VEXCEL IMAGING

FLYING HIGH WITH ULTRACAM DRAGON 4.1

Advanced Hybrid Aerial Imaging and LiDAR Technology

Vexcel Imaging GmbH, Bernhard Schachinger, 28th March 2024

Where we come from

GET TO KNOW US

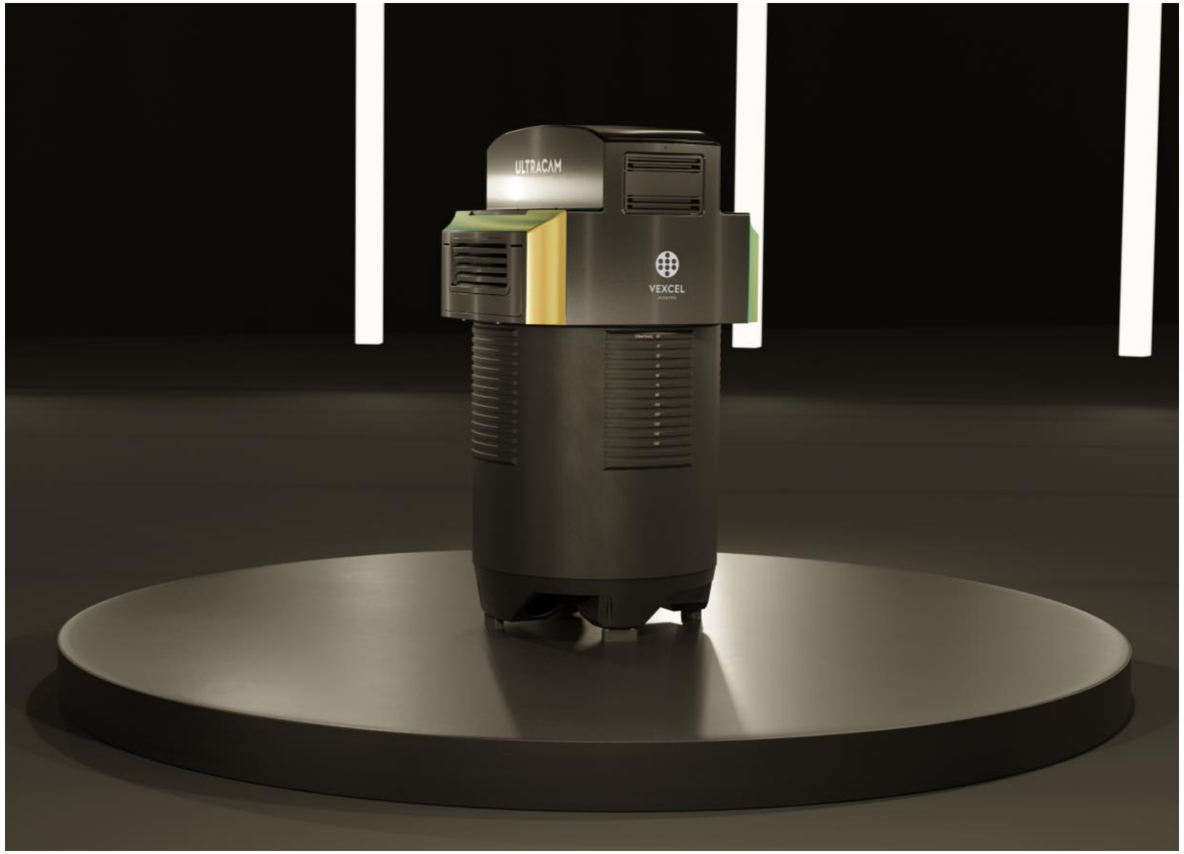
1992	2003	2006	2010	2016	2017	2020
Vexcel was founded	First UltraCam introduced	Part of Microsoft	First UltraMap version	Privately owned again	Vexcel Data Program	Verisk Acquisition

What we do

OUR PRODUCT LINE-UP

UltraCam Dragon 4.1

HYBRID AERIAL MAPPING SYSTEM

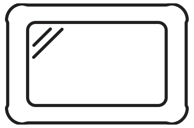


System Components

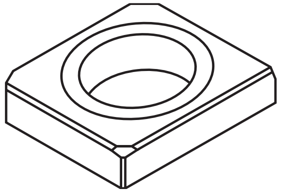
Cameras

LiDAR scanner

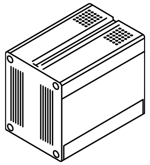
UltraNav v7 (610 level)



3 Vexcel IPTs for camera, LiDAR scanner & UltraNav plus 1 pilot display



UltraMount GSM 4000



4th generation data units (16, 32 TB)

VEXCEL
IMAGING

UltraCam Dragon 4.1

KEY METRICS

43 cm

80 cm

POWER CONSUMPTION

Max. 665 W

WEIGHT

<75 kg

CYLINDER DIAMETER

395 mm

UltraCam Dragon 4.1

HIGH-PERFORMANCE CAMERAS

>83 dB at base ISO	0.7 frames per second	14 bits at 4 bands
Adaptive Motion Compensation (multi-directional)	Prontor magnetic-0 HS2 shutter (field exchangeable)	True Pixel Processing approach

Adaptive Motion Compensation (AMC)

PROCESSING OVERVIEW

Blurry Image

Adaptive Motion Compensation (AMC)

PROCESSING OVERVIEW

Orientation data
(GNSS & IMU)

Object geometry with per pixel image scale based on external DEM and camera orientation

