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The IGI UrbanMapper- a 2-in-1 Camera for the Efficient Simultaneous Capturing of Nadir and Oblique Aerial Images

Jens Kremer

ISPRS Hannover Workshop 2017, 8.06.2017

www.igi-systems.com

Modular aerial camera-systems

- The IGI UrbanMapper 2-in1 concept

System Layout

- The DigiCAM-100 module
- The IGI UrbanMapper
- Sensor geometry & stitching

Practical Experiences

- … some numbers
- Example images & products

IGI UrbanMapper

„Penta“ Images for the Creation of 3D-City Models

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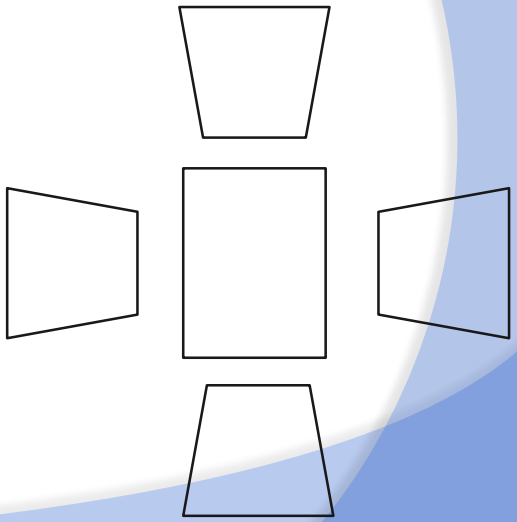
Weaknesses of traditional Penta-configurations:

Relatively low resolution in the nadir view

- GSD in the nadir-view lower than in the oblique-views
- Limited speed to keep necessary forward overlap
- Dense flying strips to keep necessary side overlap
- Low altitude to ensure a good model geometry

Limitation of the productivity

Limitation of the operational conditions



„Penta“ Images for the Creation of 3D-City Models

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Implementation of a high resolution nadir view with high image repetition rate.

Requirements

- Significantly larger nadir-footprint.
- High image repetition of the camera-modules.
- Short exposure time for high flying speeds (usual FMC techniques are not applicable for oblique images).
- High sensitivity for short exposure-times.
- High dynamic range for optimal matching-results.

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IGI UrbanMapper

Modular Medium Format Cameras

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Applications:

- Aerial camera for special applications and light aircraft
- Complementary sensor for multi-sensor systems
- Multiple camera systems for a large nadir views
- Penta configurations for nadir & oblique

DigiCAM-100

www.igi-systems.com

100 Mpixel CMOS

Based on Phase One IXU-RS 1000

0.6s Image repetition

84db Dynamic range

1/2500 s min. exposure time

High endurance shutter with
> 0.5 mio. cycles

Lens options:
32mm / 40mm / 50mm / 70mm / 90mm
(1/2000sec) / 110mm / 150mm

DigiCAM-100

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100 Mpixel CMOS

Based on Phase One IXU-RS 1000

0.6s Image repetition

84db Dynamic range

1/2500 s min. exposure time

High endurance shutter with
> 0.5 mio. cycles

IGI SMU-2 with 2 x 2TB hotplug SSD
Space for 10000 or 20000 images
(redundant / not redundant)

IGI UrbanMapper

2-IN-1 Aerial Camera System

- Large format camera with NIR module
- Oblique camera (4 x 100Mpixel)

Modular Design:

- Upgradeable NIR & Oblique Camera Modules

RGB 28,200 x 11,600 pixels

RGBI 24,900 x 11,600 pixels (option)

