

UltraCamX

Digital Aerial Camera

Microsoft
Photogrammetry

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Stuttgart, September 2007

UltraCamX

Large Format Digital Frame Camera
Announced in May 2006

Microsoft

Acquires VEXCEL
May 2006

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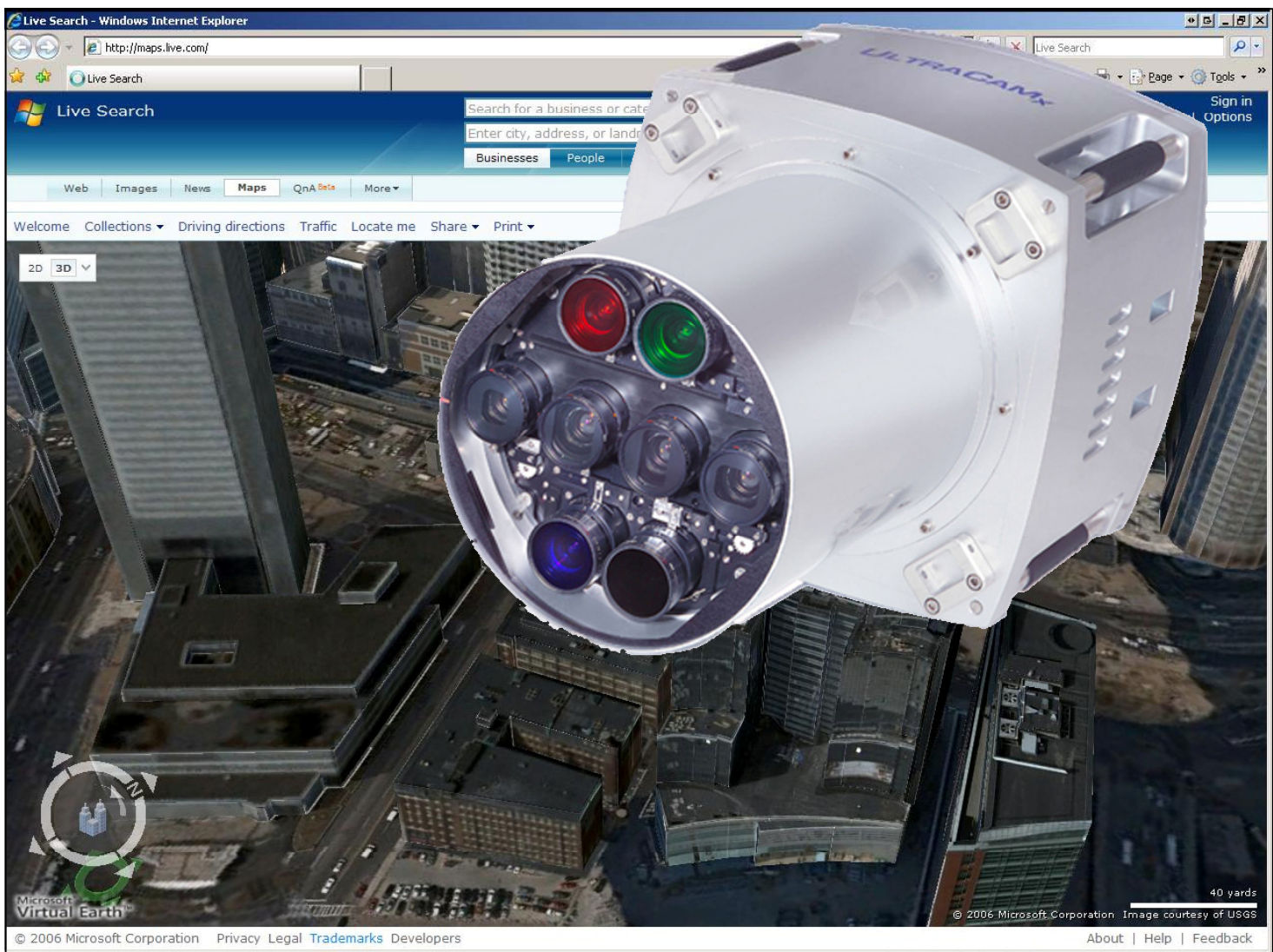
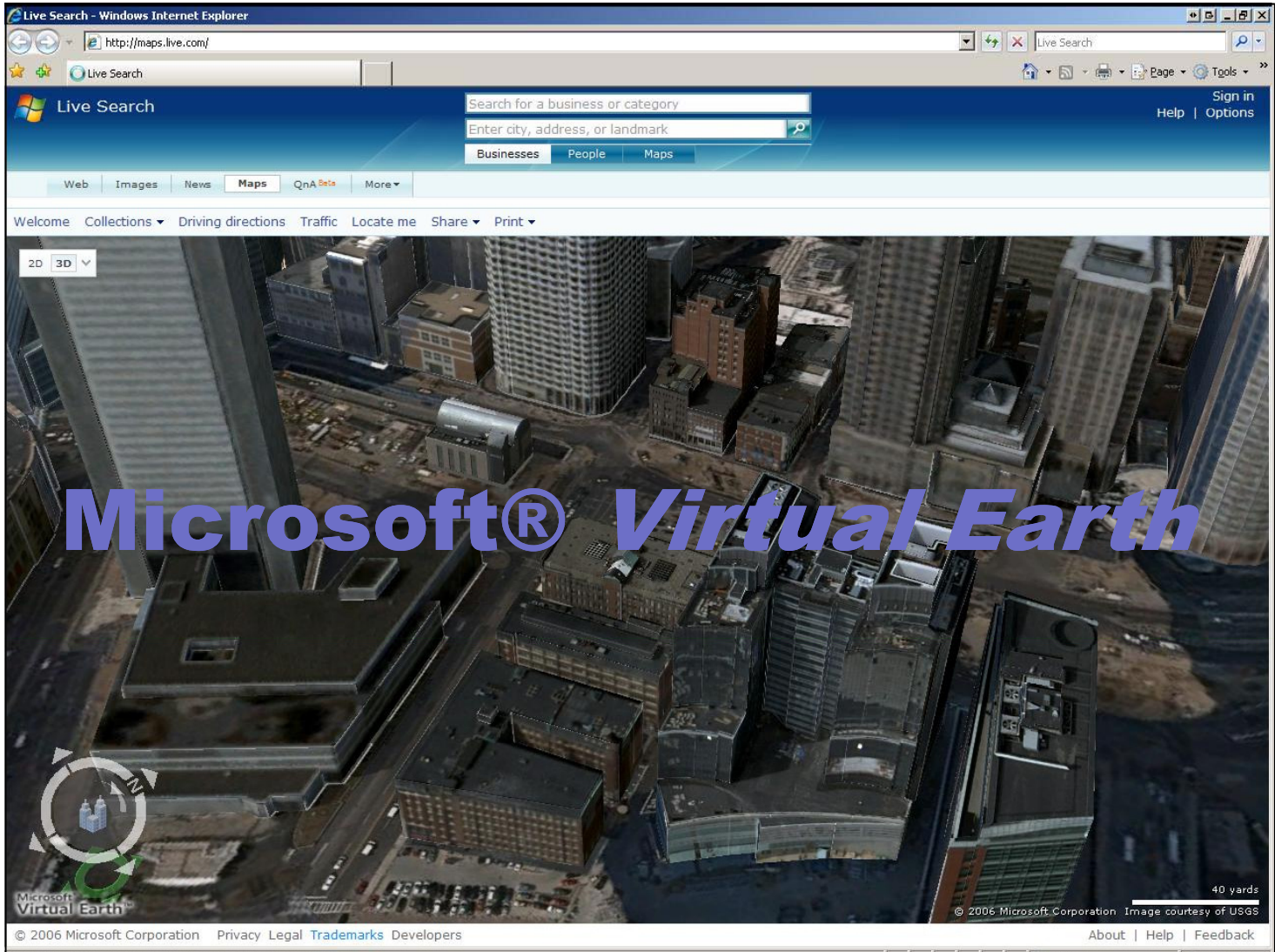
UltraCamX Camera System



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UltraCam_x

Largest Image Format

14430 by 9420 pixel (136 Mpixel)

Novel on board Data Storage

‘unlimited’ storage space

Short frame intervall (1,35 sec)

2,5cm GSD / 60% Endlap / 140 kn



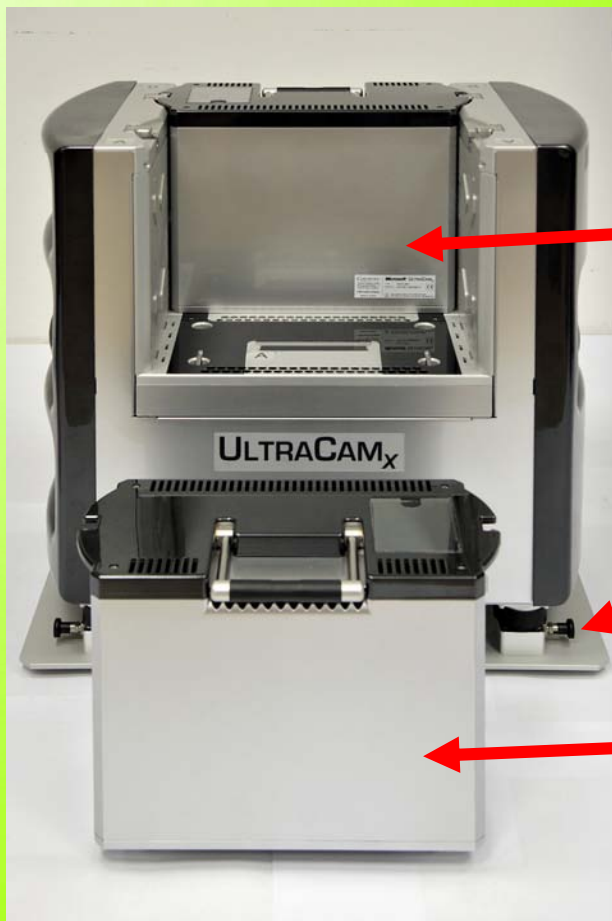
**New CCD Sensors
(7.2 μm pitch)**

**New Lens System
(100mm / 33mm)**

Improved Design

Sensor Unit SUx

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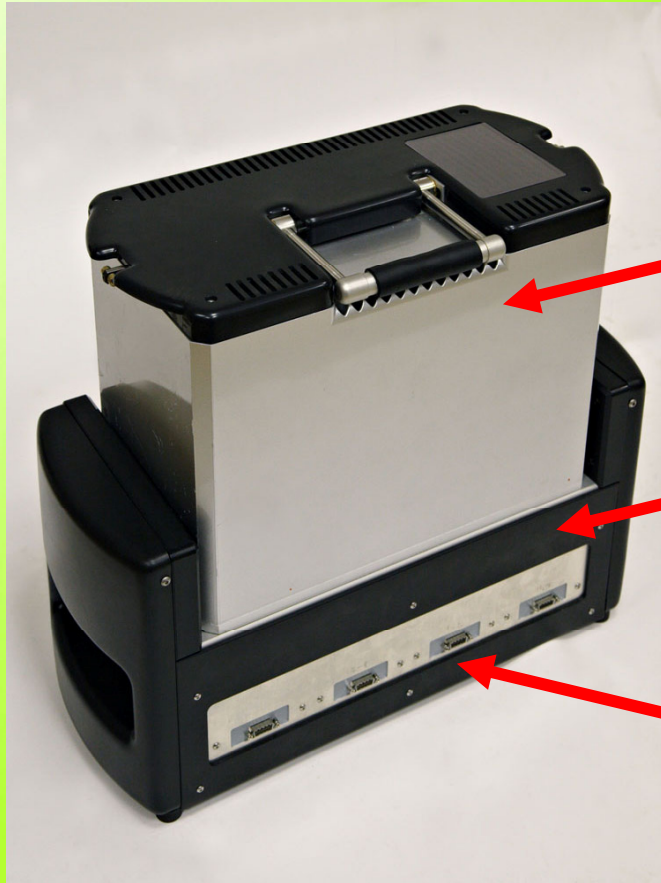


Computing Unit

Aircraft Plate

**exchangeable
Data Unit**

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Data Unit

Docking Station

**4 parallel
Download ports**

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End-to-End Digital Workflow



Recording



Mission Office

UltraCamX and Data Unit X



Download



Main Office



Archiving

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UltraCam

Background Information

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Design Basics

Panchromatic Channel:

