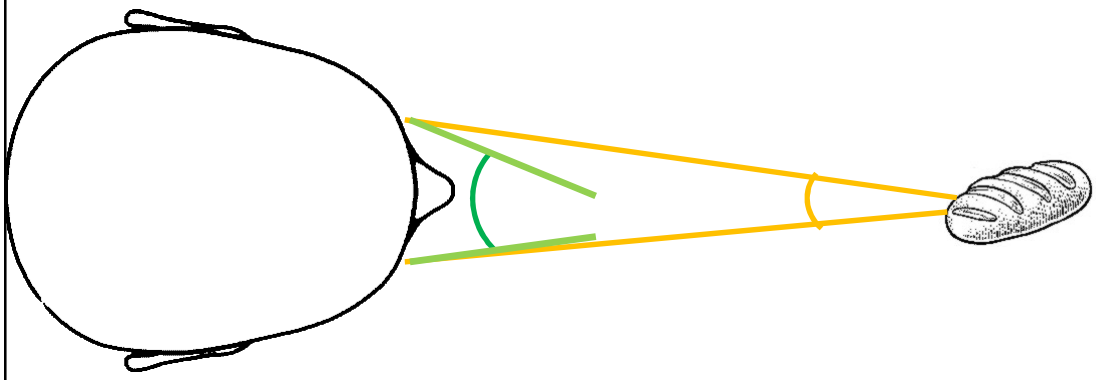
Stereo vision/photogrammetry



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Drone and sensor technology

Adjustment for incoming light and GPS

DJI Matrice 210 RTK V.2

Micasense RE dual sensor 10 wavelengths

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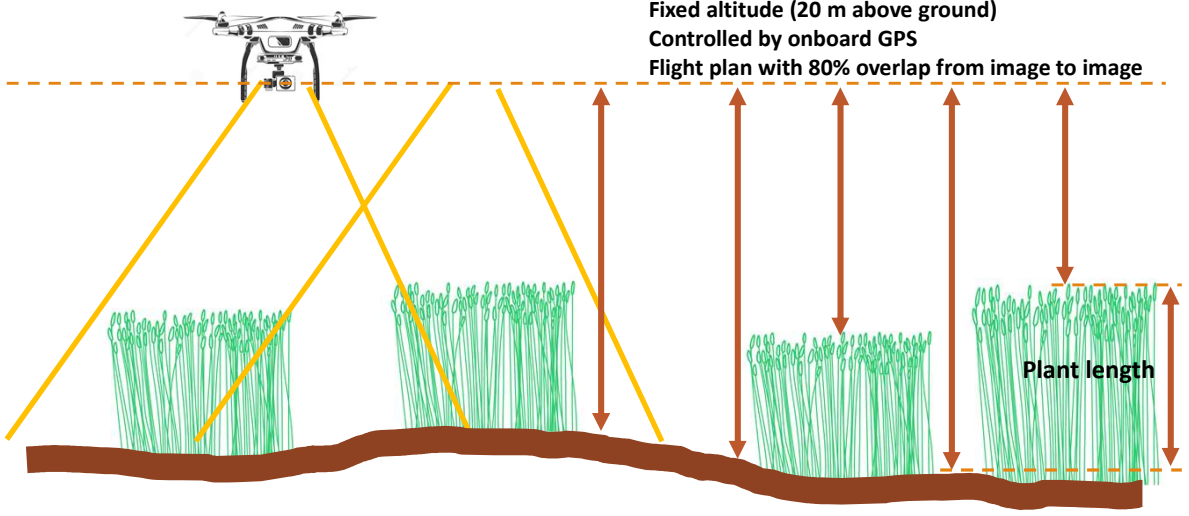
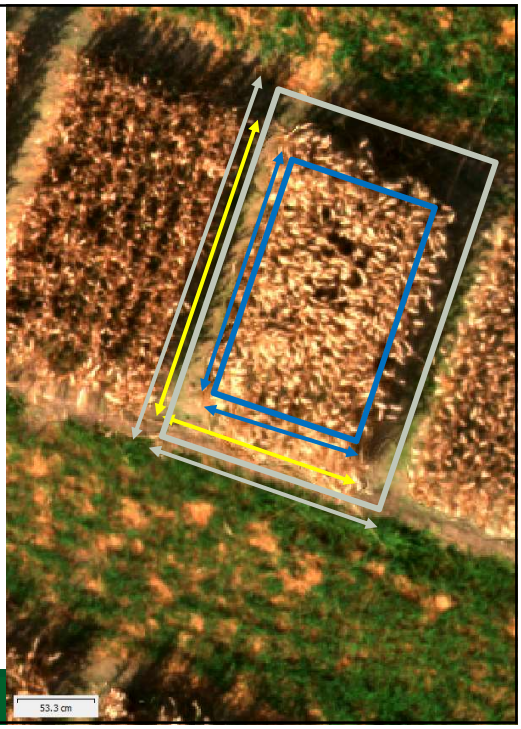
Digital Elevation Model



