Retos en la fotogrametría y captura LiDAR con drone

P. Molina

GeoNumerics
Av. Carl Friedrich Gauss 11
Parc Mediterrani de la Tecnologia
E-08860 Castelldefels (Spain)

geonumerics mapKITE

geonumerics

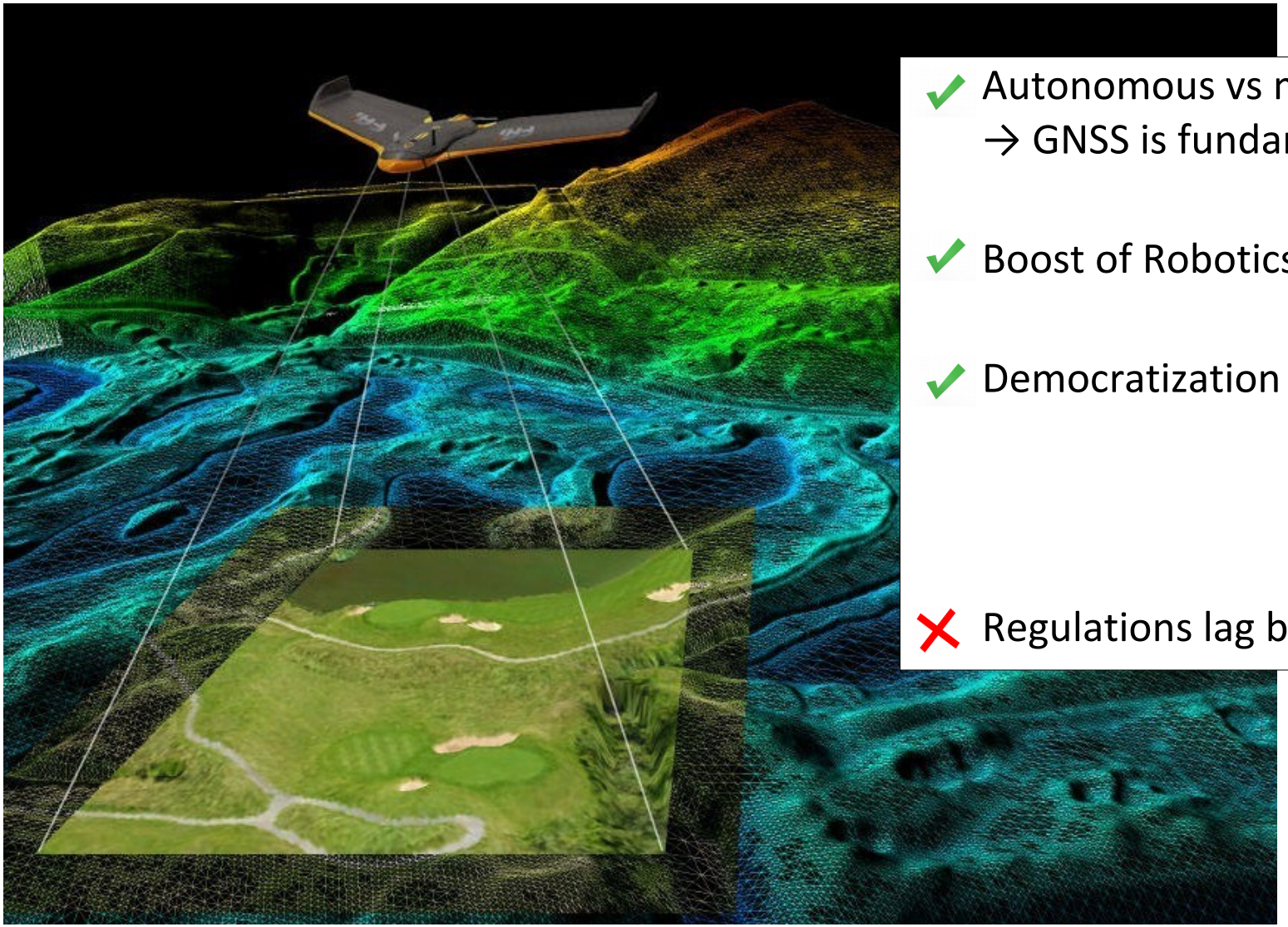
GeoNumerics' primary goal is to develop state-of-the-art geomatic software **and deliver outstanding services to the geomatic community.**

- (kinematic) geodesy + (RT & PP) navigation
- remote sensing & (aerial & terrestrial) photogrammetry
- GPS and GPS/INS trajectory determination

INNOVATIVE SME
Valid until Dec 31st 2018
GOBIERNO DE ESPAÑA · MINISTERIO DE ECONOMÍA Y COMPETITIVIDAD

Awarded the "Innovative SME" seal by the Spanish Ministry of Economy and Knowledge (2015-12) for the period 2016-2018.