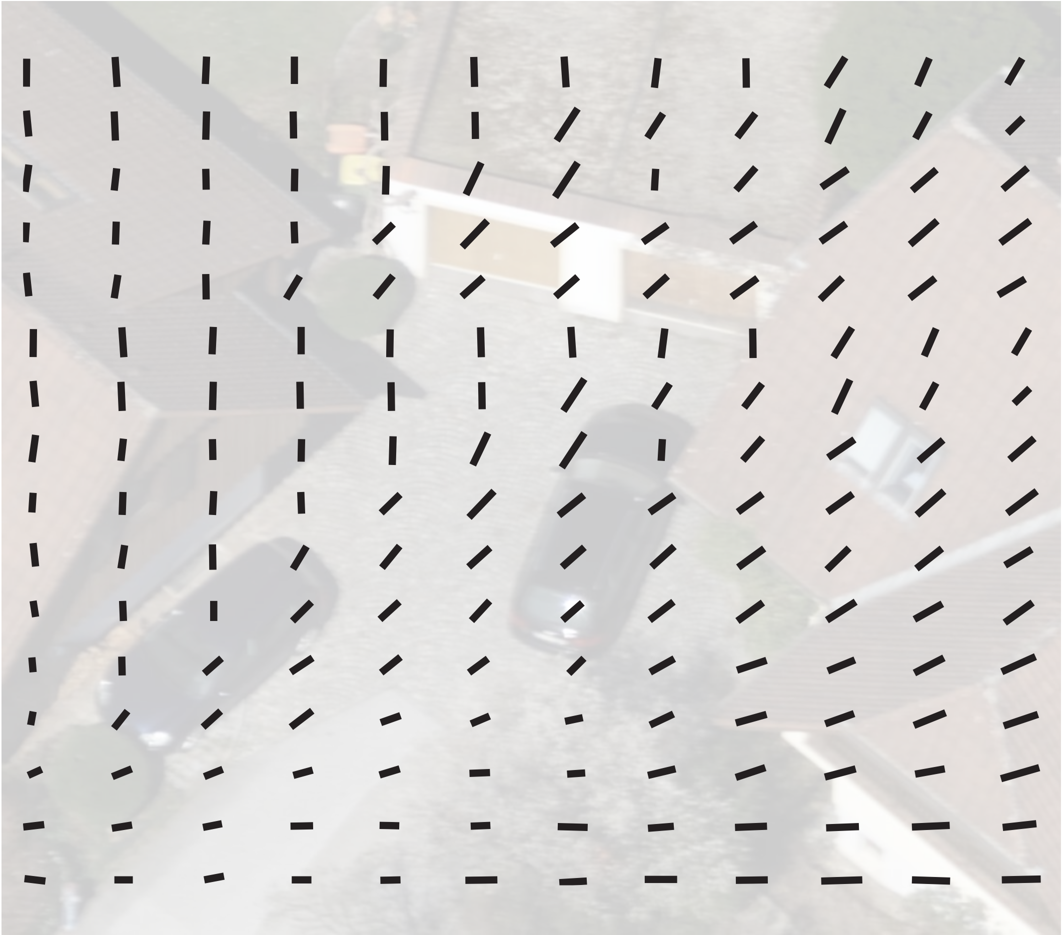
Precise exposure information from UltraCam

Raw Image

Three Known Factors

Adaptive Motion Compensation (AMC)

PROCESSING OVERVIEW



Raw Image

Three Known Factors

Compute PSFs

Adaptive Motion Compensation (AMC)

PROCESSING OVERVIEW

Raw Image

Three Known Factors

Compute PSFs

Solve Blur Model

UltraCam Dragon 4.1

CAMERA SYSTEM LAYOUT

UltraCam Dragon 4.1

CAMERA SYSTEM LAYOUT

3.76 µm CMOS

Custom lenses

1 x 150 MP RGB nadir

14,144 x 10,560 pixels

1 x 150 MP NIR nadir

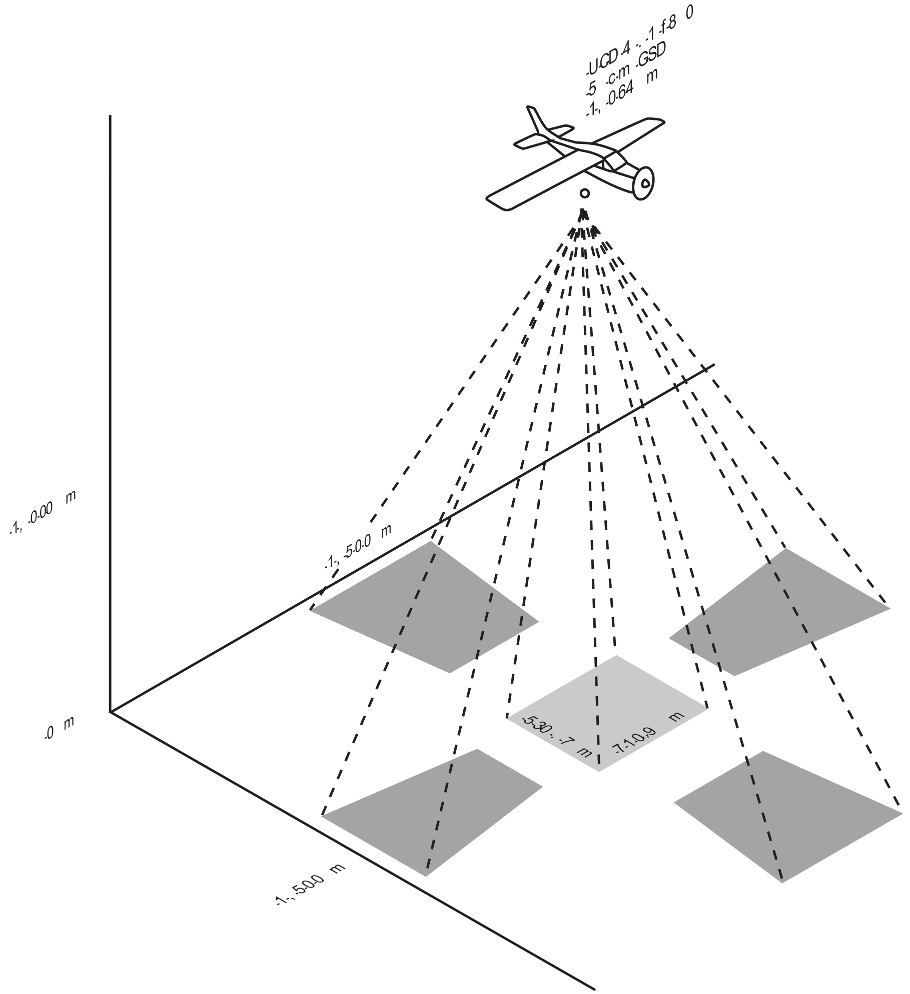
14,144 x 10,560 pixels

4 x 150 MP RGB oblique

14,144 x 10,560 pixels

UltraCam Dragon 4.1

2 FOCAL LENGTH OPTIONS



		f80
NADIR	Focal length	80 mm
	FOV across track along track	36.8° 27.9°
OBLIQUE	Focal length	123 mm
	FOV across track & along track	45°