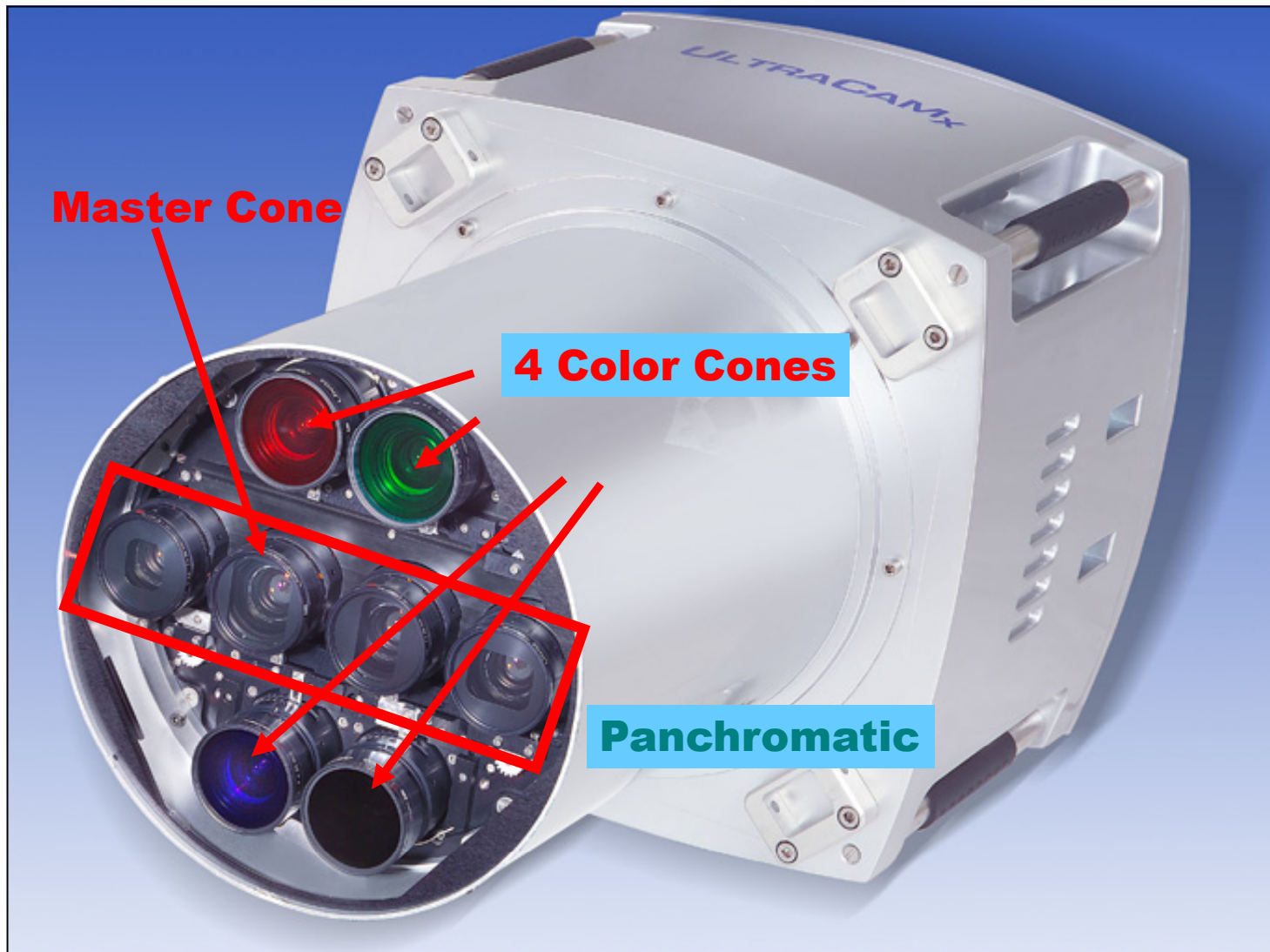
**Set of four Cones and 9 CCDs
one Master Cone**

Multispectral Channels:

Set of four Cones

Red-Green-Blue-Nir

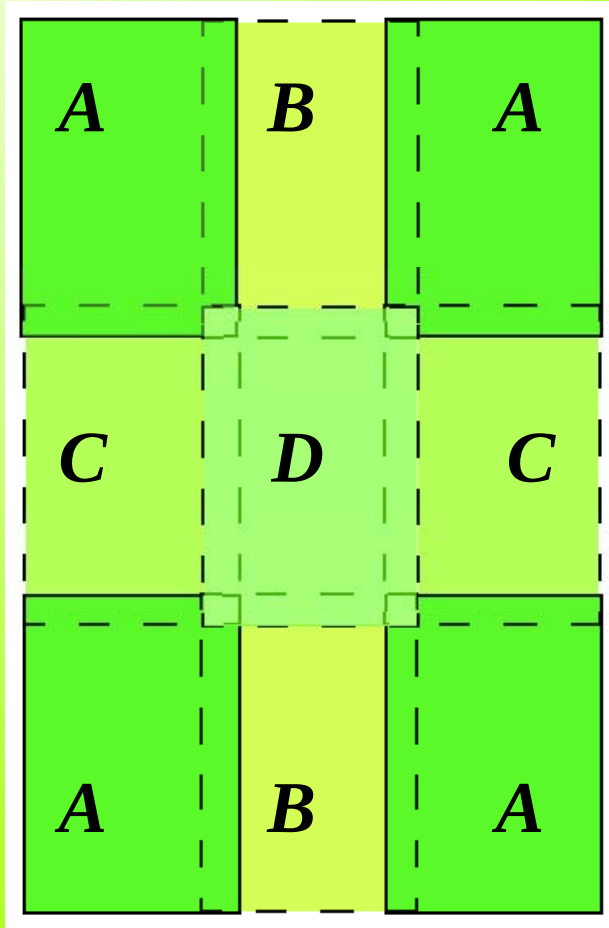
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Panchromatic Large Format Image

Master Cone





4 Cones

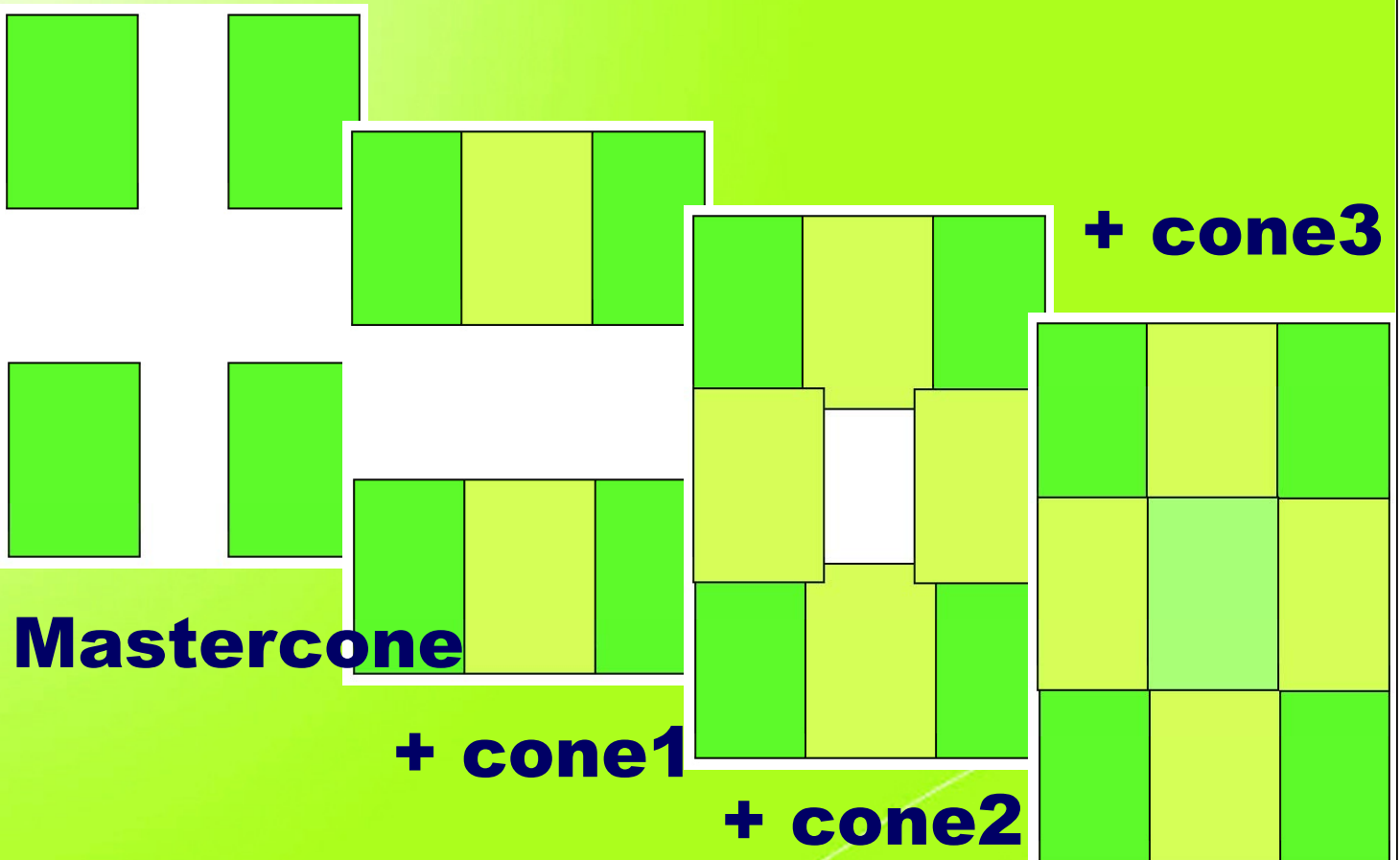
4 Lenses

4 Focal Planes

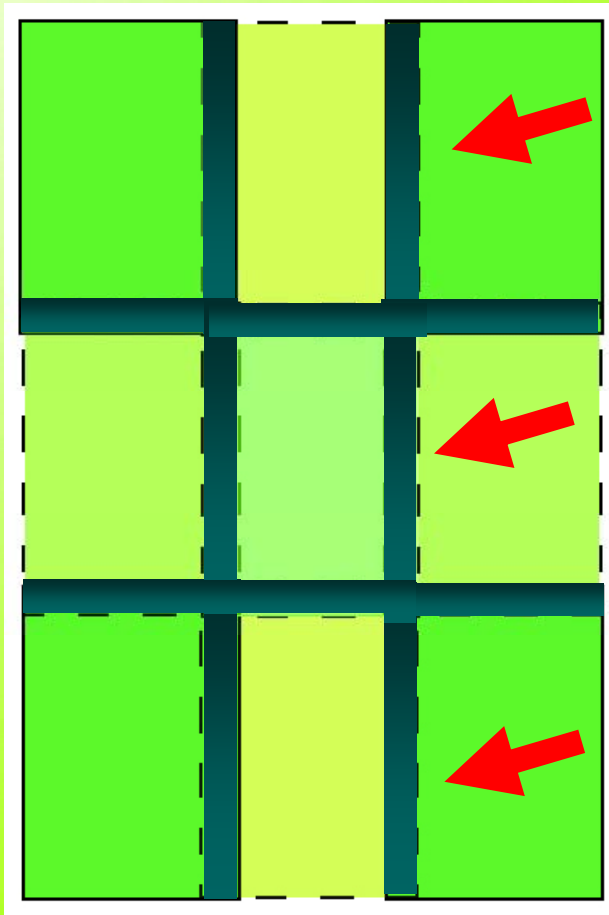
9 CCD SensorArrays

12 Overlap Areas

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Stuttgart, September 2007



4 Cones

4 Lenses

4 Focal Planes

9 CCD SensorArrays

12 Overlap Areas

Stuttgart, September 2007

■ **Stitching**

is subpixel accurate ($RMSE > 0.1$ Pixel)

▪

is documented for each frame (XML)

▪

is the basis for geometric QC of each frame

▪

improved by material parameters of the camera body

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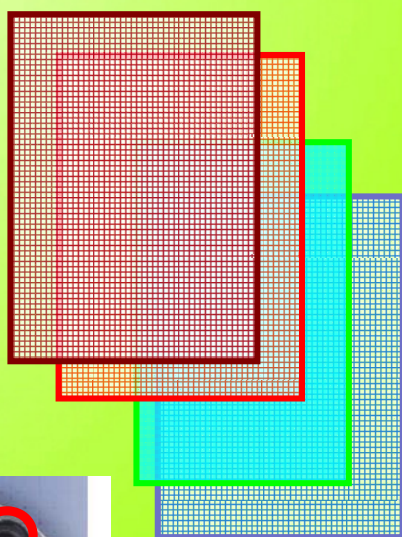
Multispectral (RGB+NIR) Image

RGB and NIR

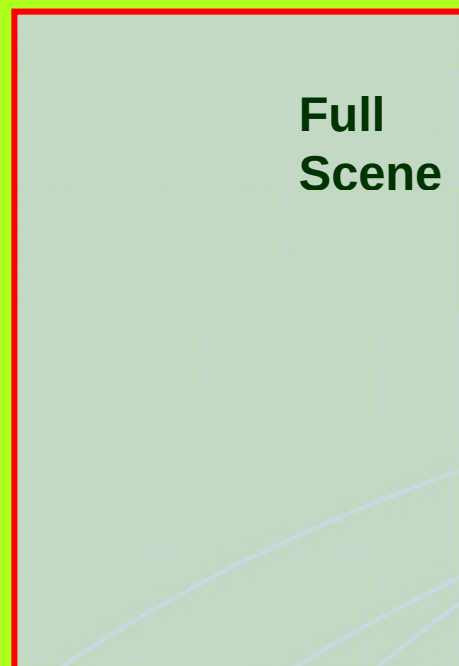


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Cone # 5,6,7,8, each 1 Sensor Elements



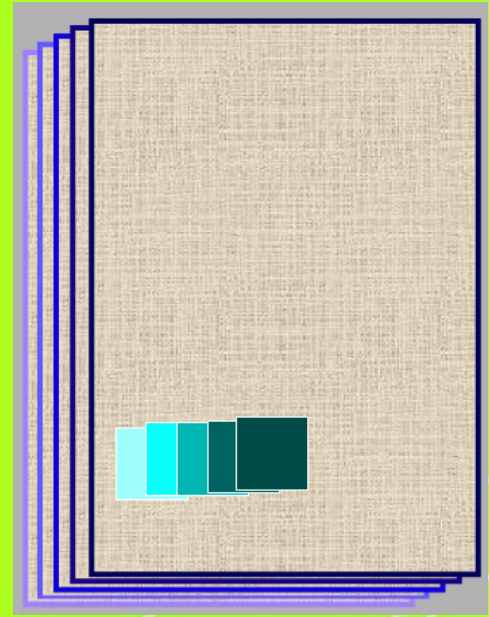
**RGB/IR
bands
merged
with pan
scene**



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■ **UltraCamX, Forward Motion Compensation (FMC)**