Mapping revolution: the unmanned technology



- ✔ Autonomous vs manual
  → GNSS is fundamental
- ✔ Boost of Robotics & mini-sensors
- ✔ Democratization of technology
- ✘ Regulations lag behind tech

LiDAR for drones in numbers (old times)

- First LiDAR drone references back in 2004
  - Emergency responses (2009)
  - Topography (2009)
    - RIEGL LMS-Q160 (compact, light-weight)
      - Up to 200m, 4.6 kg
    - Scout B1-100 (3.3m, 44kg)

Figure 2. SUBARU RPH2

Weight	330 kg
Pay load	100 kg
Motor	83.5 hp
Main Rotor	Diameter 4.8m

Table 3. Specification of RPH2

Extracted from: Colomina, I.; Molina, P. *Unmanned aerial systems for photogrammetry and remote sensing: A review*. ISPRS J. Photogramm. Remote Sens. 2014, 92, 79–97.

LiDAR for drones in numbers (new times)

- LiDAR Drone Market worth **144.6 Million USD by 2022**
  - $ 16.1 M (2015) → $ 144.6 M (2022), at a **CAGR of 35.2%**
  - **Rotary wing** LiDAR drone expected to grow at the highest CAGR.
  - The **corridor mapping** application held the largest market share in 2015
  - **North America region** held the largest share of the LiDAR drone market in 2015
    - Precision farming leading

  - The **major players** operating in this market are Velodyne LiDAR (U.S.), Phoenix Aerial Systems (U.S), Riegl Laser Measurement Systems GmbH (Austria), SICK AG (Germany), and YellowScan (France), 3D Robotics, Inc. (U.S.), DJI (China), FARO Technology (U.S.), Leica Geosystems AG (Switzerland), Optech, Inc. (Canada) and Trimble Navigation Limited (U.S.)

Extracted from Markets and Markets:
http://www.marketsandmarkets.com/Market-Reports/lidar-drone-market-128835365.html

State-of-the art LiDAR systems for drones: some examples

HDL-32E (Velodyne, US)

- 1Kg (1.33 w/ cables)
- <100m
- Dual-return, 32 planes
- 700 KHz

MiniVUX-1UAV (Riegl, AT)