0.6 sec Image Repetition Rate

Mount Support GSM-3000/4000, PAV80/100

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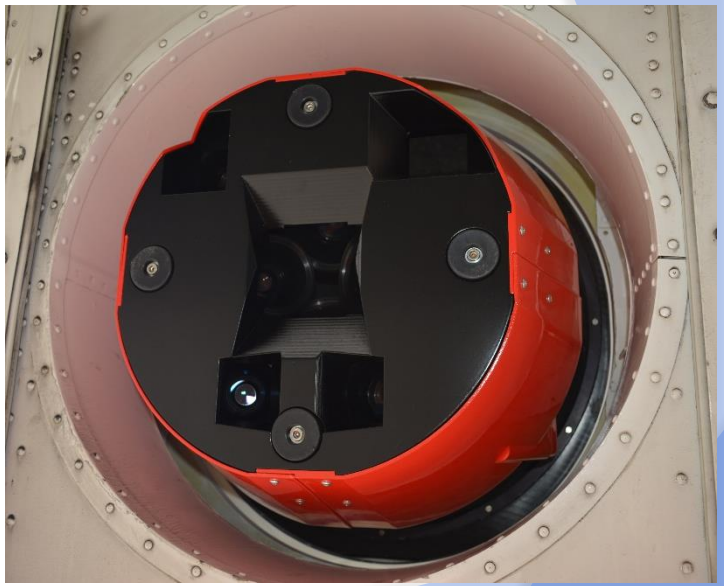

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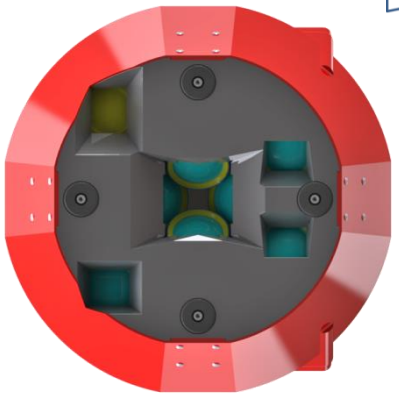
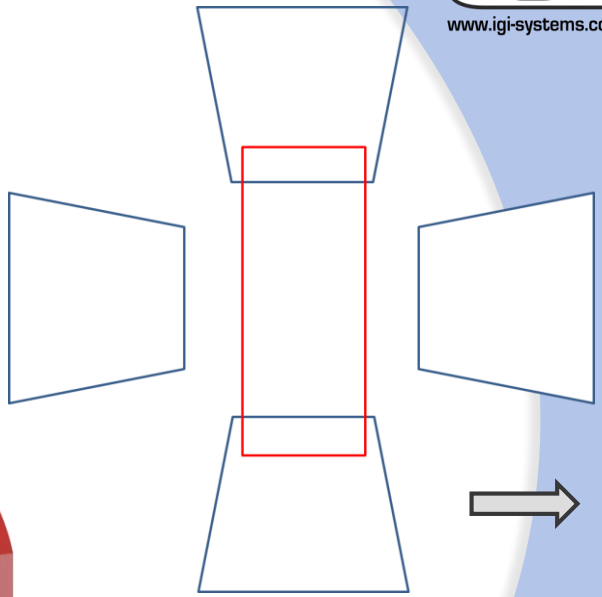
IGI UrbanMapper

Nadir-view	**28.200 x 11.500 Pixel**
Oblique-view	**11.600 x 8.700 Pixel**
Oblique angle	**42°**
Image repetition	**0.6 sec**
Focal length	**90mm**
$GSD_{oblique}$	≈ **1.4** x GSD_{nadir}