UltraCam Dragon 4.1

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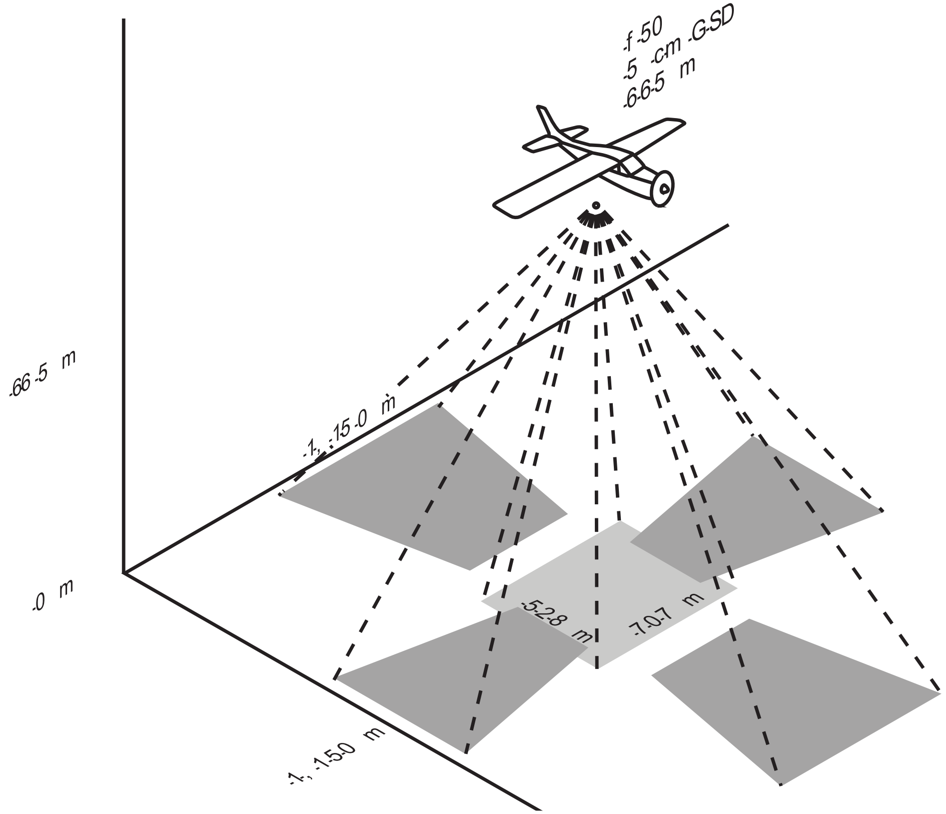

		f80	f50
NADIR	Focal length	80 mm	50 mm
	FOV across track along track	36.8° 27.9°	56.0° 43.3°
OBLIQUE	Focal length	123 mm	80 mm
	FOV across track & along track	45°	45°

UltraCam Dragon 4.1

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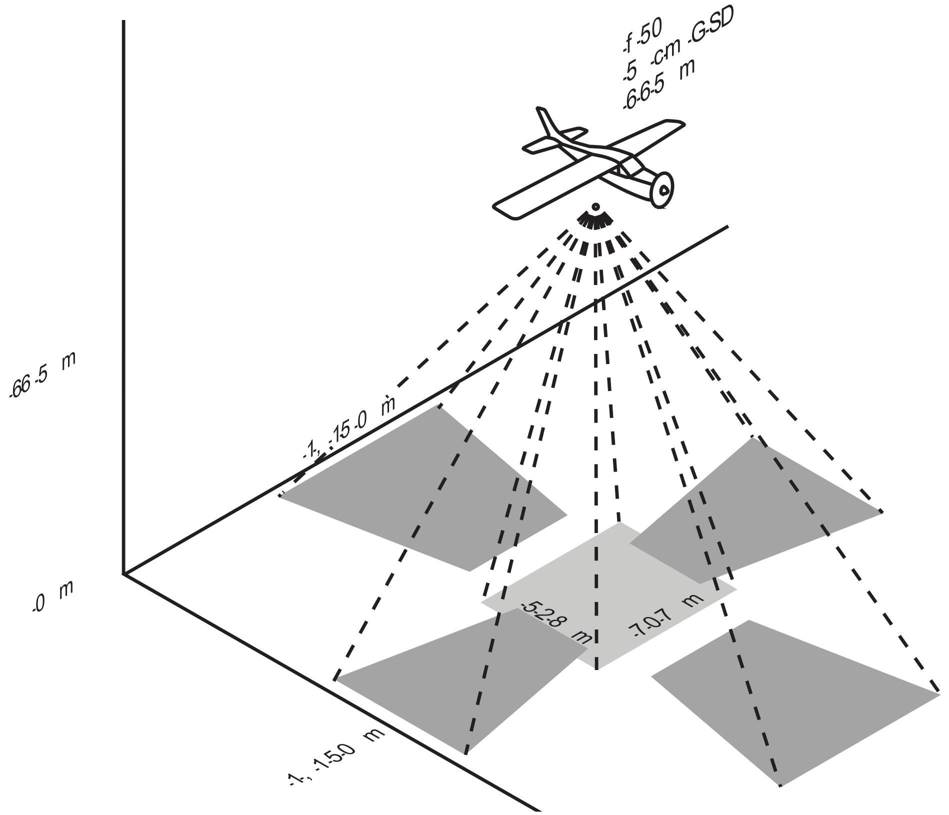

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UltraCam Dragon 4.1 f80
5 cm GSD @ 1,064 m AGL @ 120 knots
~25 pt/m2 @ 2 MHz PRR

UltraCam Dragon 4.1

RIEGL VQ-680 OEM LIDAR SCANNER

- Systems integrator edition
- Functional housing with hard mounting points
- Small aperture dimensions
- External GNSS synchronization
- Laser safety mechanism support
- For integration into hybrid camera/lidar systems

UltraCam Dragon 4.1

RIEGL VQ-680 OEM LIDAR SCANNER

Class 3B laser product	Online waveform processing
Multiple target capability	1,052 nm NIR wavelength

UltraCam Dragon 4.1

LIDAR SCANNER

ECHO SIGNAL INTENSITY

for each echo signal

LASER PULSE REPETITION RATE (PRR)

Up to 2.4 MHz (selectable)