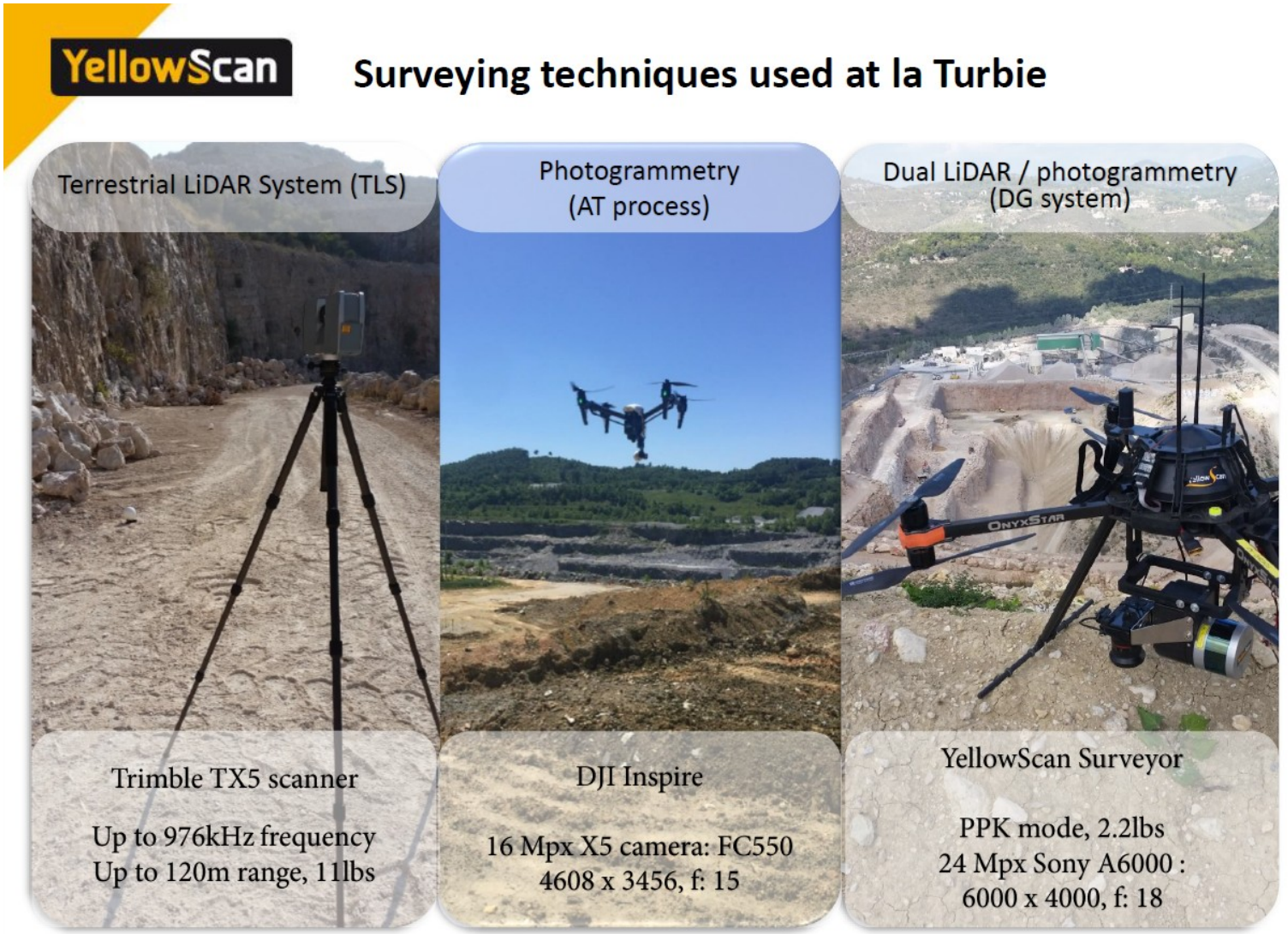
- 1.5Kg
- <250m (60%), 150 (20%)
- 5-return, 1 planes
- 100 KHz

SORA 200 (Cepton, US)