**Implemented by
TDI
(Time Delayed Integration)
Up to 50 pixel**



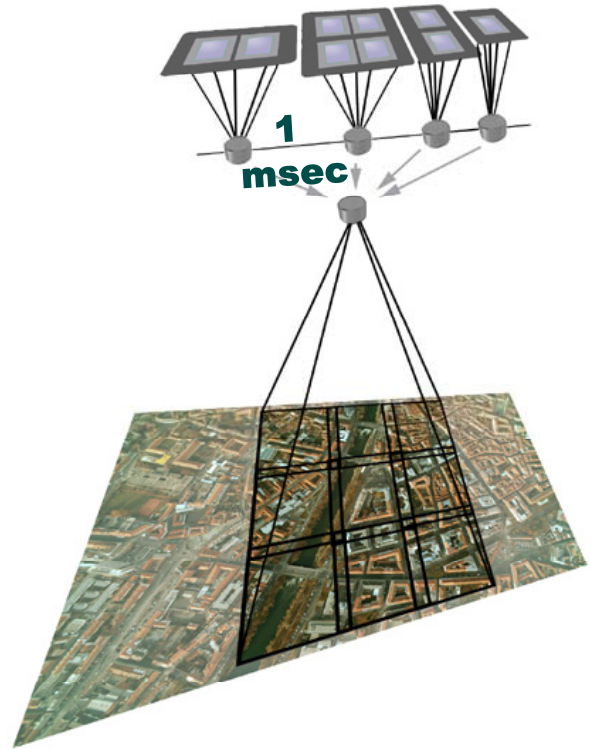
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Syntopic Exposure

Synchronous
vs
Syntopic

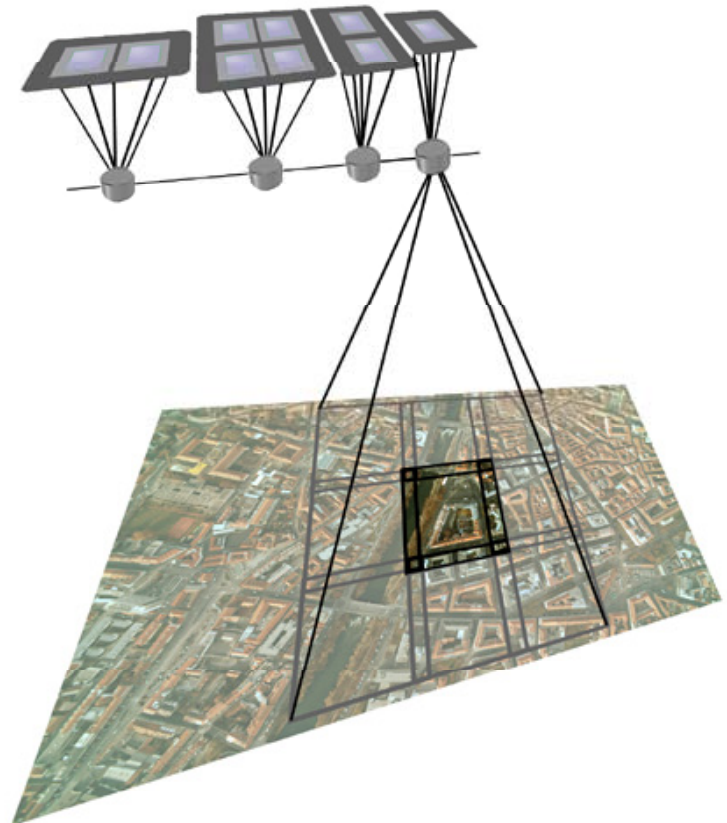
Option:
Position of the four
camera cones
at identical positions
("Syntopic" exposure)



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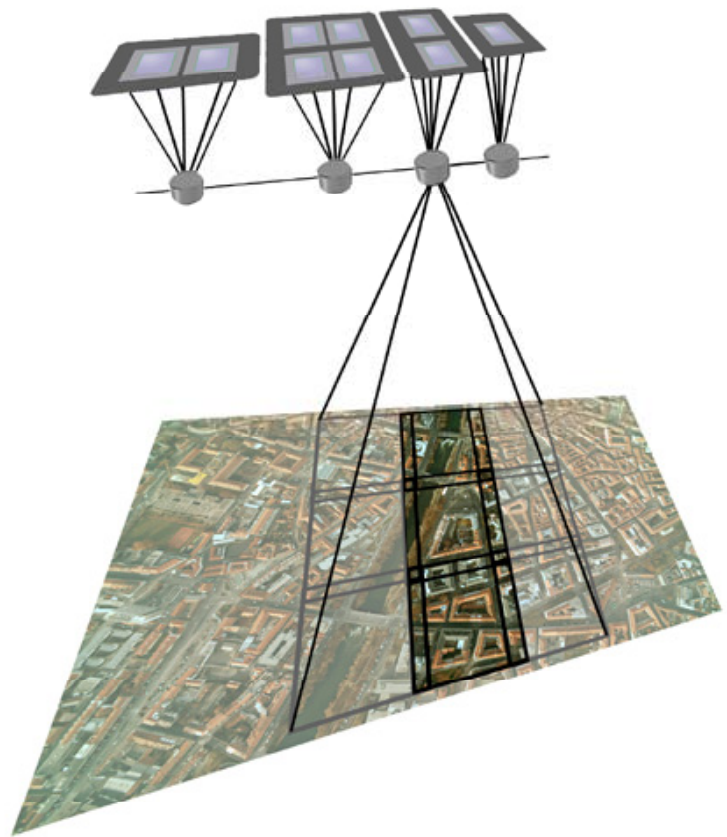
Time t_1
($t_1 + 0$ msec)

Start Expo
Cone 1



Time t_2
 $(t_1 + 1 \text{ msec})$

Start Expo
Cone 2



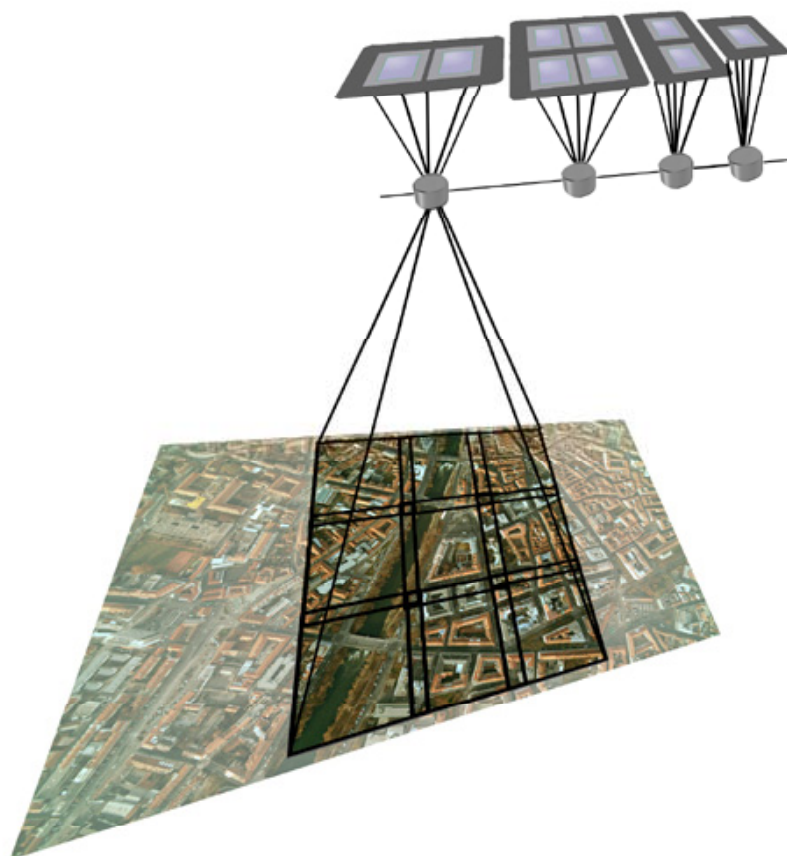
Time t_3
 $(t_1 + 2 \text{ msec})$

Start Expo
Cone 3



Time t_4
 $(t_1 + 3 \text{ msec})$

Start Expo
Cone 4



Full Frame
 $T_1 + 3 \text{ msec}$

Cone
1+2+3+4





Large Scale Capability

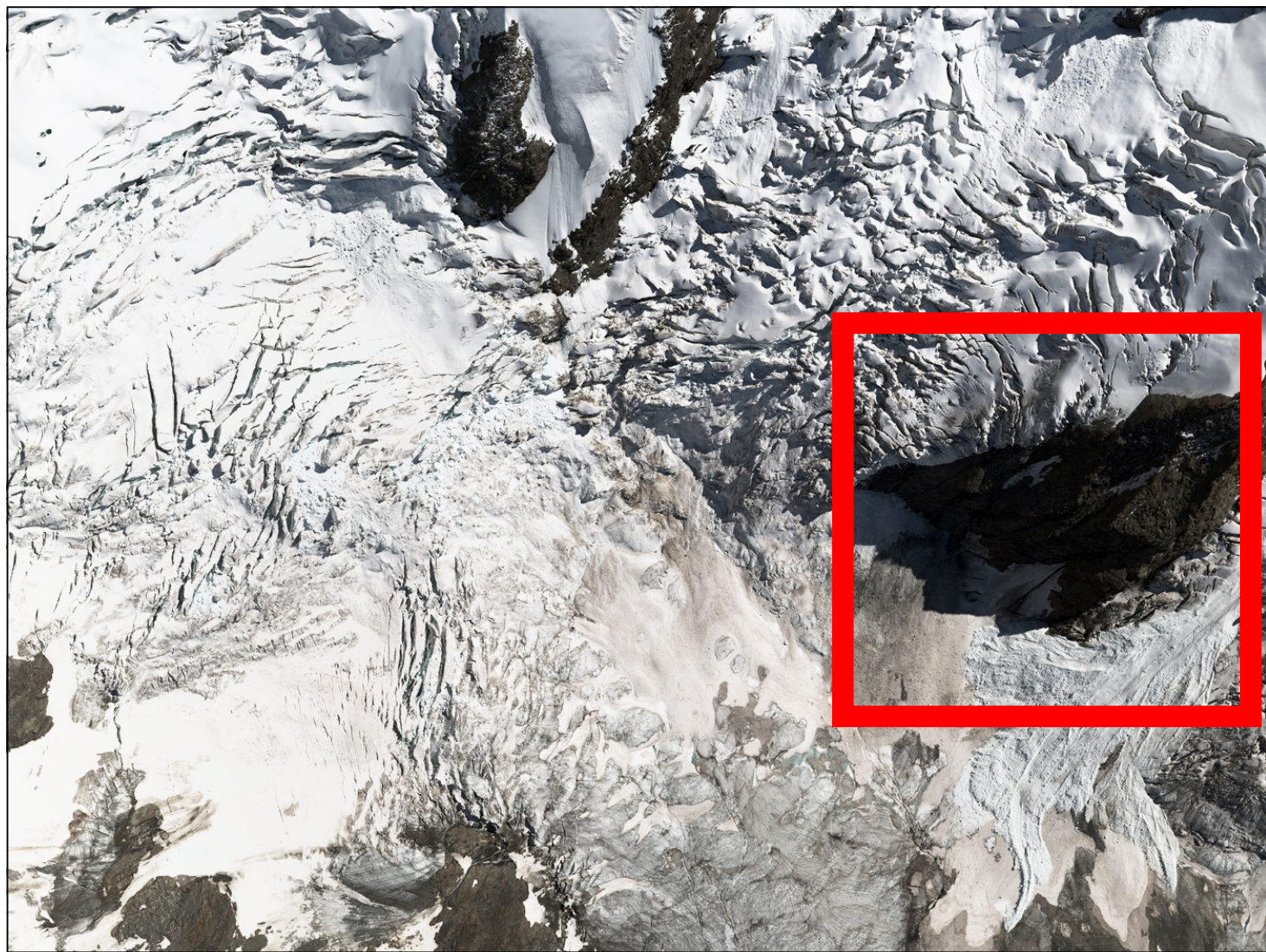
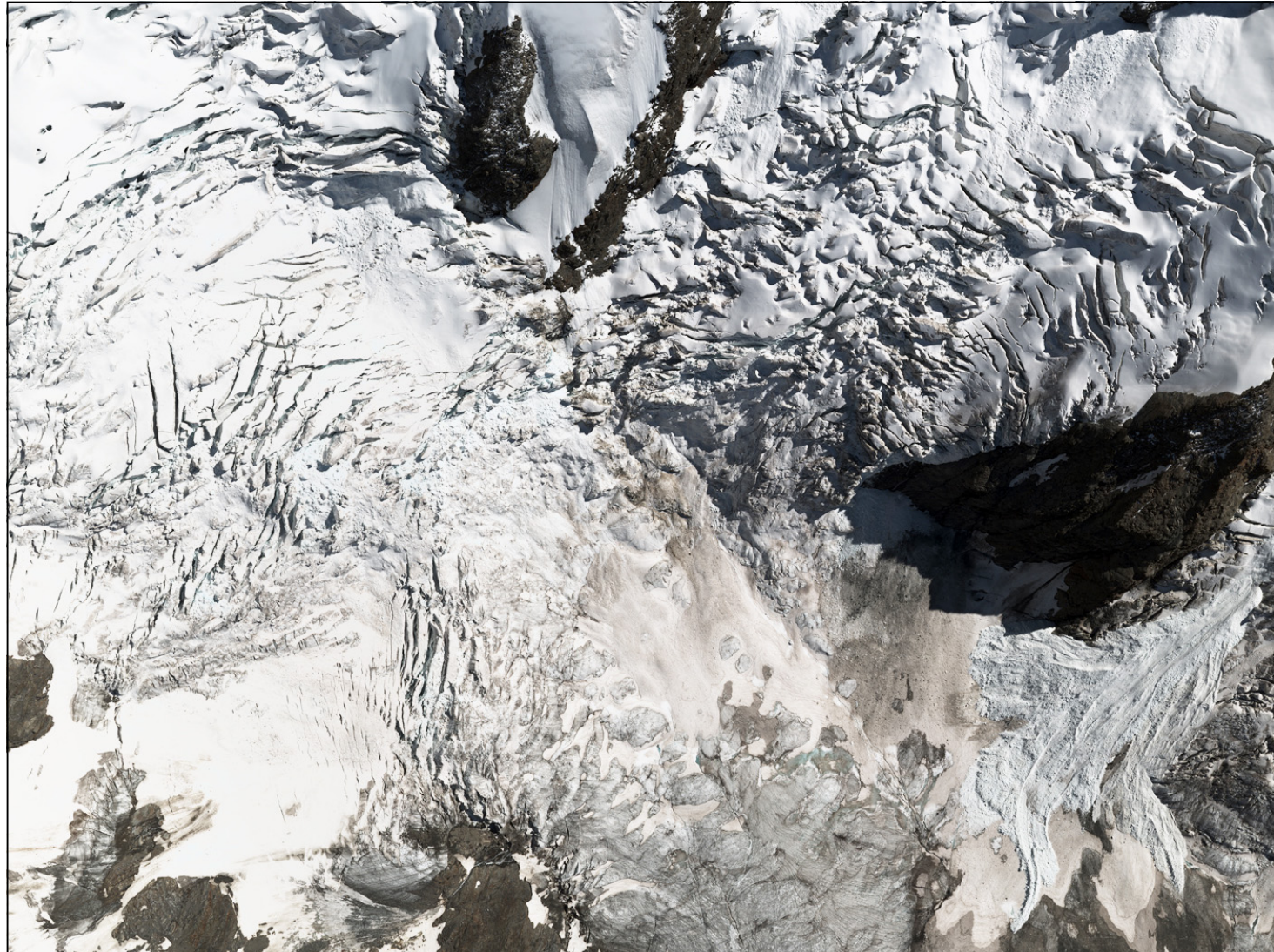
Graz, Airport Thalerhof
GSD: 8 cm