Materials and methods

- 300 winter wheat genotypes
- 2 replicates
- Plot size brutto 1,5*2m
- Manual plant length measurements
  - 26JUL21
  - 5 subsamples / plot
  - Stretched plants
- Drone images
  - 24JUL21
  - 2330 subsamples/plot (2,7 cm/pixel)
  - Digital elevation model from Agisoft Metashape v 1.8.1
  - Height above sea level of **Crop surface** = Clip 1*1,7 m (98% fraqtile)
  - Height above sea level of **Soil surface** = Clip 1,6*2,5 m (min observation)
  - Canopy height (plant length)= Crop surface – Soil surface



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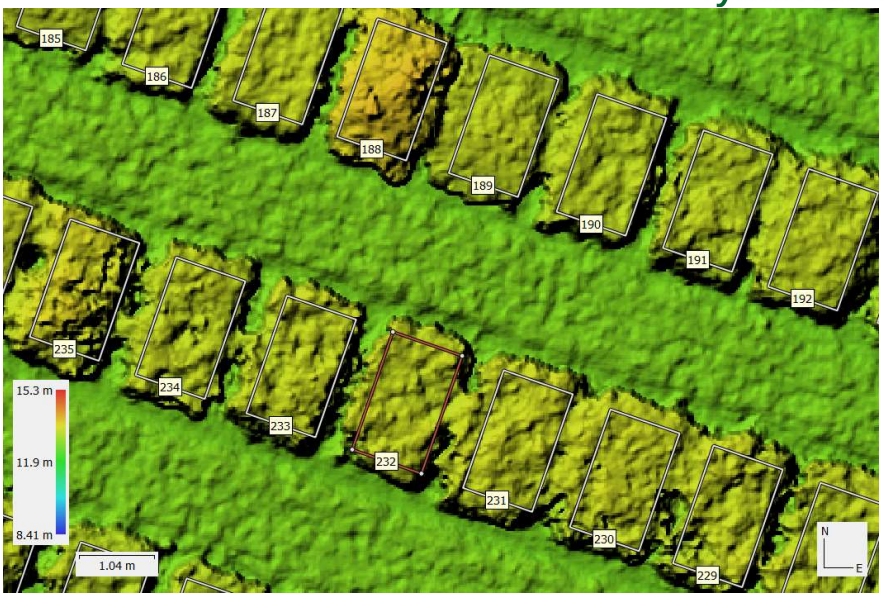