IGI UM Images for the Creation of 3D-City Models

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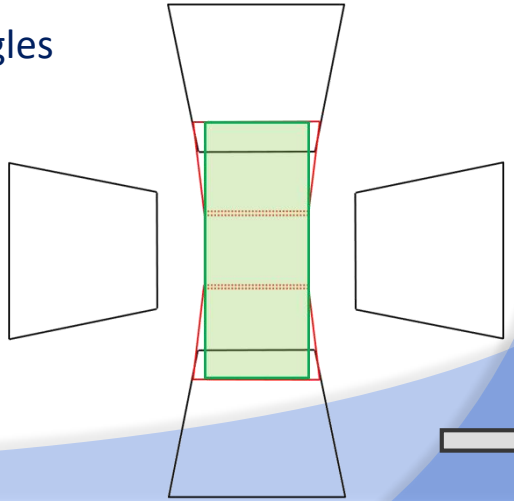
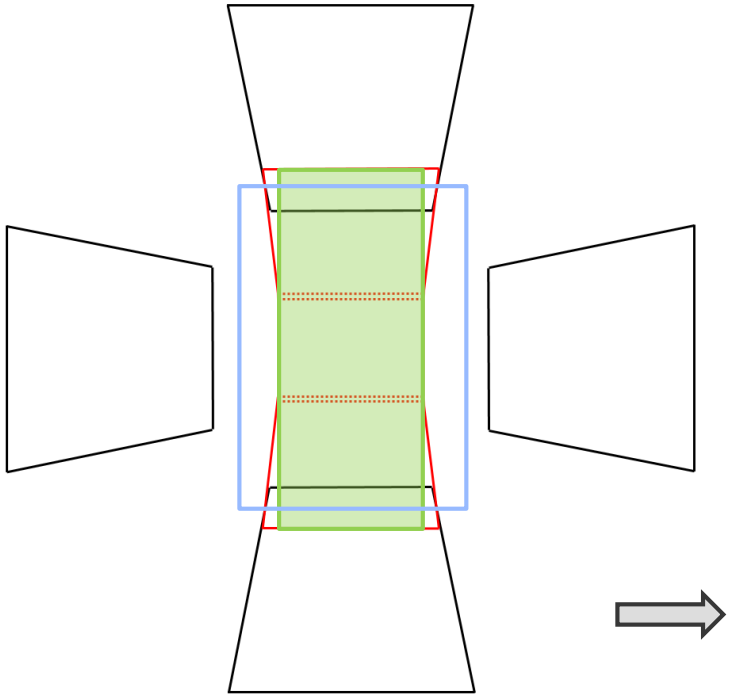
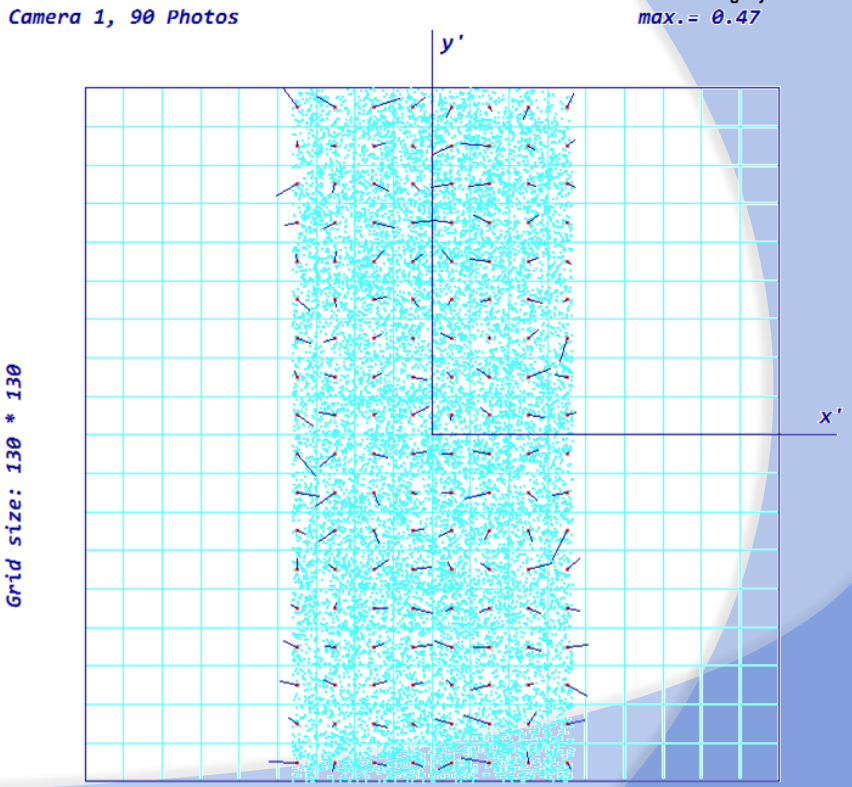
Optimal configuration for the creation of 3D-city models