MAX. TARGETS PER PULSE

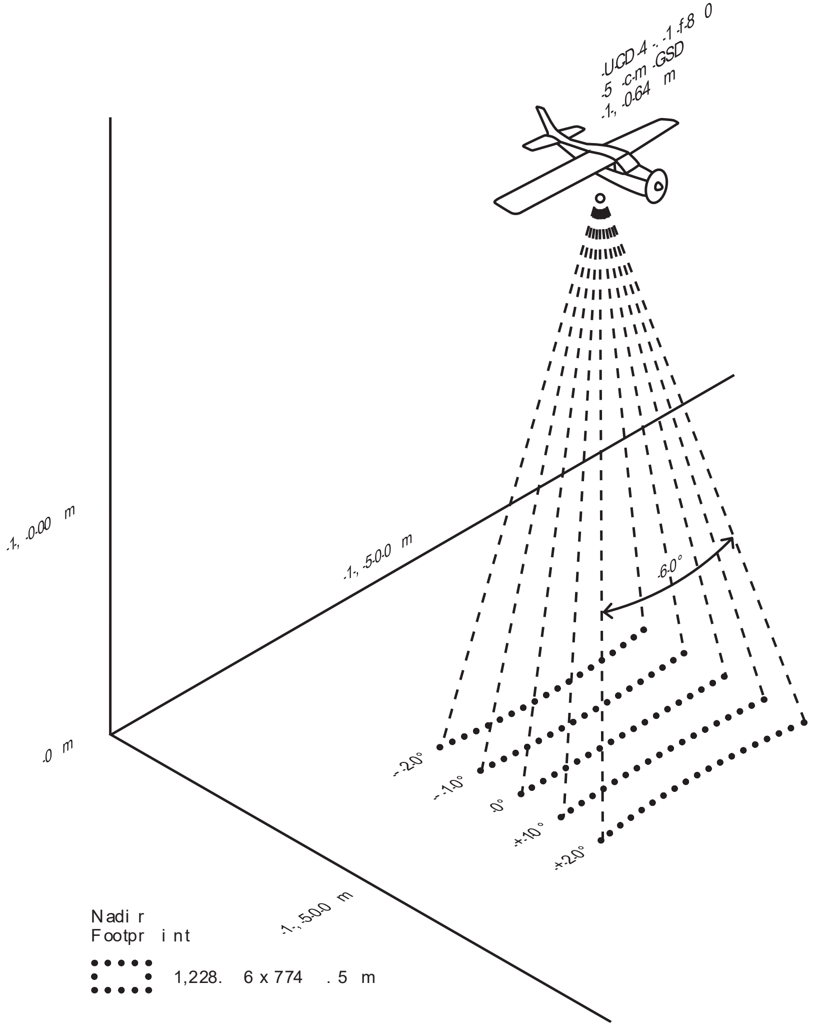
Up to 32

MAX. MEASUREMENT RATE

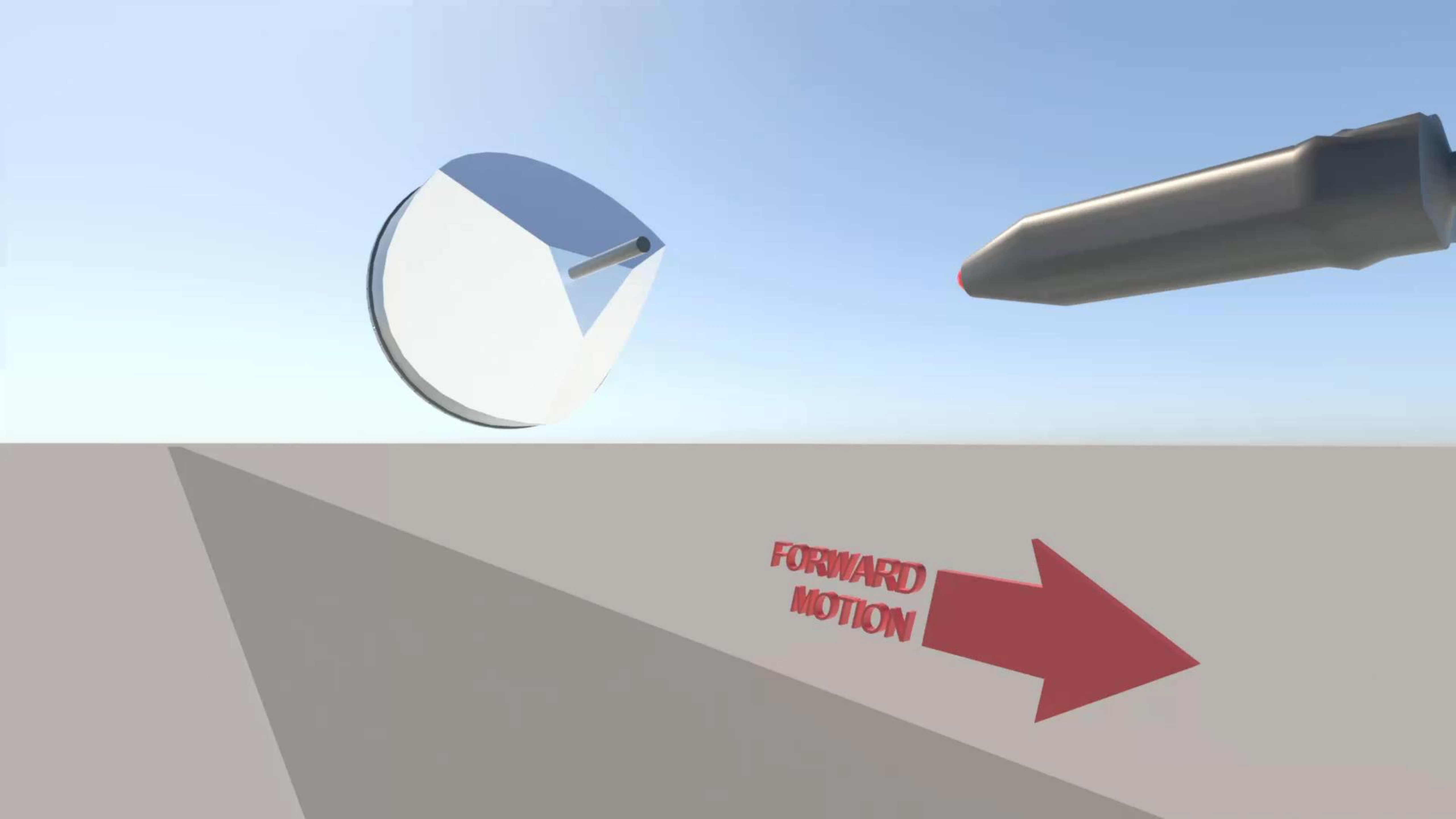
Up to 2,000,000 measurements/second

UltraCam Dragon 4.1

EFFICIENT LIDAR SCAN PATTERN

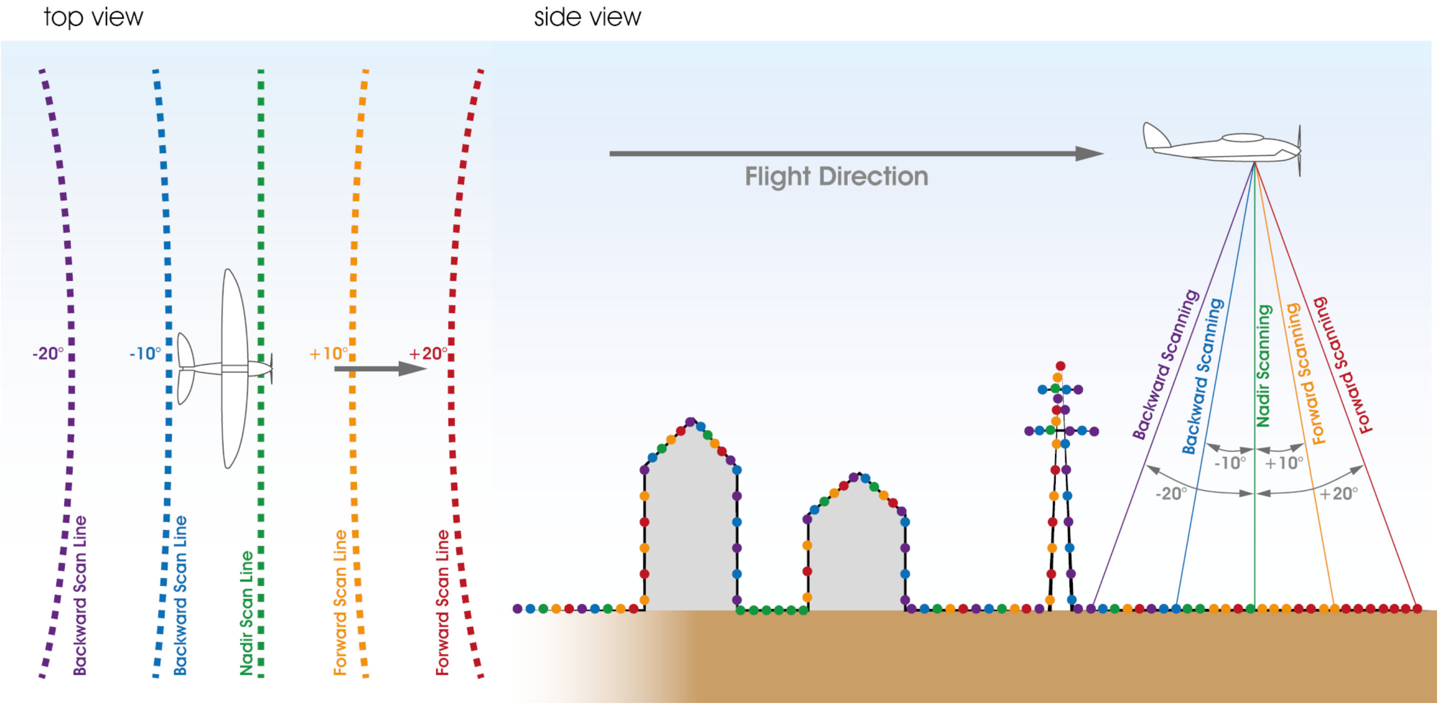


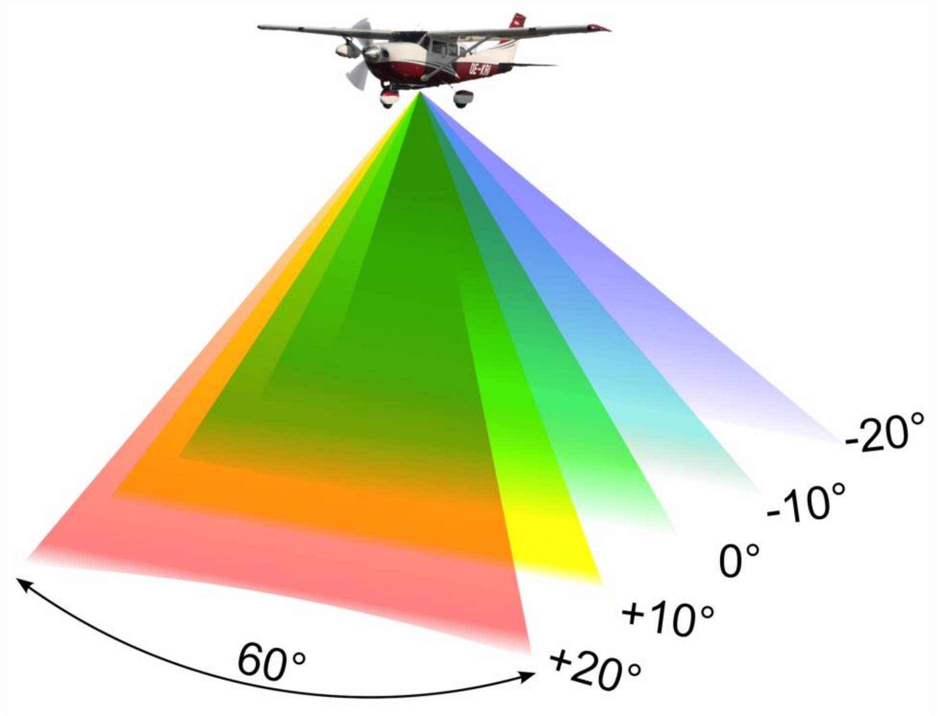
Scanning mechanism	Rotating polygon mirror
Scan pattern	Regular scan grid with 5 parallel scan lines (2 forward, **1 nadir**, 2 backward)
FOV, across track along track	60° 40°
Angular directions along track	-20°, -10°, **0°**, 10°, 20°
Total scan rate	50-500 lines per second (configurable)