- 0.55 kg
- < 200m
- 200 Hz “frames”

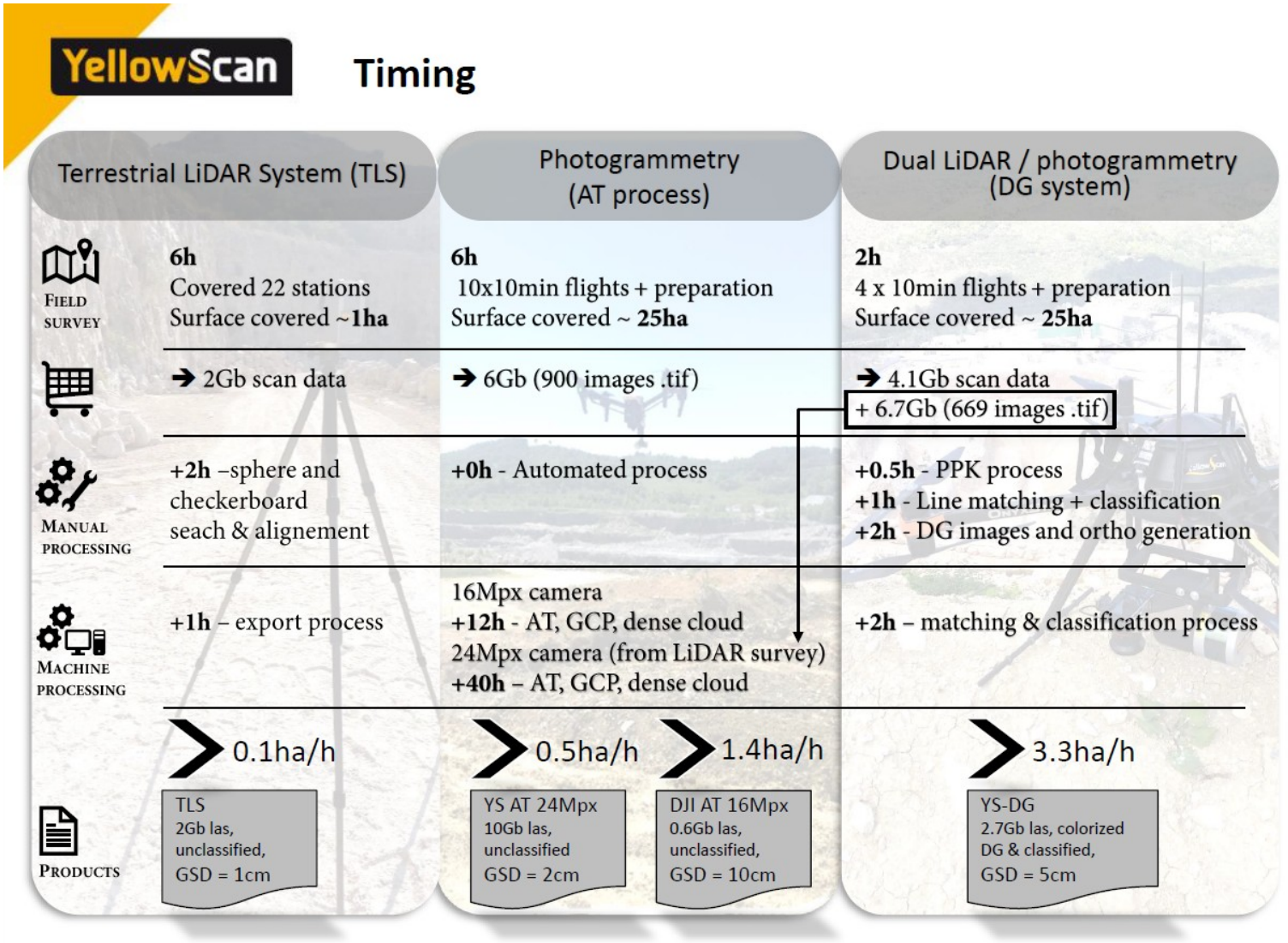
...but we live in the “integrators era”