- High flying-height with same GSD – high image similarity / sharper edges
- High flying-height with same GSD – advantages for high buildings
- Better intersection geometry & high redundancy because of the very wide nadir frame
- Continuous coverage from nadir to high-oblique angles
- High dynamic range for good matching results
- Improved efficiency with better model quality

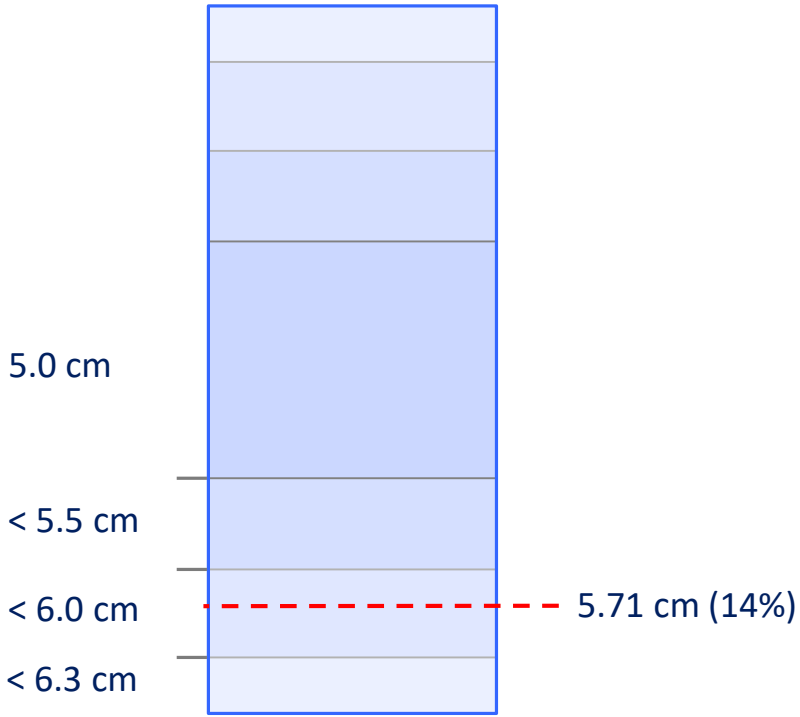


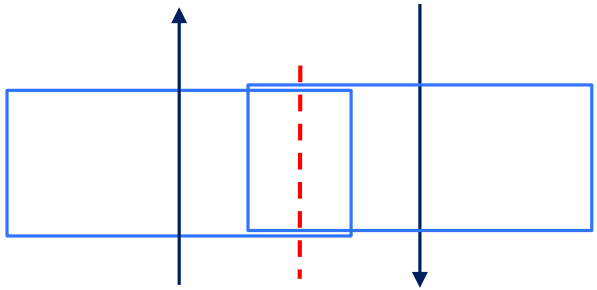
IGI UrbanMapper – Stitching Process





IGI UrbanMapper – Stitching Process





30% side-overlap

IGI UrbanMapper

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- **Image repetition 0.6 sec**

Forward overlap:

Speed/ GSD	2 cm	5cm	10 cm	20cm
70 kn	91%	96%	98%	99%
100 kn	87%	95%	97%	99%
120 kn	84%	94%	97%	98%
160 kn	78%	92%	96%	98%

