Photogrammetric Accuracy and Modeling of Consumer Cameras

Christoph Strecha

Founder Pix4D

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Founded 2011
10+ years of research
High tech company

90+ employees ww
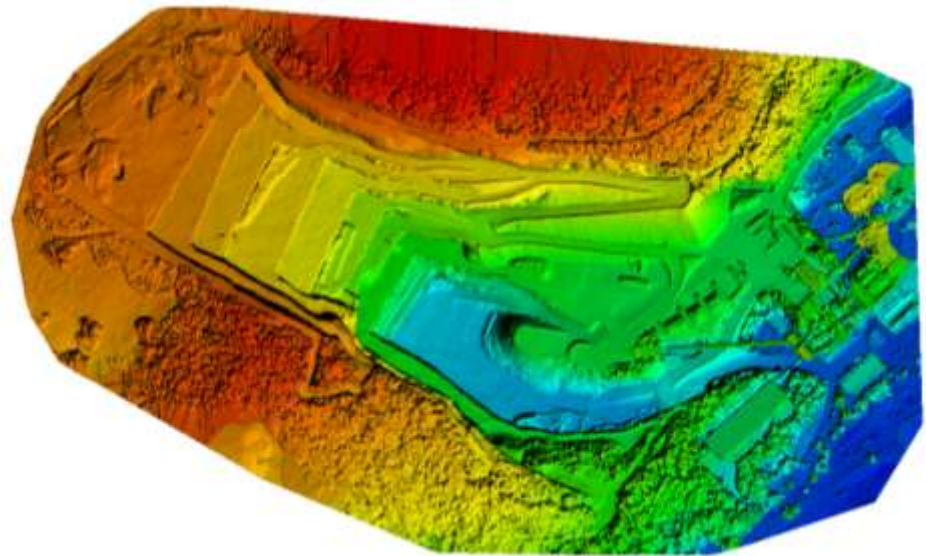170+ resellers ww

Images to 3D

Customer orientation

SAN FRANCISCO
U.S.A

LAUSANNE
SWITZERLAND

SHANGHAI
CHINA