LiDAR vs Photogrammetry: yet another comparison



Extracted from: Chaponiere, P. 2017: "*Quarry Use Case - YS Surveyor vs Photogrammetry" - Yellowscan User Workshop*

LiDAR vs Photogrammetry: yet another comparison



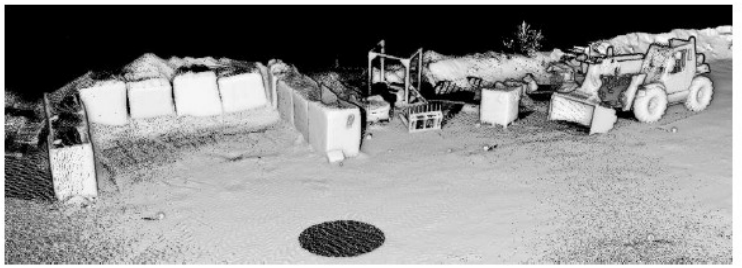
Extracted from: Chaponiere, P. 2017: "*Quarry Use Case - YS Surveyor vs Photogrammetry" - Yellowscan User Workshop*

LiDAR vs Photogrammetry: yet another comparison

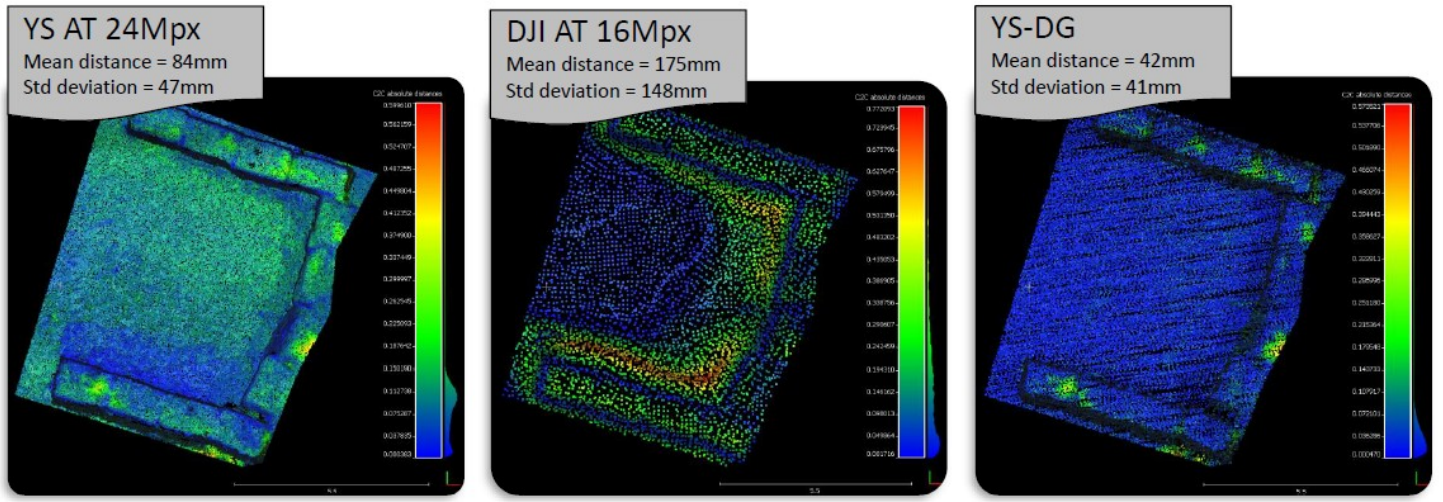
YellowScan

Accuracy assessment – cloud to cloud

Cloud selection representative of sharp slope changes



TLS ✓ Used as reference



Extracted from: Chaponiere, P. 2017: "*Quarry Use Case - YS Surveyor vs Photogrammetry" - Yellowscan User Workshop*

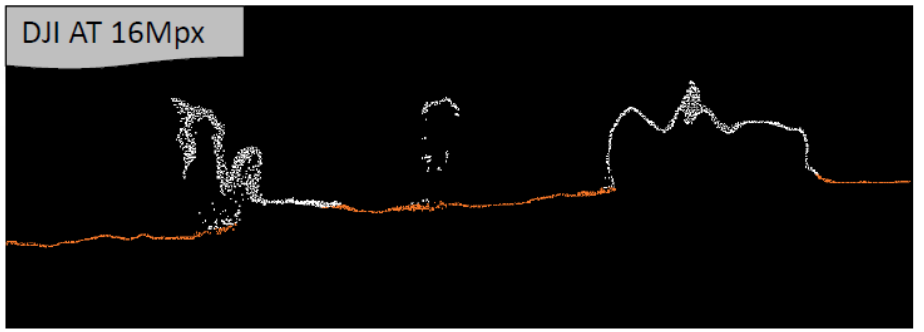
LiDAR vs Photogrammetry: yet another comparison

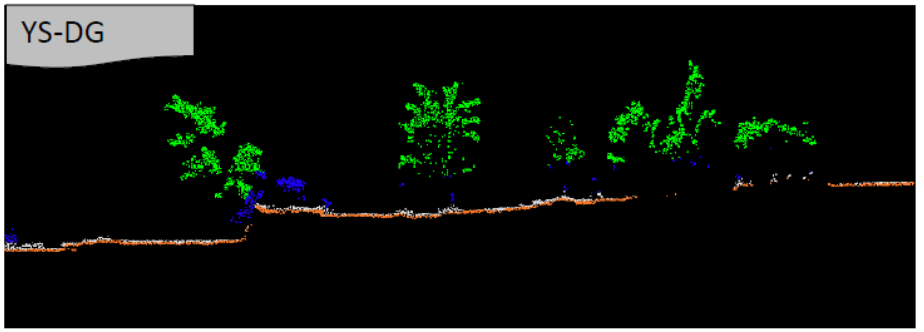
YellowScan

Qualitative comparison

Vegetation penetration

20cm cross section view
at same extent & scale





Extracted from: Chaponiere, P. 2017: "*Quarry Use Case - YS Surveyor vs Photogrammetry" - Yellowscan User Workshop*

Summary of LiDAR challenges for drones

	LiDAR	Photogrammetry
Flight Time	No overlap → Less flights	Overlap → more flights
Data size	Moderate	Moderate
Manual processing	High (classification)	
Automated processing		Larger extension →higher penalisation
Dataset	Vegetation penetration, suitable for powerlines (thin)	Colorized point cloud,
Processing	High-quality INS/GPS + PPK	GCPs (or not)
Operations	Automated Night flights (UAV!)	Automated Requires good illumination
Weight	1 – 1.5 kg (sensor-only)	0.5 kg (UAV+cam!)
Price	35 > k€ (payload) 120 k€ (payload+UAV)	2-10 k€ (UAV+SW)