IGI UrbanMapper – the Operator's View

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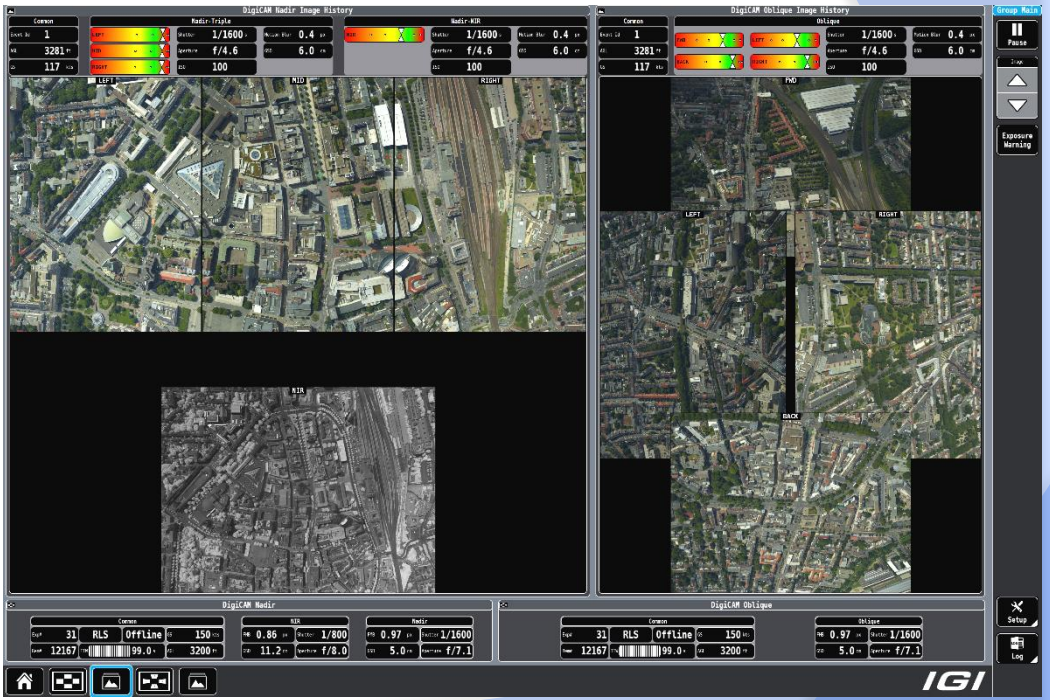
- 20" / 4K touch screen
- Control of camera groups & single modules
- Tools and indicators for optimal illumination



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IGI UrbanMapper

IGI UrbanMapper – @ AEROWEST

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IGI UM in practical operation since spring 2017

> **60** projects (> 0.6 mio. images) flown with one system, thereof

- **35** projects to produce oblique image based products
- **20** projects to produce dense-point-matching based products
- **10** projects to produce a textured mesh product (dense-point-matching incl. oblique images)

IGI UrbanMapper – @ AEROWEST

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Project	Specification TOM (True-Orthomosaic) & MESH (3D Fotomesh)	GSD vertical	GSD oblique	km²	Overlap Vertical Image	Point Cloud from Vertical & Oblique Image	Events	Images vertical & oblique
1	TOM	10	14	**146**	80 / 65		1710	1710
2	TOM	5	7	**52**	80 / 65		1441	1441
3	TOM	8	11	**281**	80 / 65		2286	2286
4	TOM	9	12.5	**273**	80 / **75**		2570	2570
5	TOM	10	14	**312**	80 / 65		3000	3000
6	TOM	7	10	**154**	80 / **70**	YES	4232	21160
7	TOM	5	7	**73**	80 / 65		2440	2440
8	TOM	7.5	10.5	**103**	80 / 65		1312	1312
9	TOM	7.5	10.5	**107**	80 / 65		1274	1274
10	TOM & MESH	5	7	**91**	80 / 65	YES	2378	11890
11	TOM & MESH	5	7	**115**	80 / 65	YES	3286	16430
12	TOM & MESH	7.5	10.5	**52**	80 / 65	YES	1504	7520
13	TOM & MESH	6	8.5	**37**	80 / 65	YES	845	4225
14	TOM & MESH	5	7	**55**	80 / 65	YES	1989	9945
15	TOM & MESH	7.5	10.5	**544**	80 / 65	YES	6316	31580
16	TOM & MESH	10	14	**153**	80 / **70**	YES	1520	7600
17	TOM & MESH	10	14	**15**	80 / 65	YES	250	1250
18	TOM & MESH	5	7	**123**	80 / 65	YES	3107	15535
19	TOM & MESH	10	14	**204**	80 / 65	YES	2188	10940
				2890			**43648**	**154108**