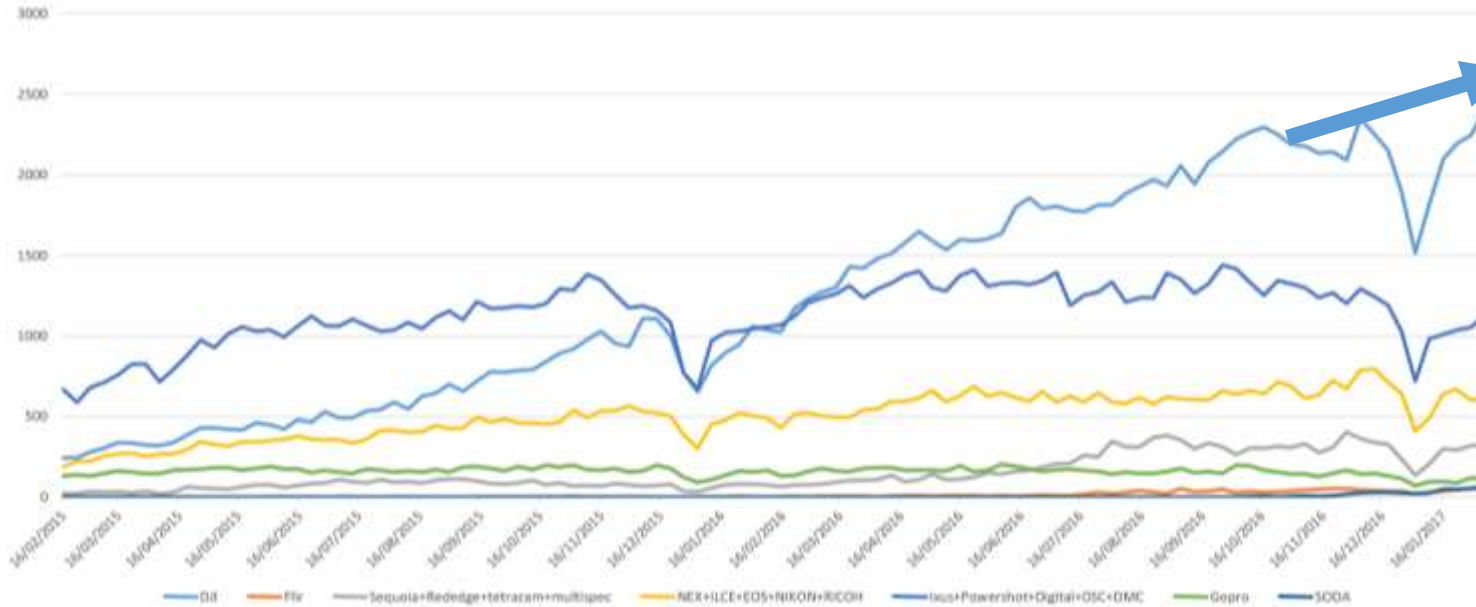# Professional Mapping Drones

Professional Mapping Drones

- $15.000-$30.000
- Accuracy 2-3 times GSD
- Accuracy usually 5 cm
- **Established surveying tool**

Consumer Drone Mapping
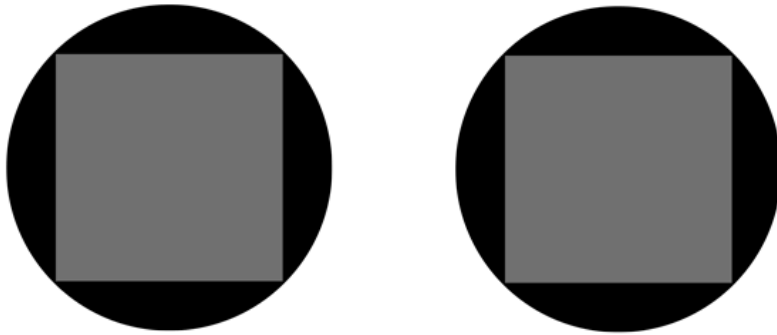

Weekly unique users and their cameras used
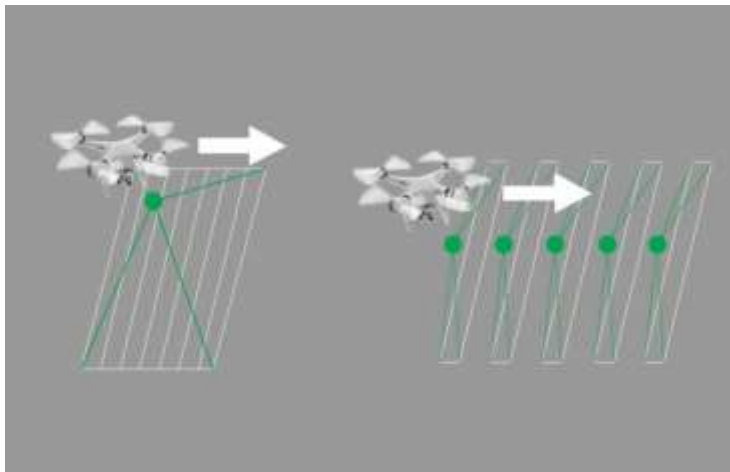
#Pix4D users with DJI drones

$500 – $5.000
What can one achieve in terms of accuracy?