FORWARD
MOTION

UltraCam Dragon 4.1

SCANNING MECHANISM





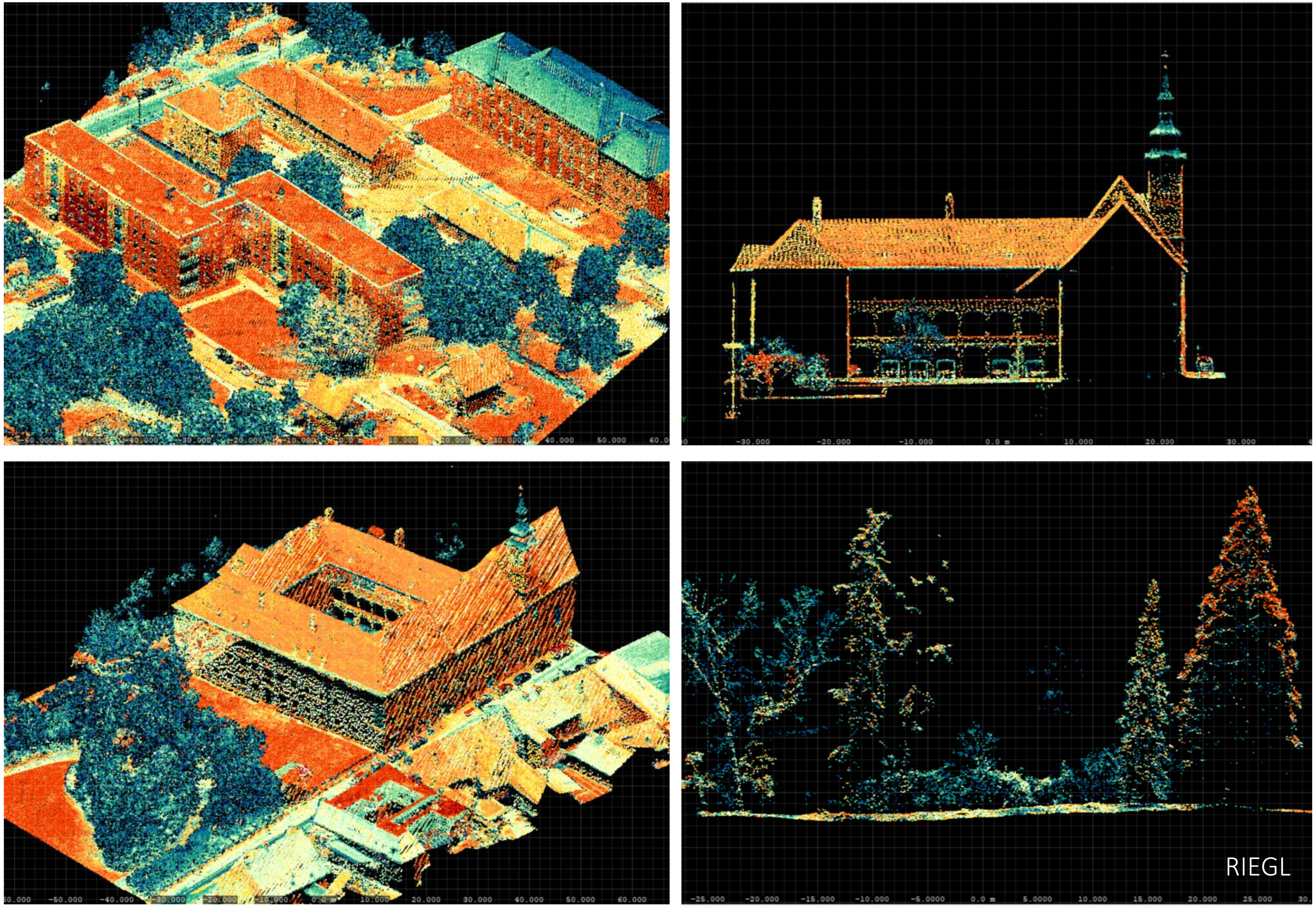
RIEGL

VQ-680 OEM

FIRST TEST FLIGHT RESULTS

Scanning at various angles brings many benefits:

- Excellent coverage of vertical structures (facades, tree shapes, …)
- Enhanced penetration of vegetation (ground level under dense tree canopy)
- Availability of façade points for even the narrowest inner courtyards



UltraCam Dragon 4.1

SOFTWARE WORKFLOW

PLAN	COLLECT	PROCESS
	Camera Operating Software (COS)	UltraMap
TOPOFLIGHT MISSIONPLANNER	TOPOFLIGHT NAVIGATOR	Applanix POSPac MMS
RiParameter	RiAcquire	RiProcess, RiUnite

Workflow overview

FIVE MODULES

Data Import

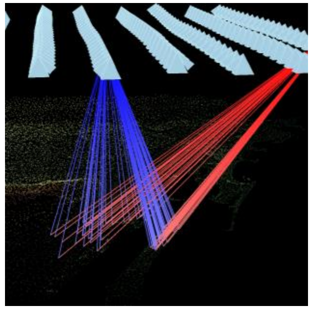
ULTRAMAP ESSENTIALS

Radiometrically aligned Images (PAN, RGBI, RGB, CIR)