IGI UM Applications: *virtualcityMAP / Nadir Image*

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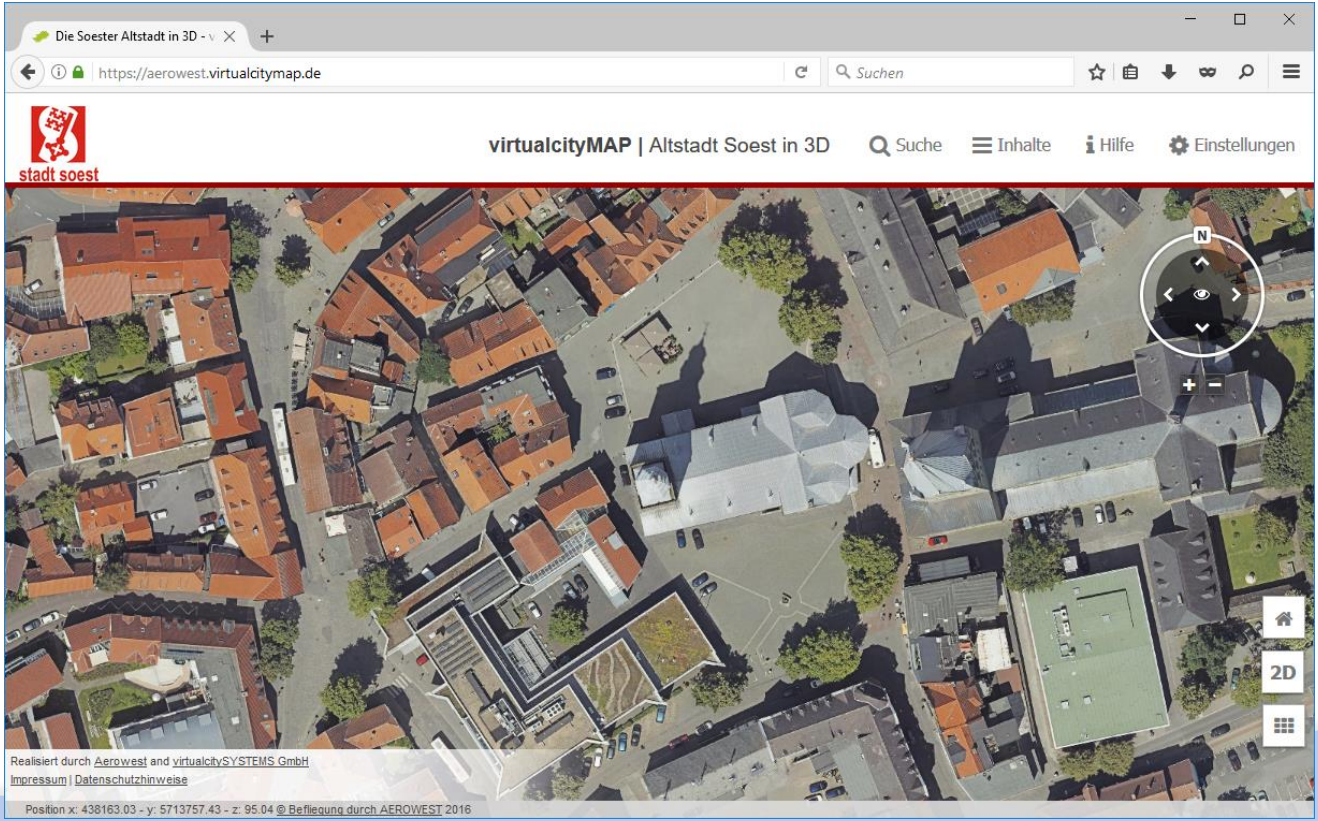