Consumer Drones - Rolling Shutter

- Scan line capture of the image

- Leads to geometric distortions when cameras move

- Geometric distortion can be modelled with Pix4Dmapper

Experiments – EPFL innovation park

- Different drones at different speed
- 6 GCP's
- 6 verification points

- Compare results with and without rolling shutter modelling

Accuracy in Pix4Dmapper

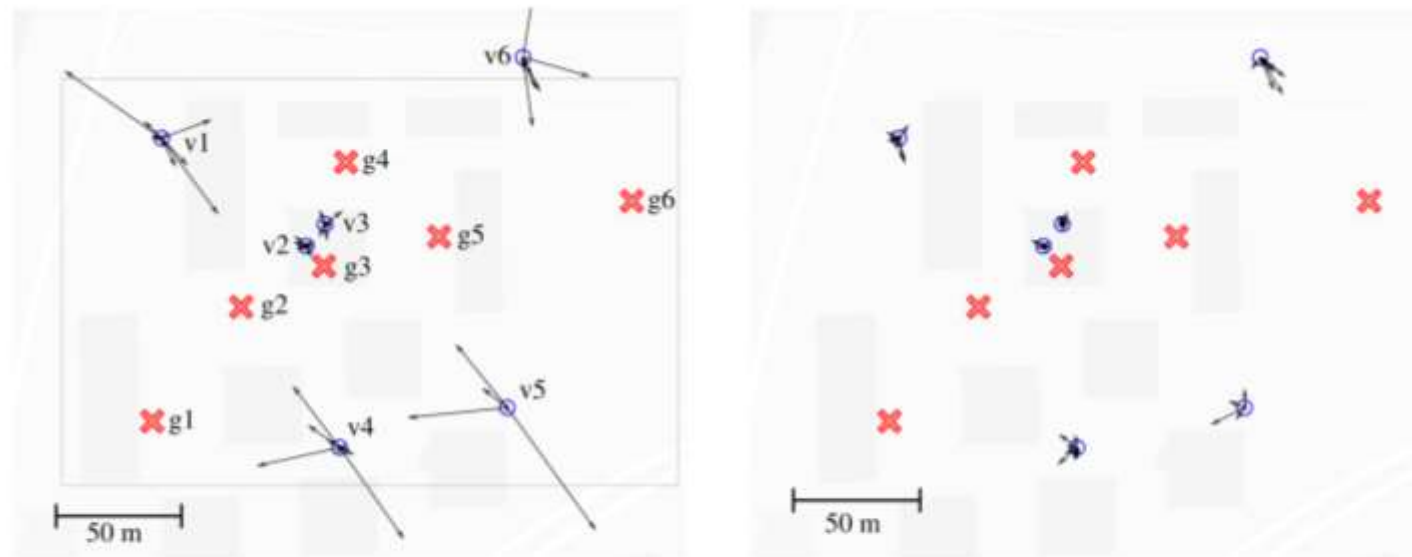Without rolling shutter modelling   With rolling shutter modelling

Figure 7. Error of the verification points, both for the reconstruction without (left) and with (right) the rolling shutter model. The red crosses depict the GCPs. The arrows are centered on the verification points and their lengths and directions show the X-Y error for each of the datasets listed in Tab. 3. The circle centered on each verification point shows the GSD in the same scale as the arrows. On the left image, the rectangle shows the contours of the flight path.

Processing Results

	Phantom 4	Phantom 4 with rolling shutter modelling	Inspire1 X5	Inspire1 X5 With rolling shutter modelling
Number of images	83	83	105	105
Estimated mean ground sampling distance (GSD)	2.66cm	2.68cm	1.62 cm	1.62cm
RMS error on GCP's in x,y,z [m]	0.730479 0.190999 0.830800	0.003781 0.001425 0.004223	0.132340 0.062856 0.047988	0.005115 0.011303 0.014894
RMS error on Validation points In x,y,z [m]	**0.718848** **0.567126** **0.876571**	**0.038477** **0.037323** **0.102230**	**0.299248** **0.097242** **0.339609**	**0.052787** **0.096158** **0.080275**
Drone speed from rolling shutter	n.a.	4.7 m/s	n.a.	5.1 m/s

- Because of the different focal length of Phantom4 and Inspire1 X5 the GSD is different

- Using Pix4D's explicit rolling shutter compensation the RMS errors on the validation points go down from 72cm to 17cm (Phantom4) and from 25cm to 7cm for the Inspire1
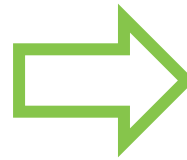
WORKFLOW

Flight-planning app
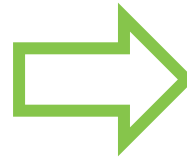
Images

WORKFLOW

Flight-planning app　　　　**Image-processing software**

Example – DJI Phanton
13 flights – 1800 images

Thank You! Consumer Drones gaining interest in surveying

Thank you!