Automated global color balancing for nadir and oblique imagery

TIFF (8/16 Bit), JPEG, GeoTIFF, WorldFile

ULTRAMAP AT

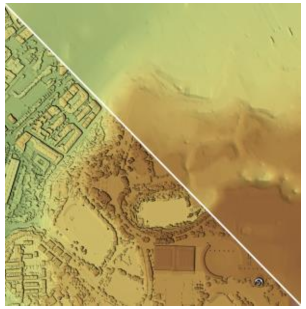


Exterior orientations

Interactive bundle adjustment for all viewing directions

CSV, Bingo, PAT-B

ULTRAMAP DENSE MATCHER



DSMs, DTMs and colored point clouds

High-density elevation with sharp edges and accurate geometry

GeoTiFF, LAS

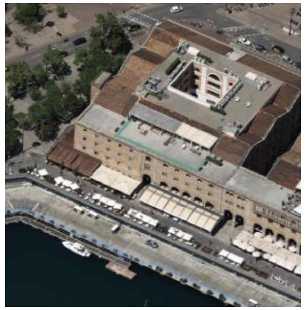
ULTRAMAP ORTHO PIPELINE

DSMOrthos and DTMOrthos

Sharp and noise free images with fine detail throughout the entire image

GeoTIFF, WorldFile, Seamlines

ULTRAMAP 3D



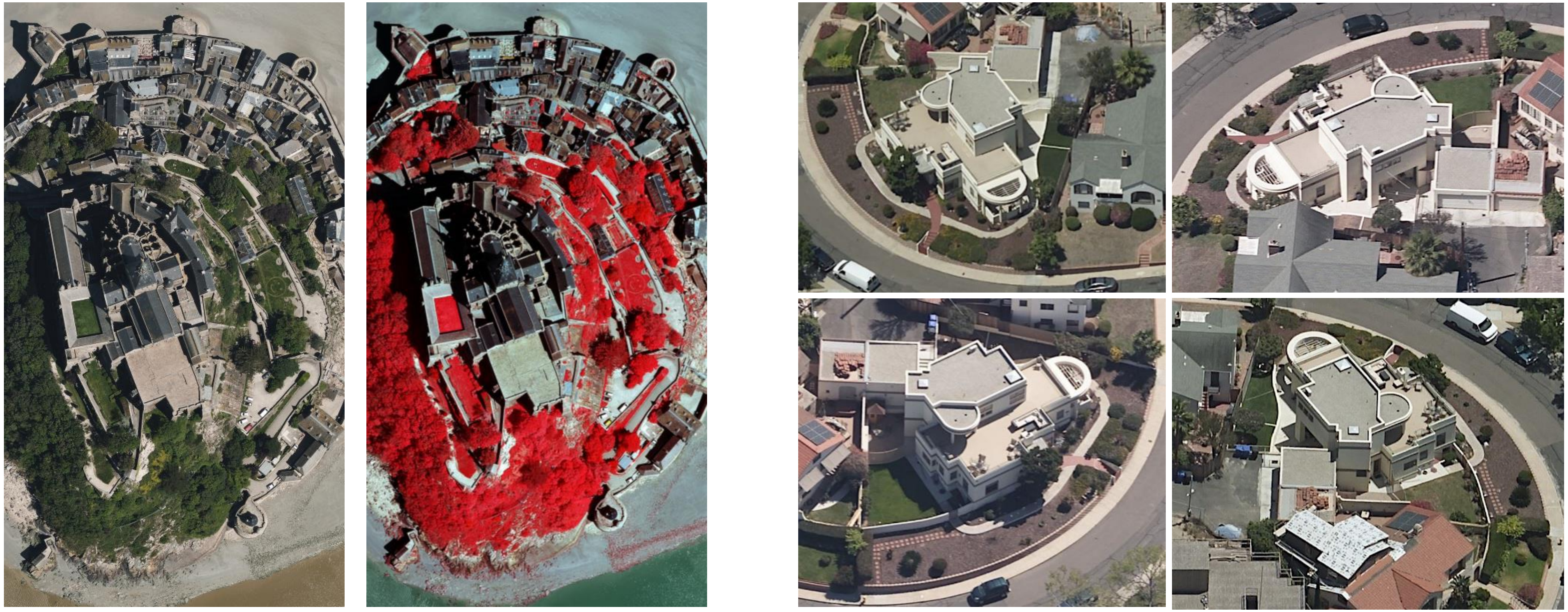
3D textured TINs and point clouds

3D data generation plus interactive view and export module

LAS, OBJ, DAE, OSGB, LODTreeExport

UltraCam Dragon 4.1 & UltraMap

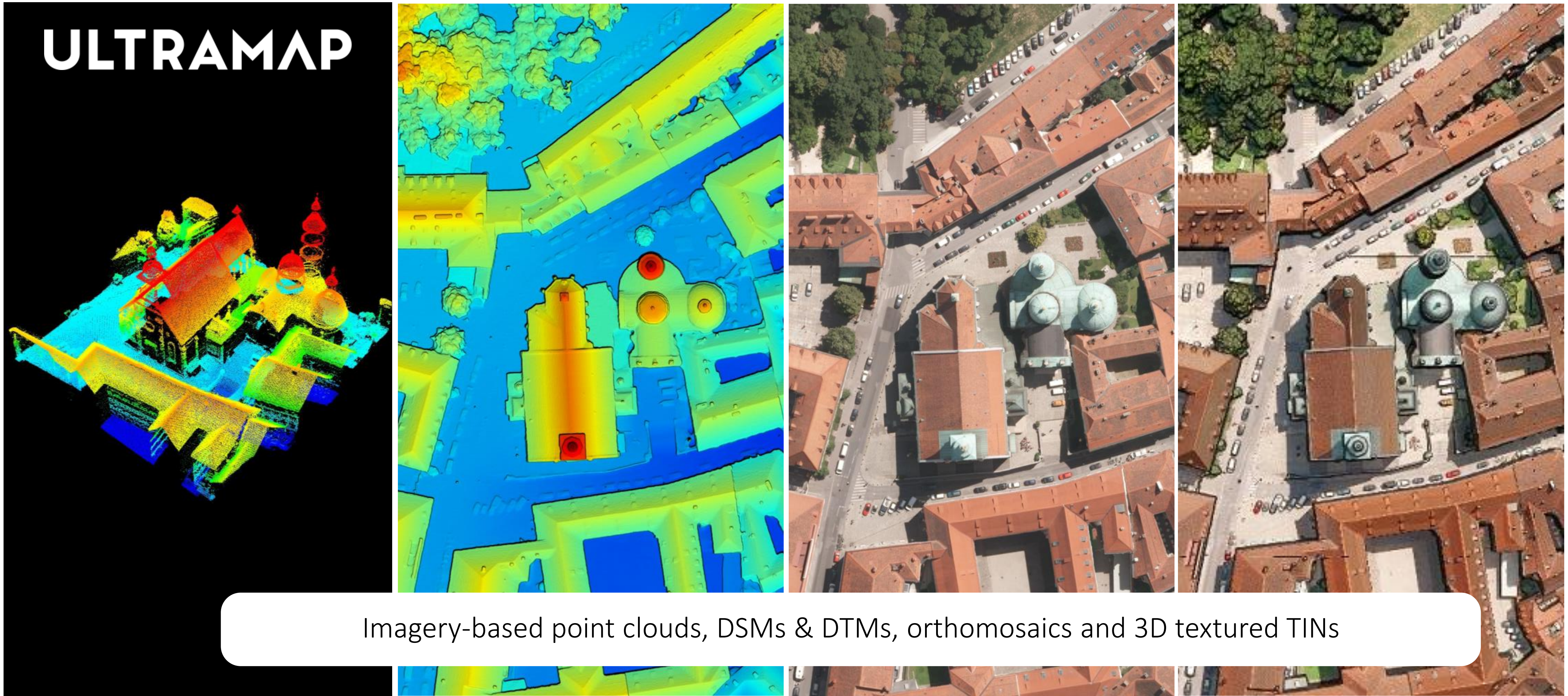
IMAGERY-BASED DATA PRODUCTS



RGB & CIR Nadir images, RGB oblique images

UltraCam Dragon 4.1 & UltraMap

IMAGERY-BASED DATA PRODUCTS



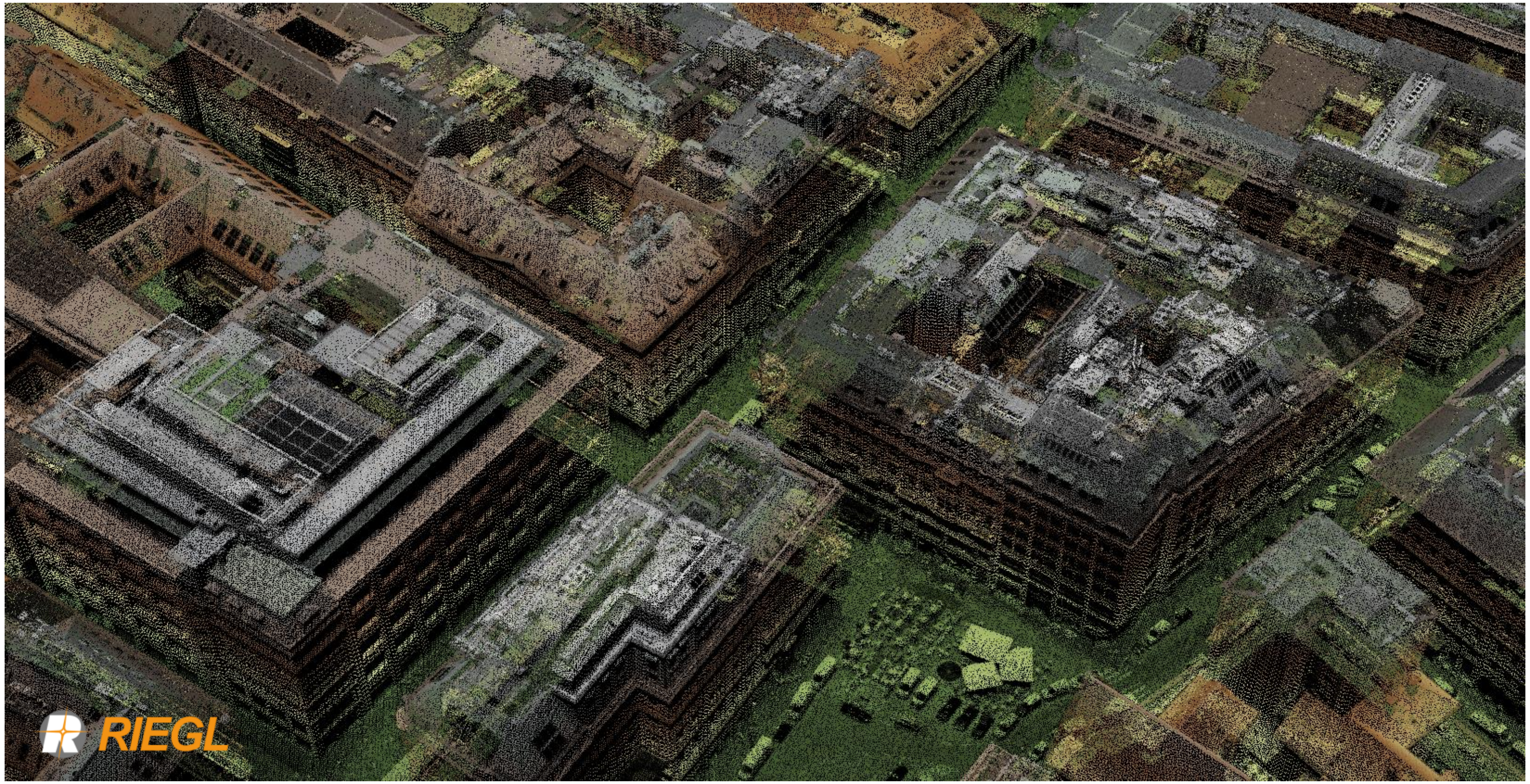