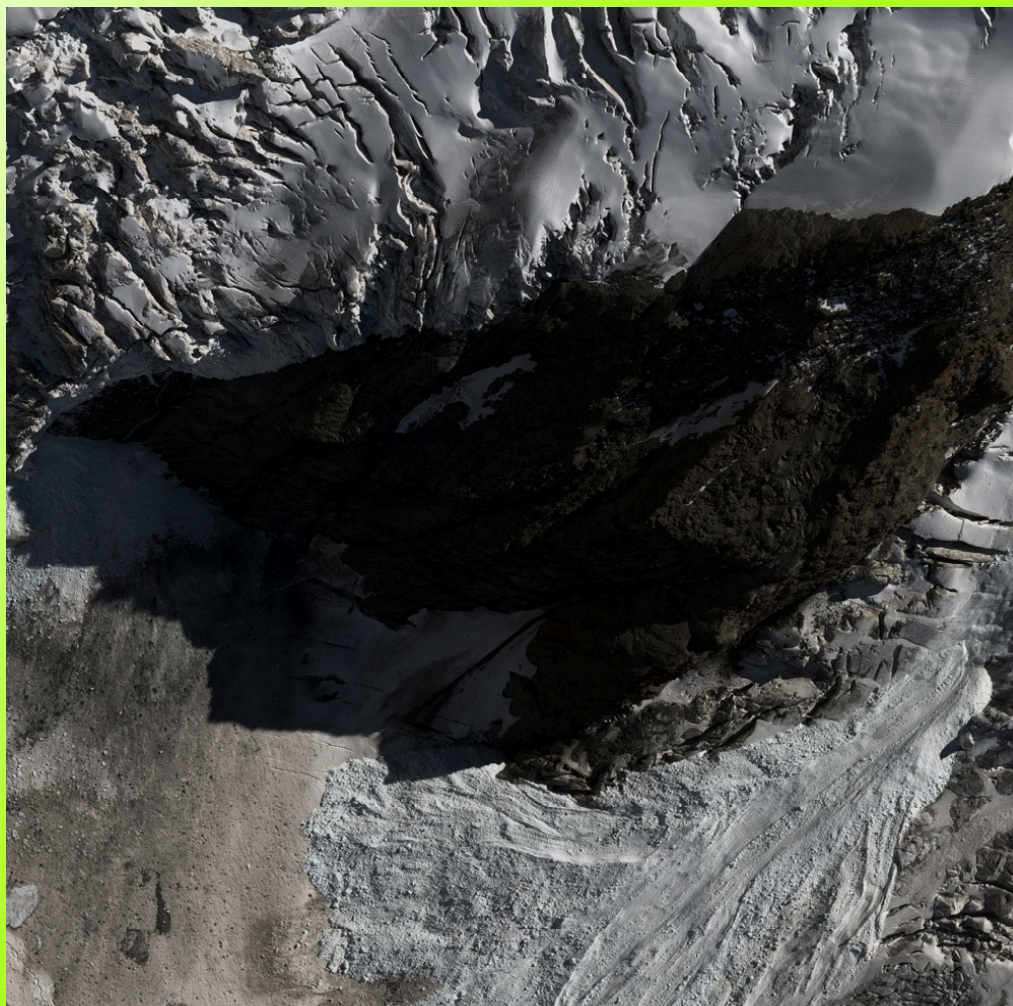
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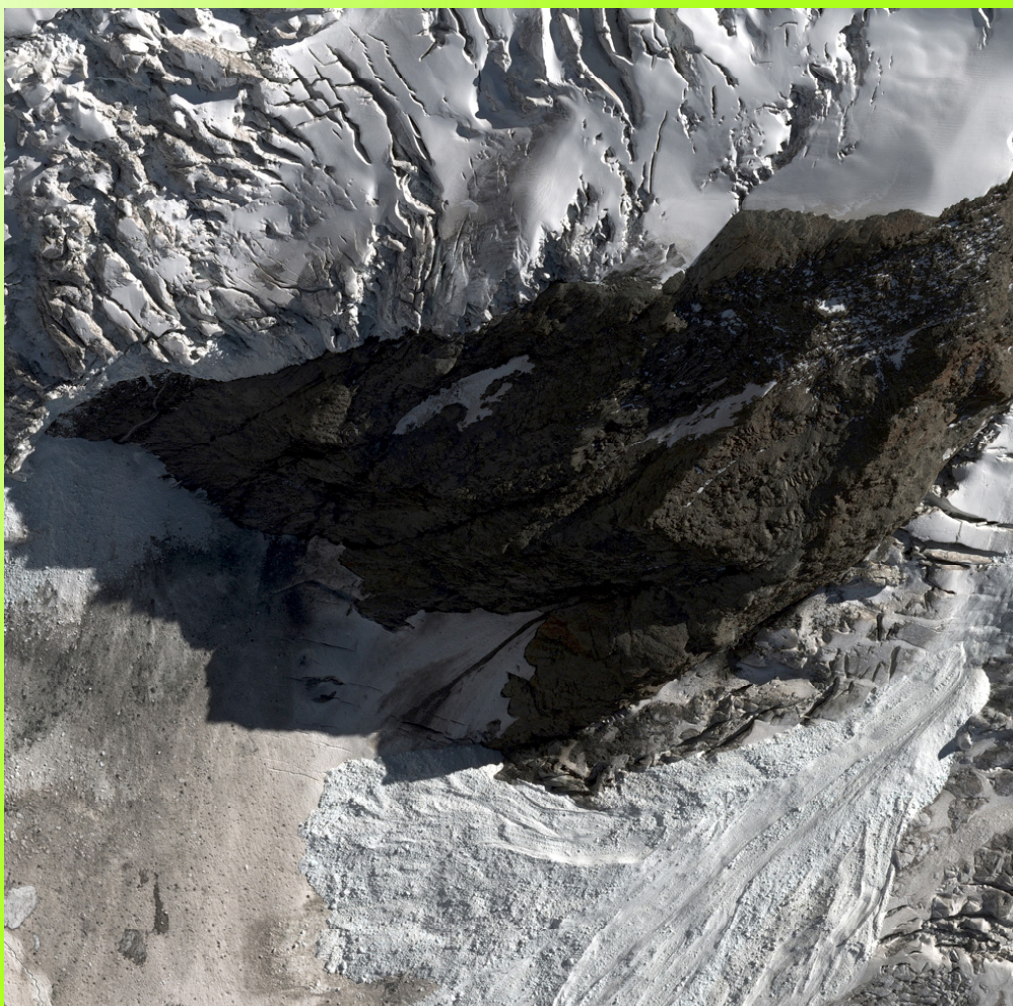