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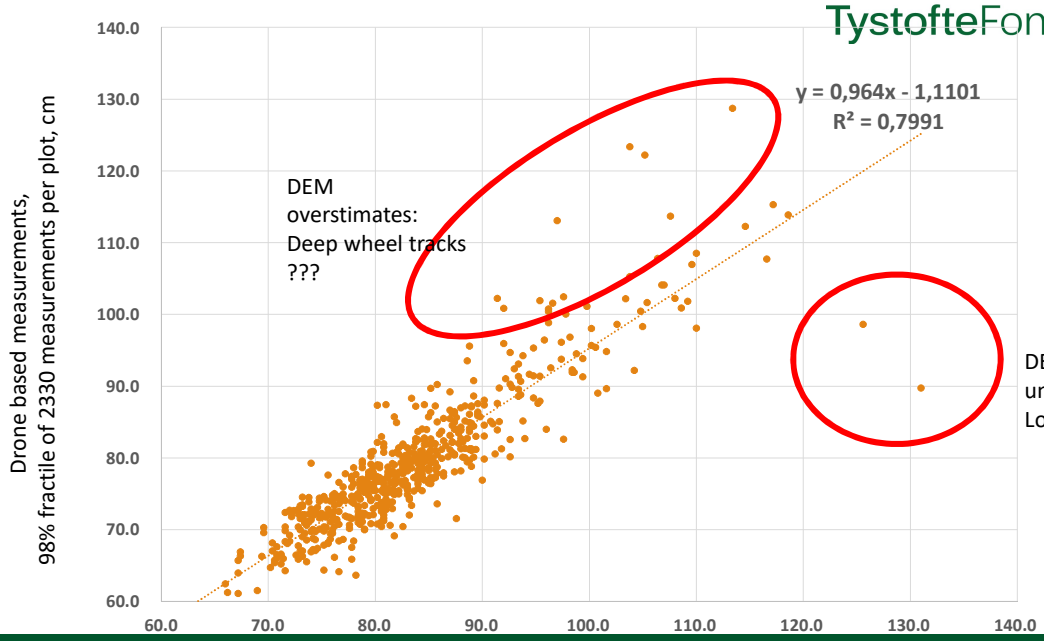

Differences between manual and drone-based plant length measurements

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Over/under estimation	Manual - DEM	n	Fraktion	Mean diff, cm	Possible reason
OK	-5.8-5.8	403	67,2%	2,5	
Under	5.9 to 9.9 cm	156	26,0%	7,3	bending heads
Under	> 10 cm	30	5,0%	13,2	lodging, low density
Over	-9.9 to -5.9 cm	6	1,0%	7,0	Soil compaction in wheel tracks compared with plot
Over	< - 10 cm	5	0,8%	15,8	?
		600	100,0%		

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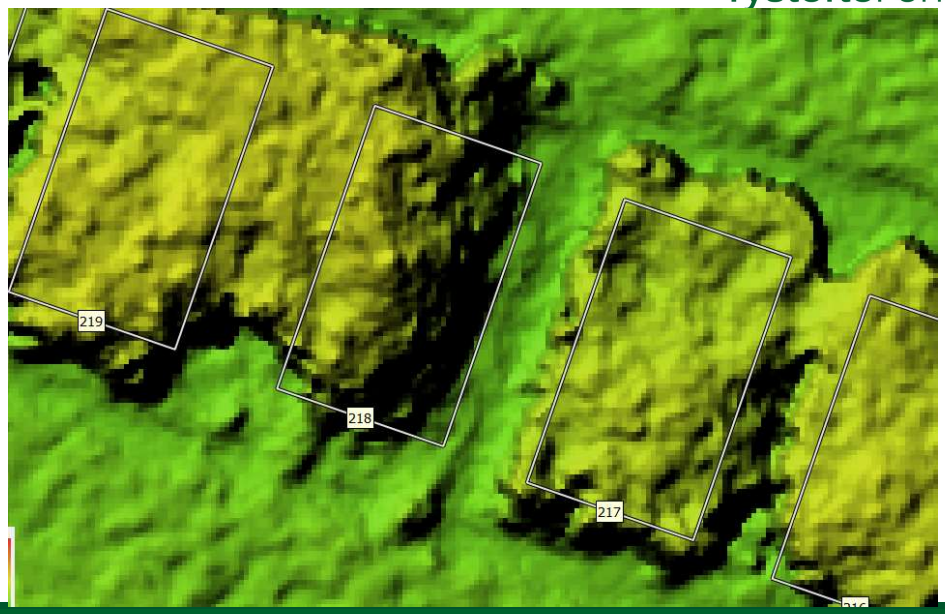

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Conclusions

Plant length estimated from drone imaging can substitute manual assessments with a satisfactory result in 67.2% of the plots

Satisfactory result = same accuracy as manual measurements

Mean range of 5 manual measurement: 5.8 cm

Under estimation (31%) can be explained by
- bending heads
- Lodging
- Low plant density

Over estimation (1.8%) needs further studies
- deep wheel tracks
- other cases

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