Imagery-based point clouds, DSMs & DTMs, orthomosaics and 3D textured TINs

UltraCam Dragon 4.1 & RiProcess

LIDAR-BASED DATA PRODUCTS

Lidar point clouds are inherently ortho-rectified and provide exceptionally good vertical height control, compared to imagery.

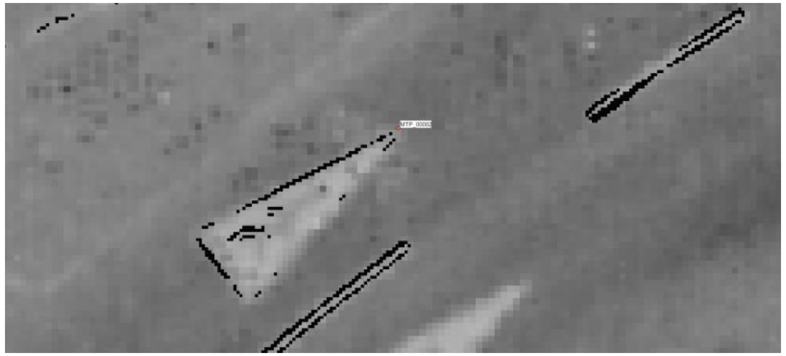
Colored by elevation and intensity.

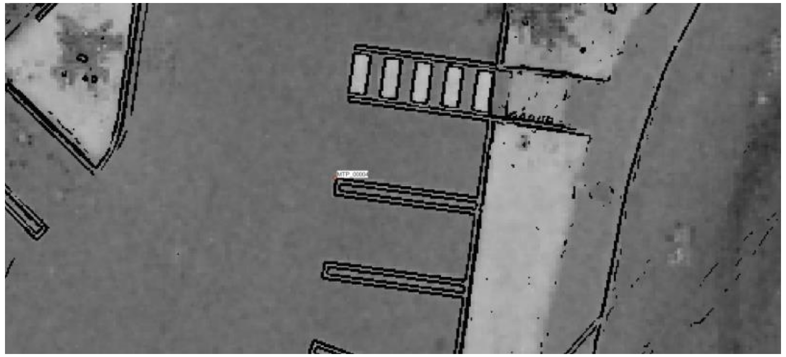


Work in Progress: Verification

ALIGNMENT OF CAMERAS AND LIDAR

- Checking relative orientation of imagery and lidar
- As early as possible in the workflow
- Simple approach:
  - Measure points in imagery
  - Measure the same points in lidar (use intensity information)
  - Calculate residuals
- Image measurements can be filtered to describe single camera components (nadir, nadir & oblique, oblique)





Work in Progress: Modification

ALIGNMENT OF CAMERAS AND LIDAR

- Use measured coordinates of points in imagery and lidar from verification
- Calculate transformation parameters
- Apply transformation to point cloud
- Rerun verification with point measurements

THANK YOU!