Radiometric Performance Resolving Dark and Bright

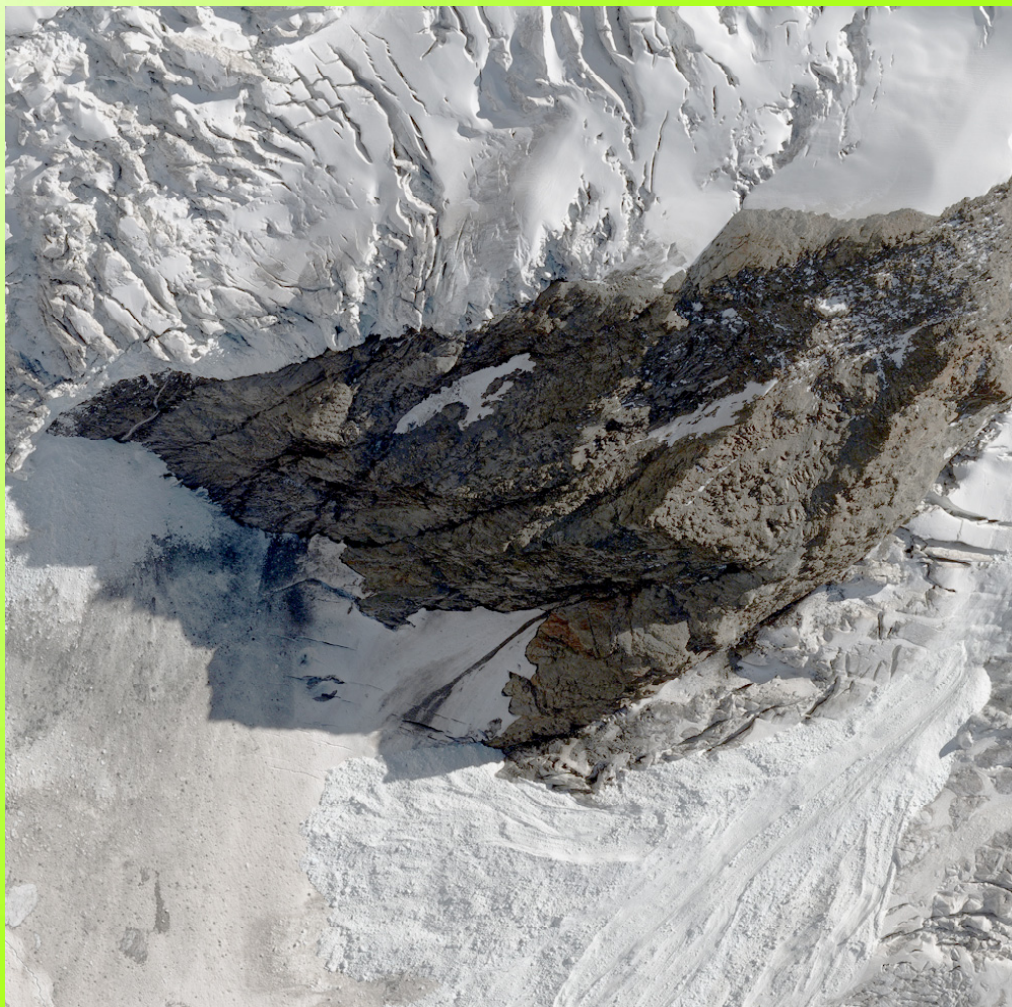




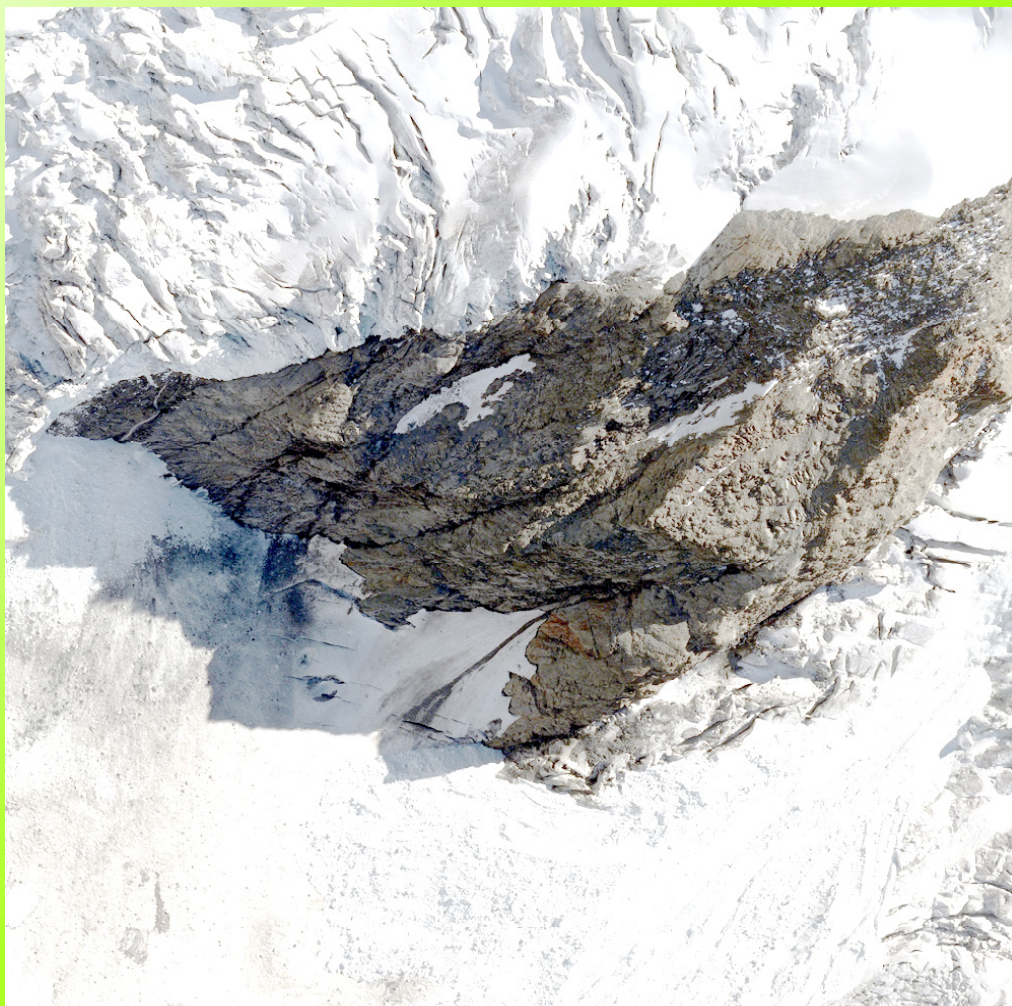
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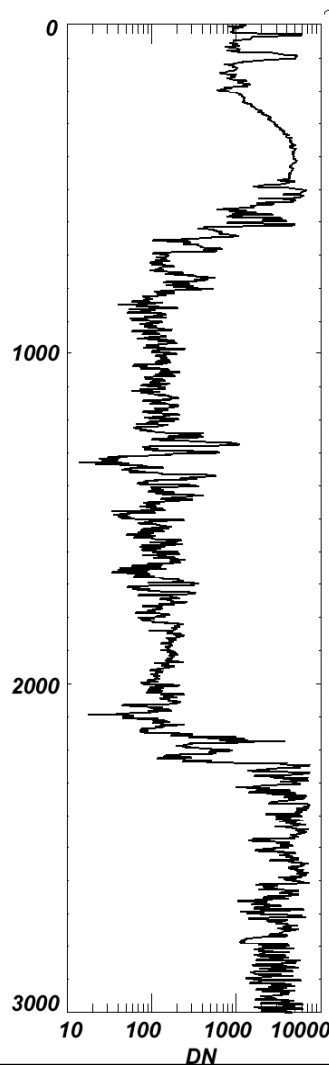
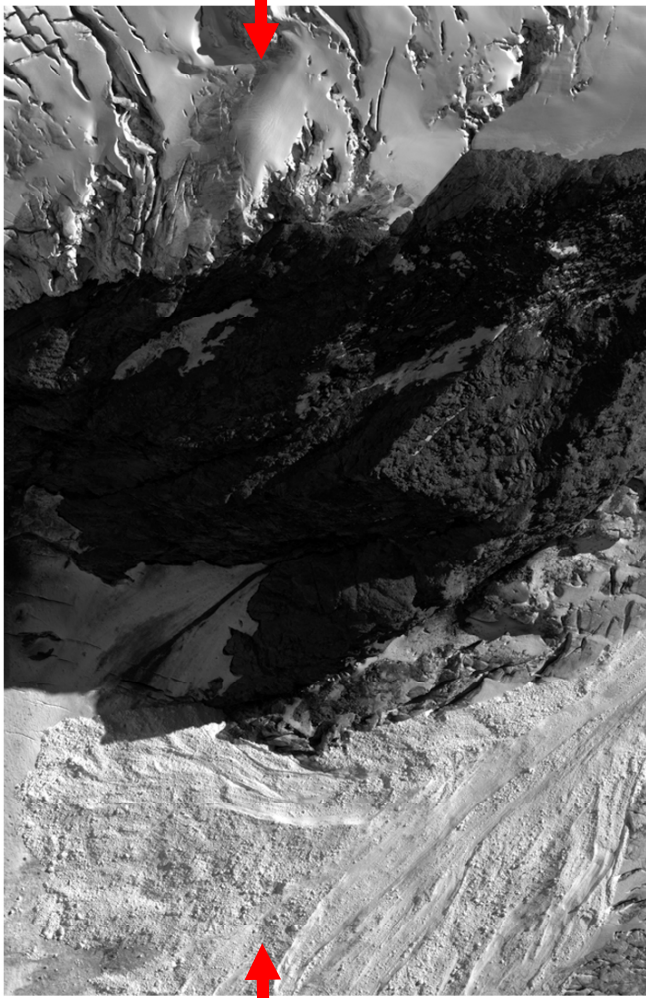
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Area:

Min 474

Max 7896

12.9 bit
(12.2 bit S/N)

Profil:

Min 488

Max 7804

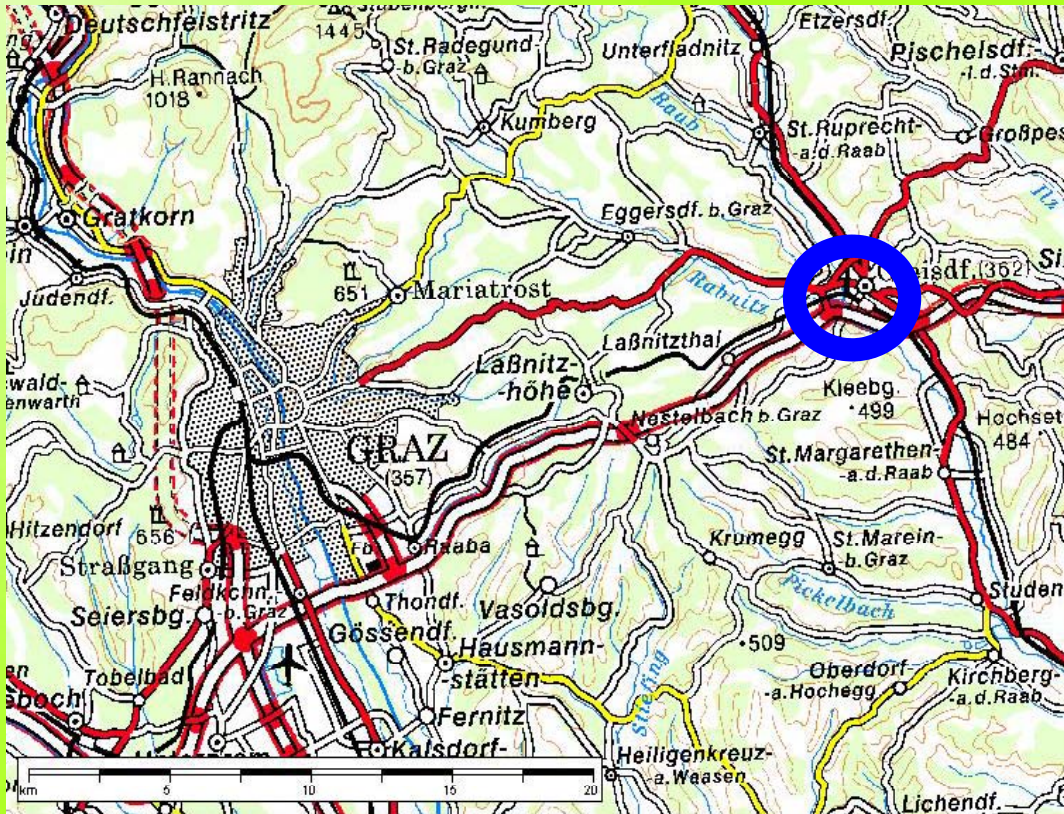
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Geometric Performance

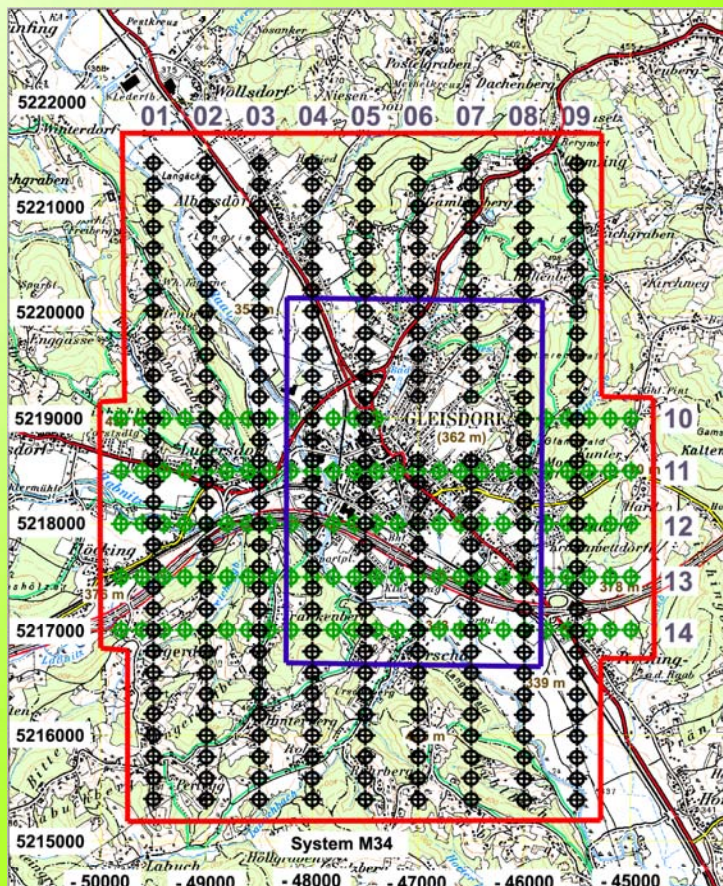
Test Flights and Aero-triangulation Results

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Testarea Gleisdorf



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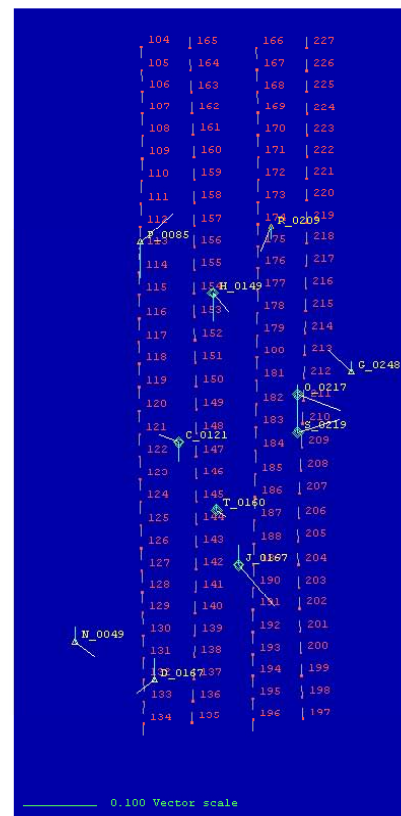
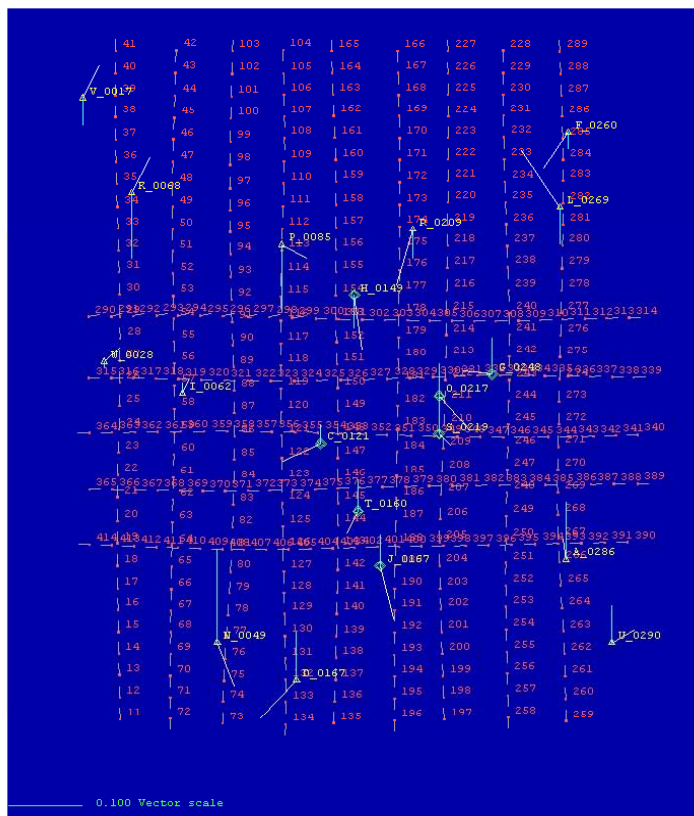
Flight Mission at two Altitudes

GSD 10 cm (1400m AGL)

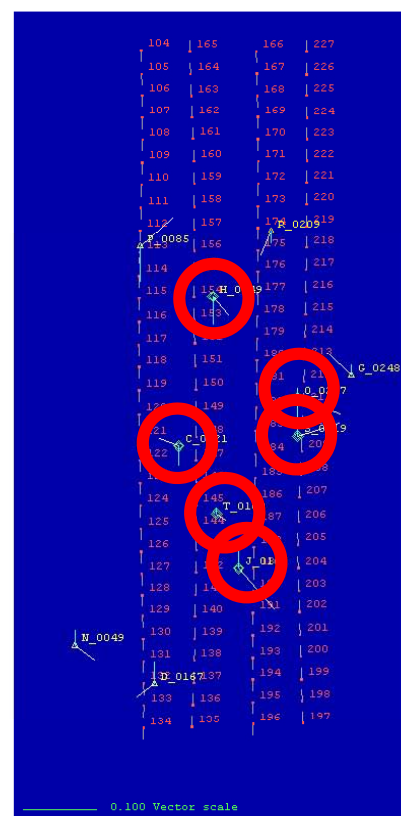
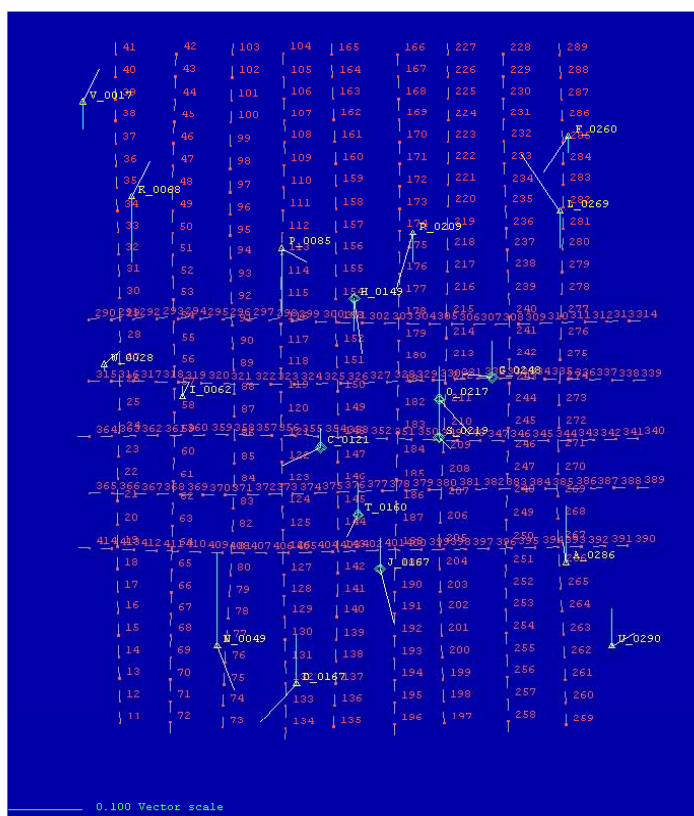
GSD 25 cm (3500m AGL)

**Cross Strips
Ground Truth (GCPs)
GPS/IMU**

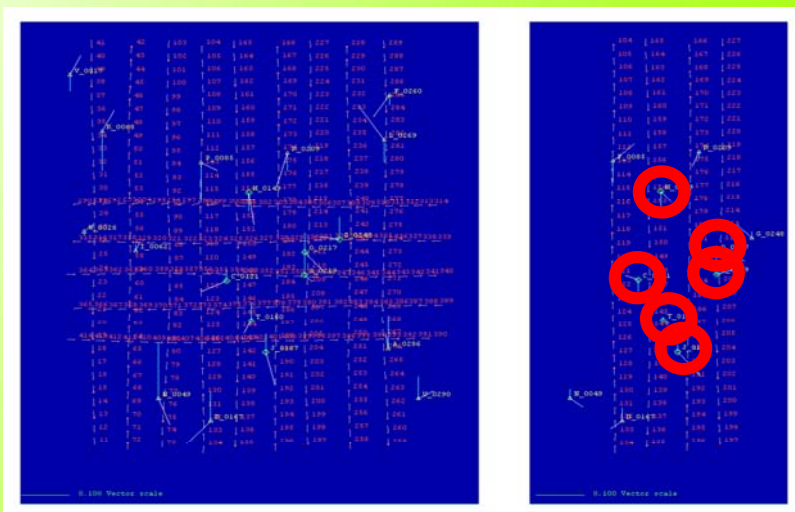
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Check Points	n	dX	dY	dZ (mm) at 10 cm GSD
	C_0121	-27.	10.	-26.
	H_0149	21.	-25.	-38.
	L_0167	49.	-57.	27.
	O_0217	58.	-22.	13.
	S_0219	57.	18.	59.
	T_0160	12.	-9.	7.
	RMS v.	42.	28.	33. (0.024o/oo)

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Geometric Performance 7 flight missions at 25 cm GSD

sigma_o	dX[cm]	dY[cm]	dZ[cm]
1.1 μm	4.1	4.3	4.1 (0.012 o/oo)
	5.7	7.1	9.4 (0.027 o/oo)

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Geometric Performance

14 flight missions at 10 cm GSD

sigma_o	dX[cm]	dY[cm]	dZ[cm]
1.0 μm	3.0	3.4	3.6 (0.026 o/oo)
	3.4	4.0	5.4 (0.038 o/oo)

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Geometric Performance

6 flight missions at 6 to12 cm GSD

sigma_o	dX[PX]	dY[PX]	dZ[PX]
1.1 μm	0.48	0.51	0.70 (0.050 o/oo)

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Geometric Performance

**Sigma_o is in the range of 0.73 to 1.65 (μm)
= 0.1 to 0.2 Pixel**

**RMSE accuracy in X/Y is ~ 0.3 to 0.5 Pixel
non signalized check points**

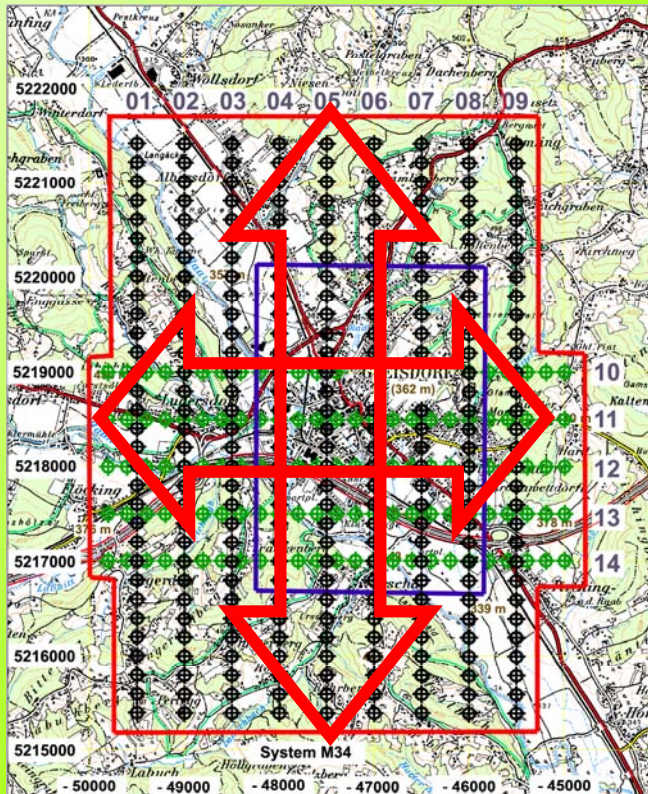
**RMSE accuracy in Z is ~ 0.3 to 0.7 Pixel
non signalized check points
(= 0.2 o/oo to 0.5 o/oo)**

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Geometric Performance

Results from a DSM analysis

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**2 DSM from
N-S flight
and
E-W flight**

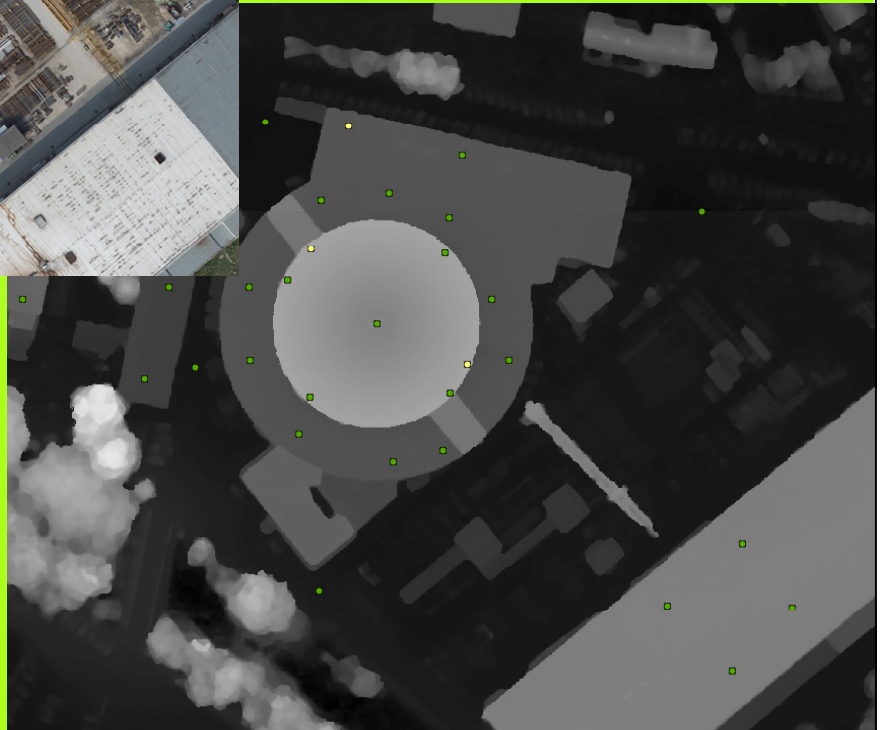
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**Images:
GSD = 10 cm
80% / 60% OLap**

Stddev(z):

**± 0.069 m (NS)
 ± 0.058 m (EW)**



Area1 Industrial Buildings



75 % < 2 Pixel (20 cm)

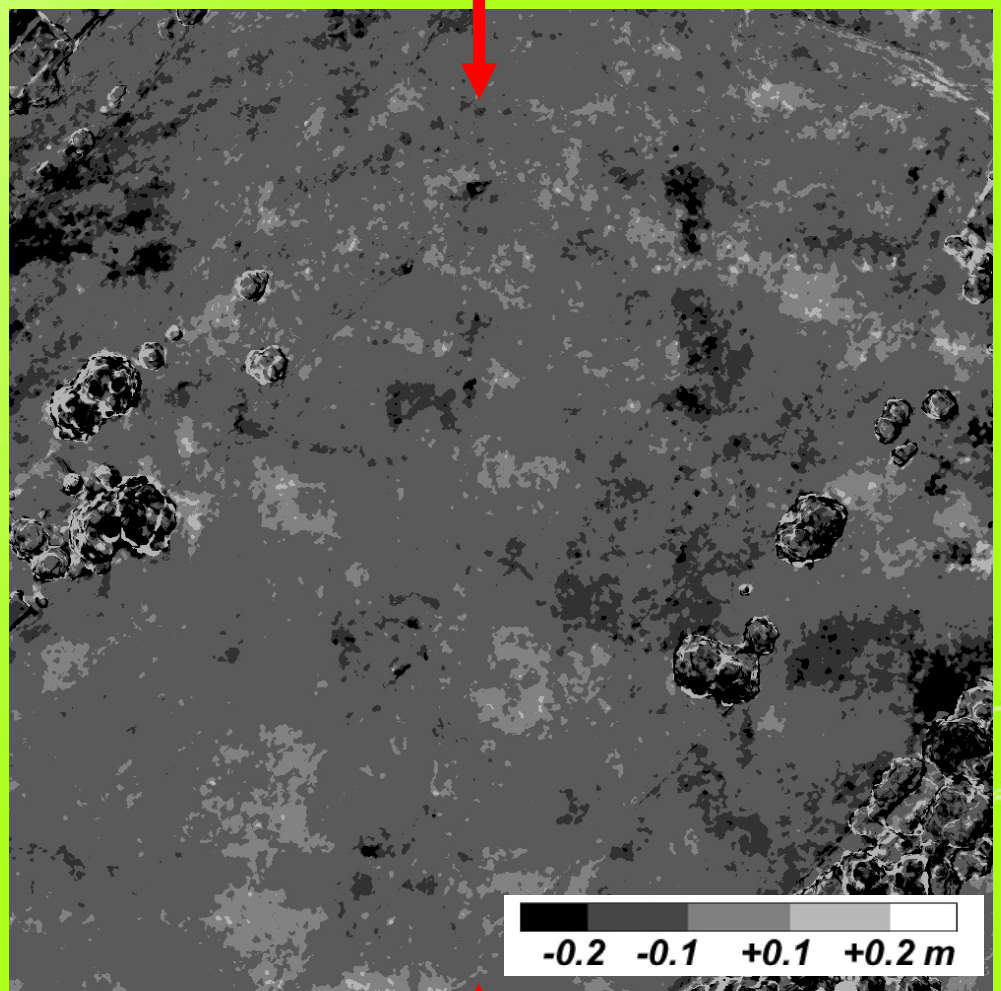
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Geometric Performance

Results from a DSM analysis

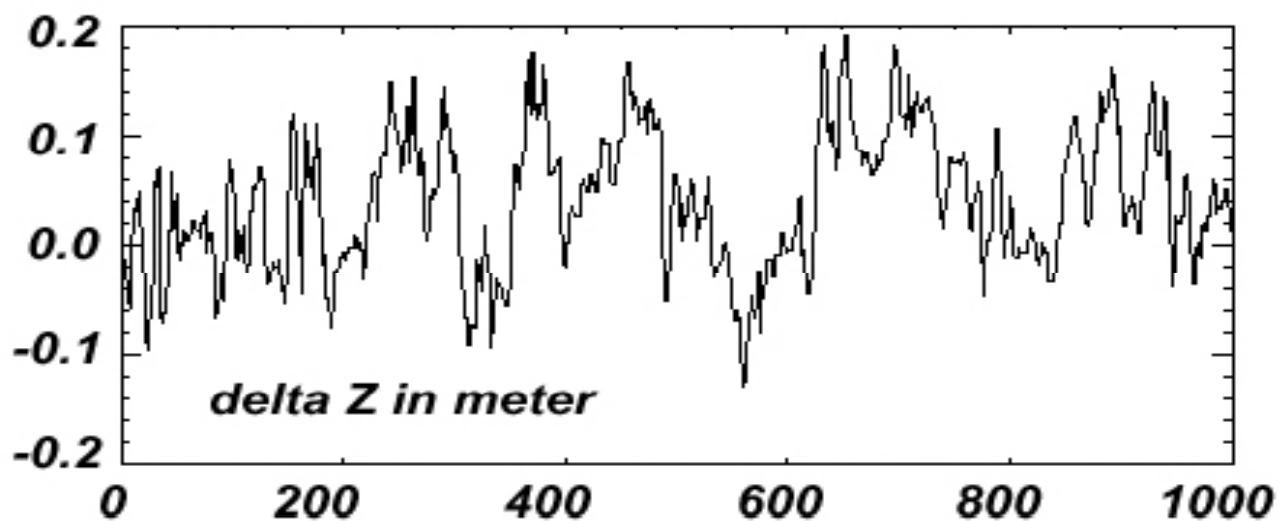
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Area2 Rural Area



70 % < 2 Pixel (20 cm)

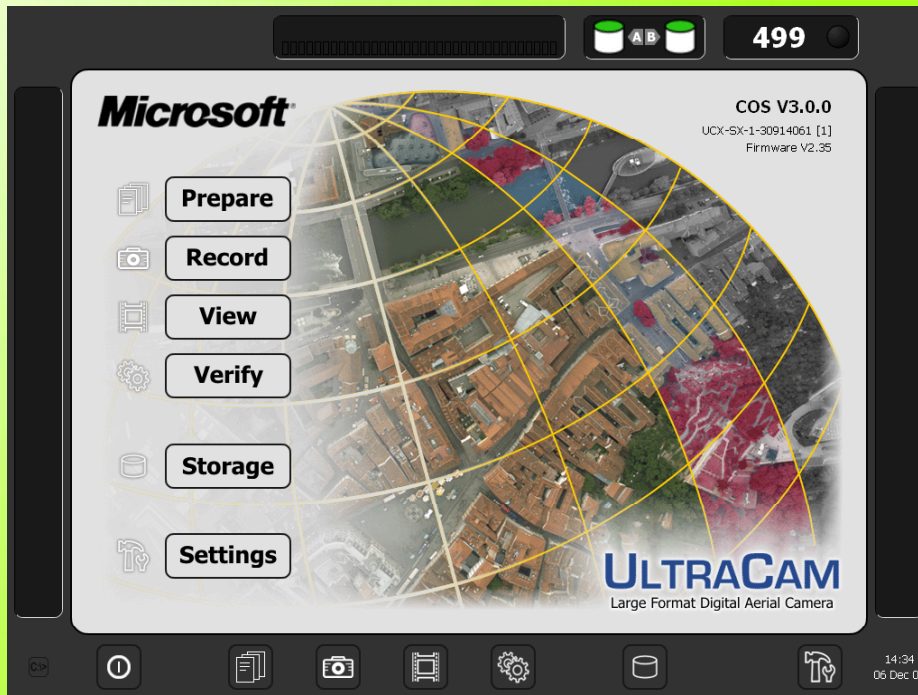
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Stddev(z)
from 1000 height differences:

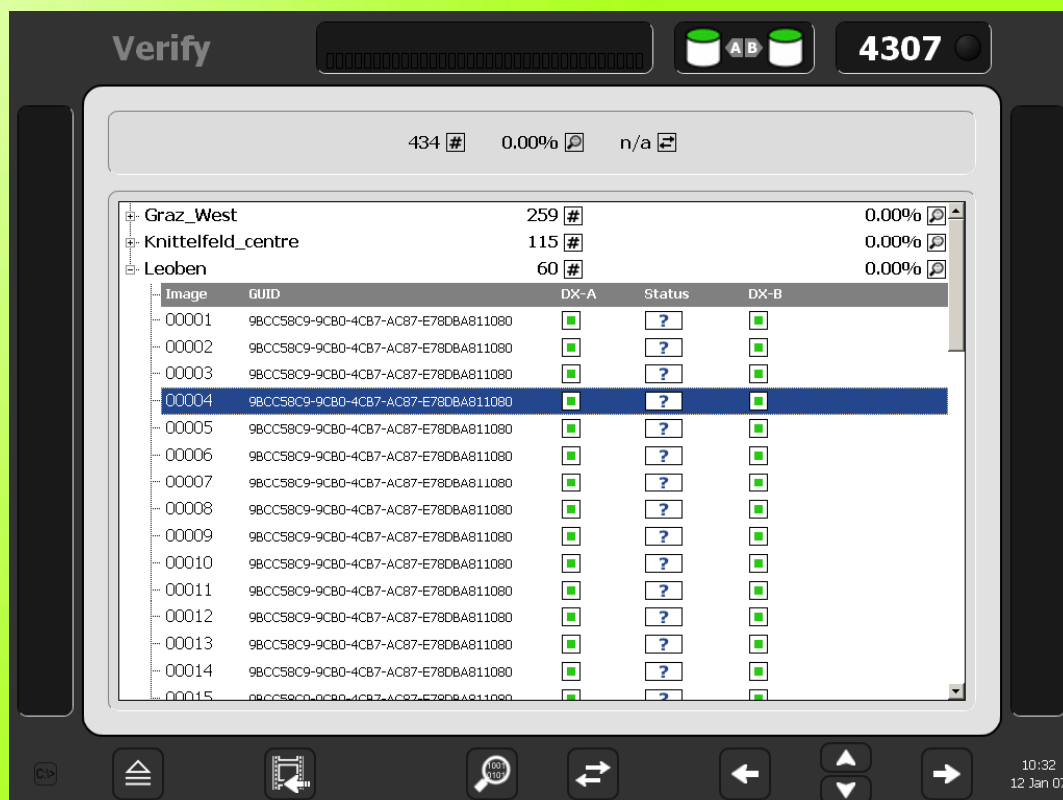
± 0.075 m (NS-EW)

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Camera Operating Software COS V3.0.0

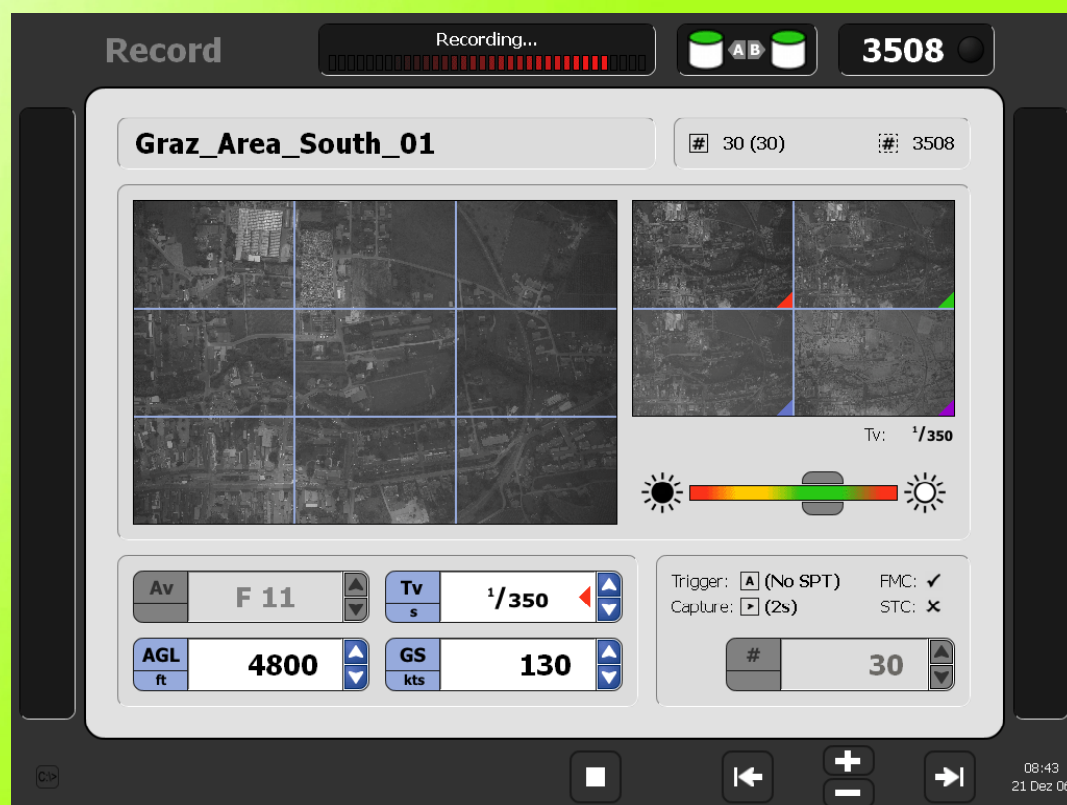
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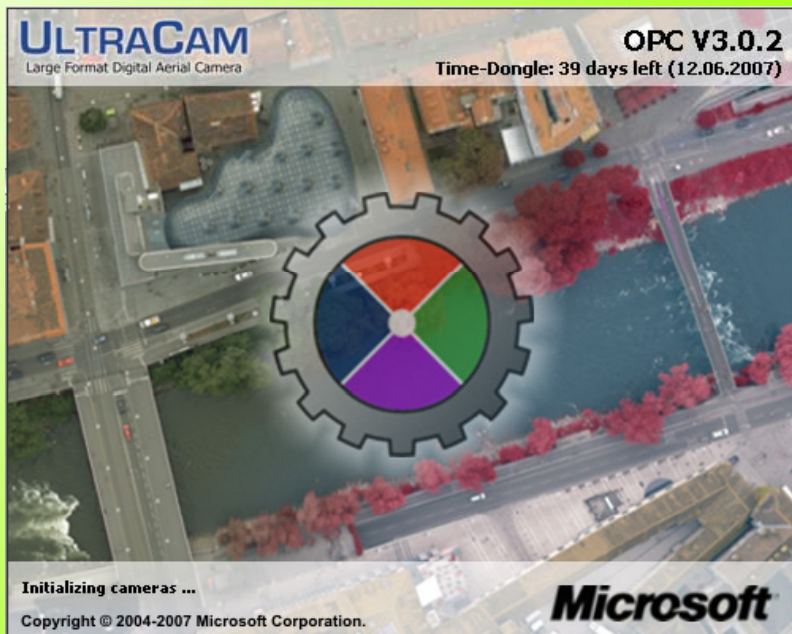
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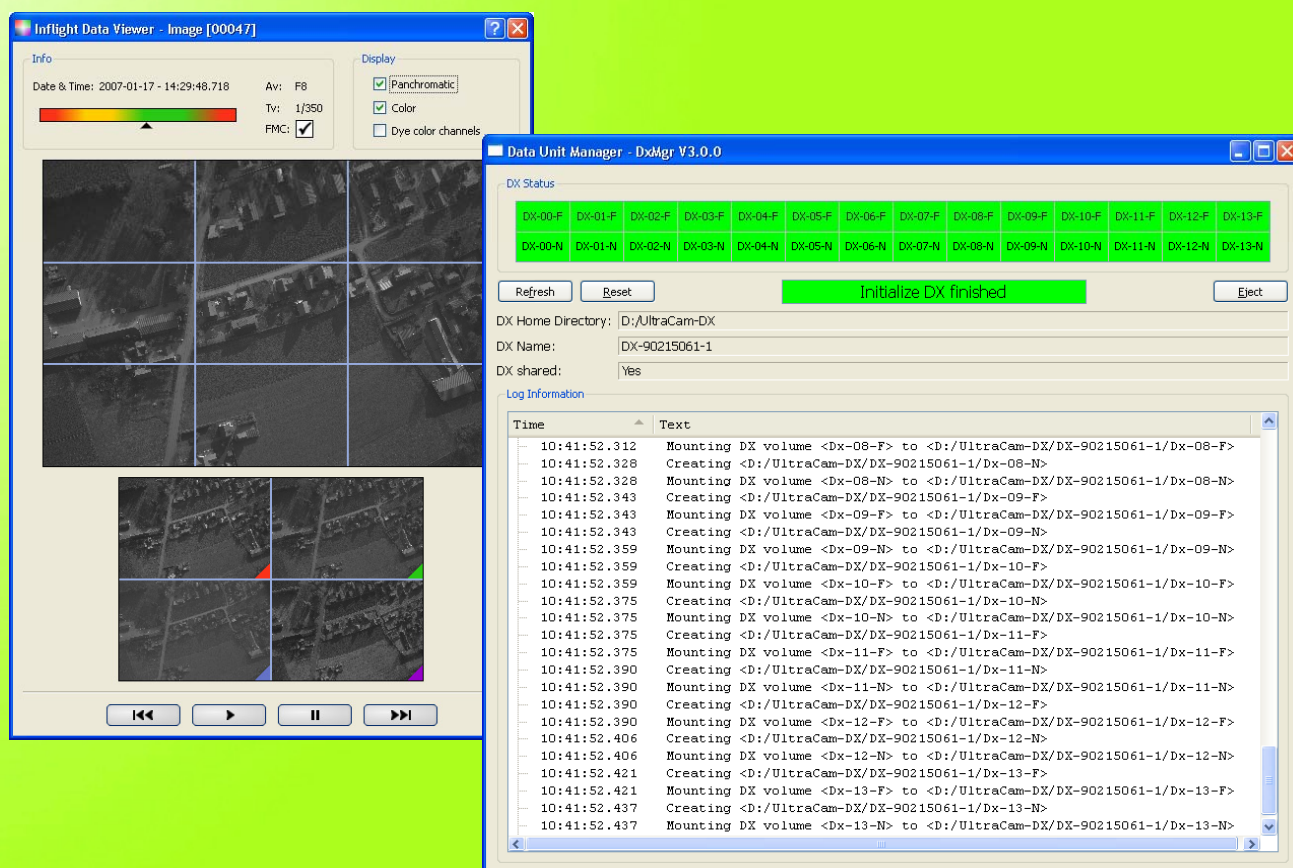


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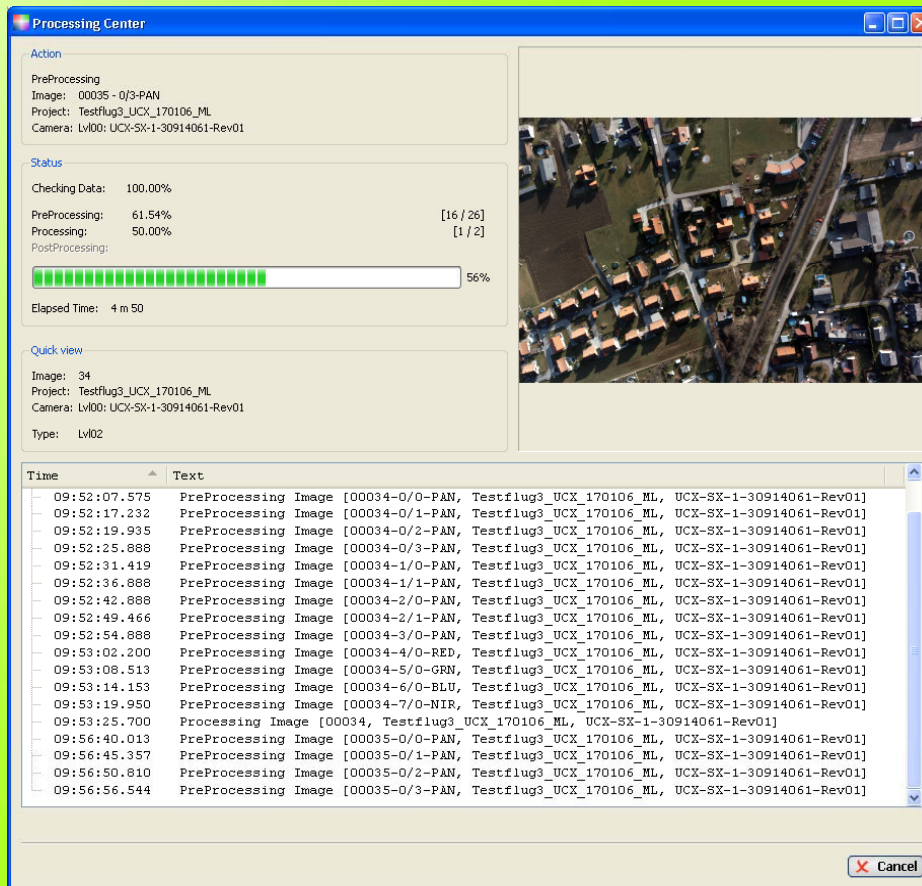


Office Processing Center OPC V3.0.2

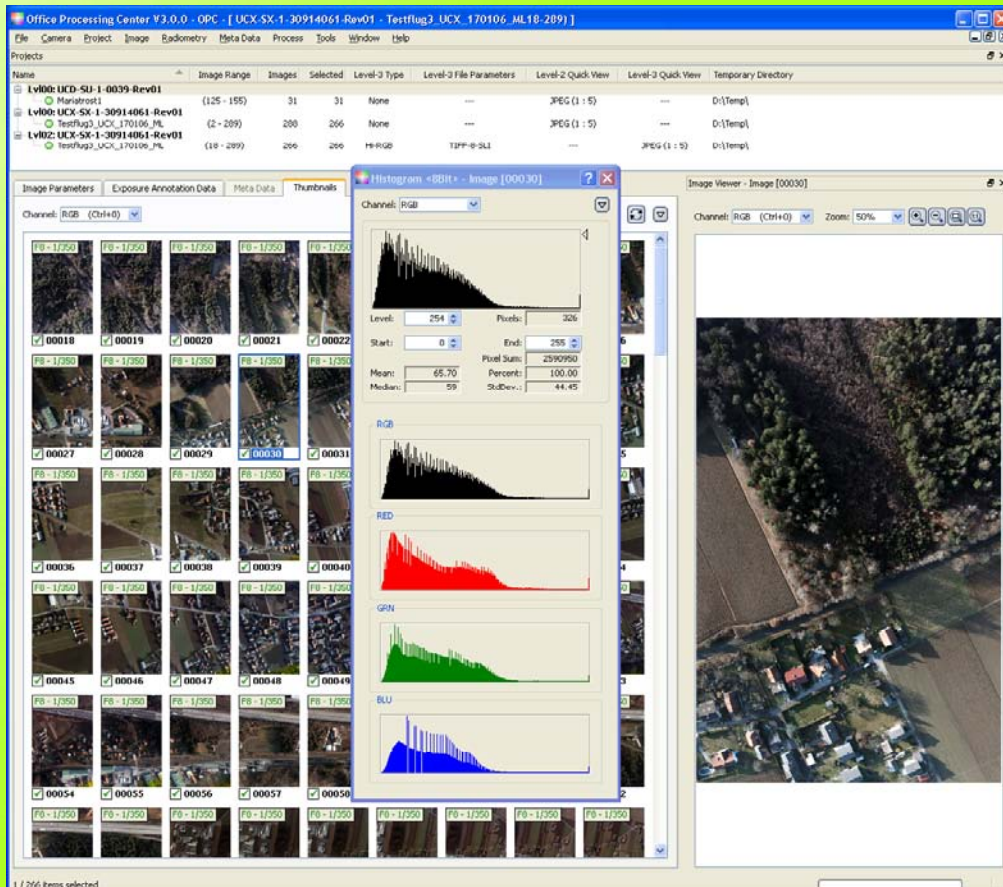
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Image Size UltraCamX

Lvl00	raw Data Format	416 MByte
Lvl02	corrected Image	397 MByte
Lvl03	production Image	408 Mbyte*

*(3*8bit RGB or CIR)

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Beyond post processing

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Large Scale Urban Mapping For Virtual Earth

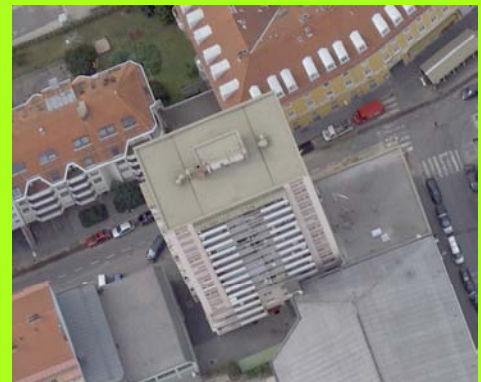
Flight Pattern: 80% / 60%
90% / 80% (downtown)

Redundant

Robust

Minimizing Occlusions

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Redundant (multi ray)
Photogrammetry



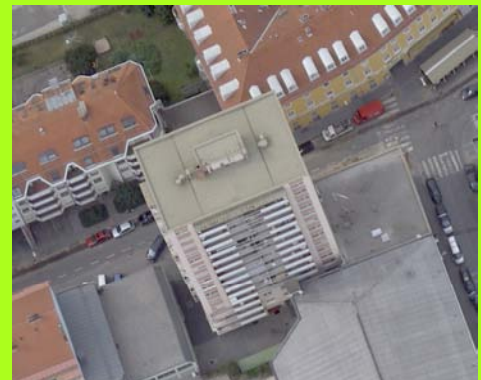
2007



Robust and highly automated Photogrammetry



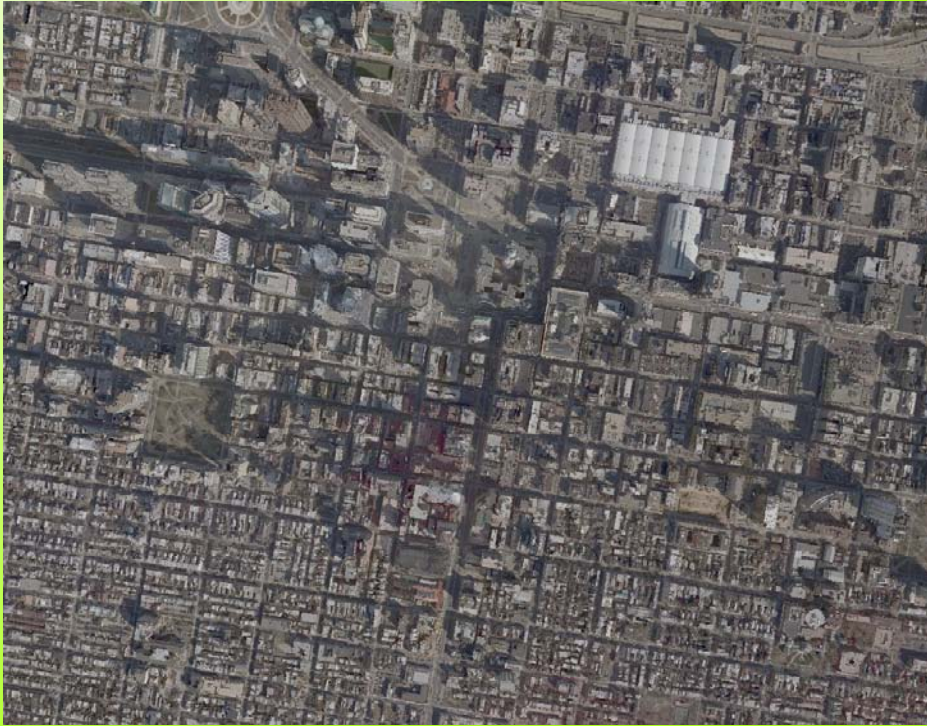
2007



Effective occlusion avoidance



2007



Philadelphia

**3D City model
from
UltraCam
Aerial Images**

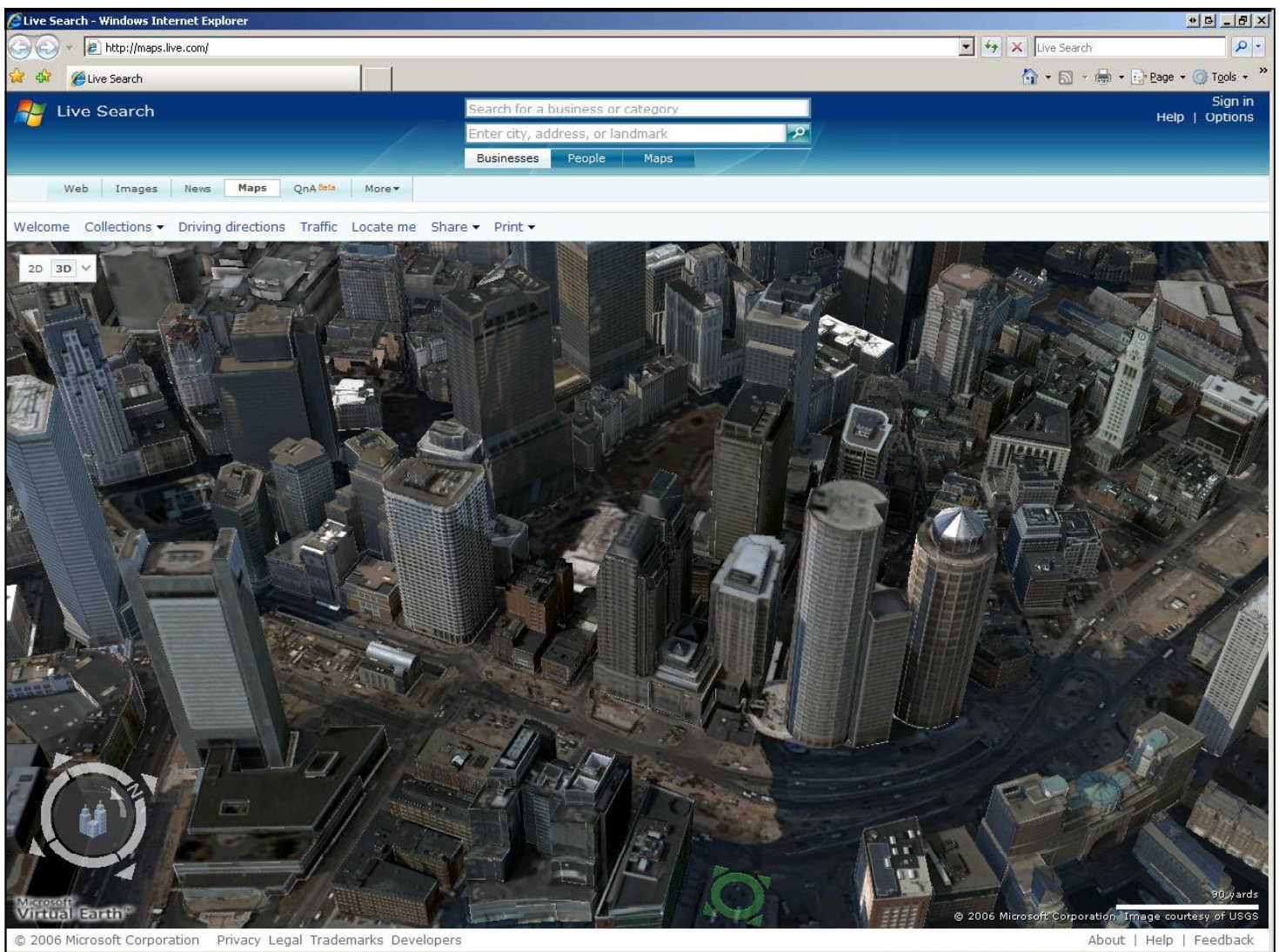
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...and then

<http://maps.live.com/>

Stuttgart, September 25, 2007





Stuttgart, September 2007