IGI UM Applications: virtualcityMAP / Oblique Image

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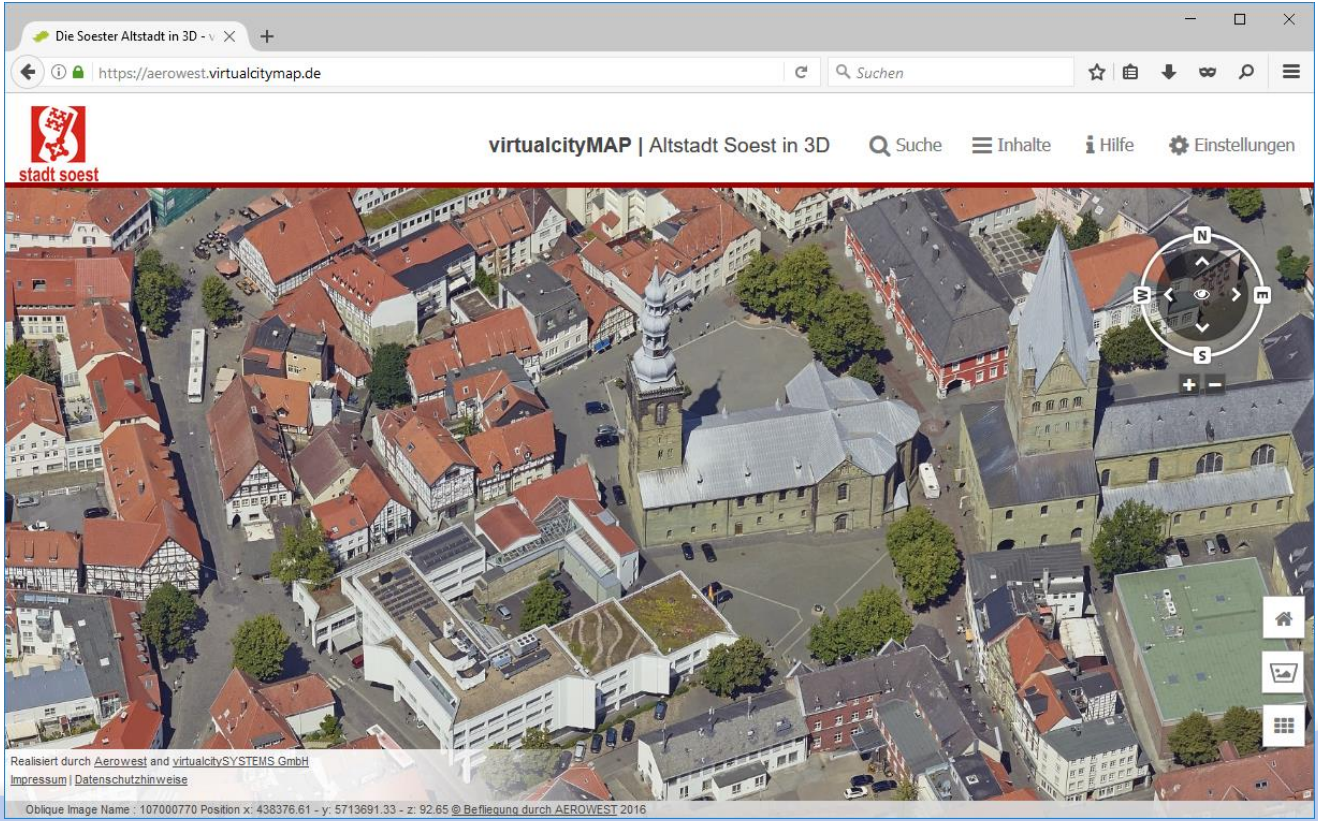

IGI UM Applications: *virtualcityMAP / Oblique Image*

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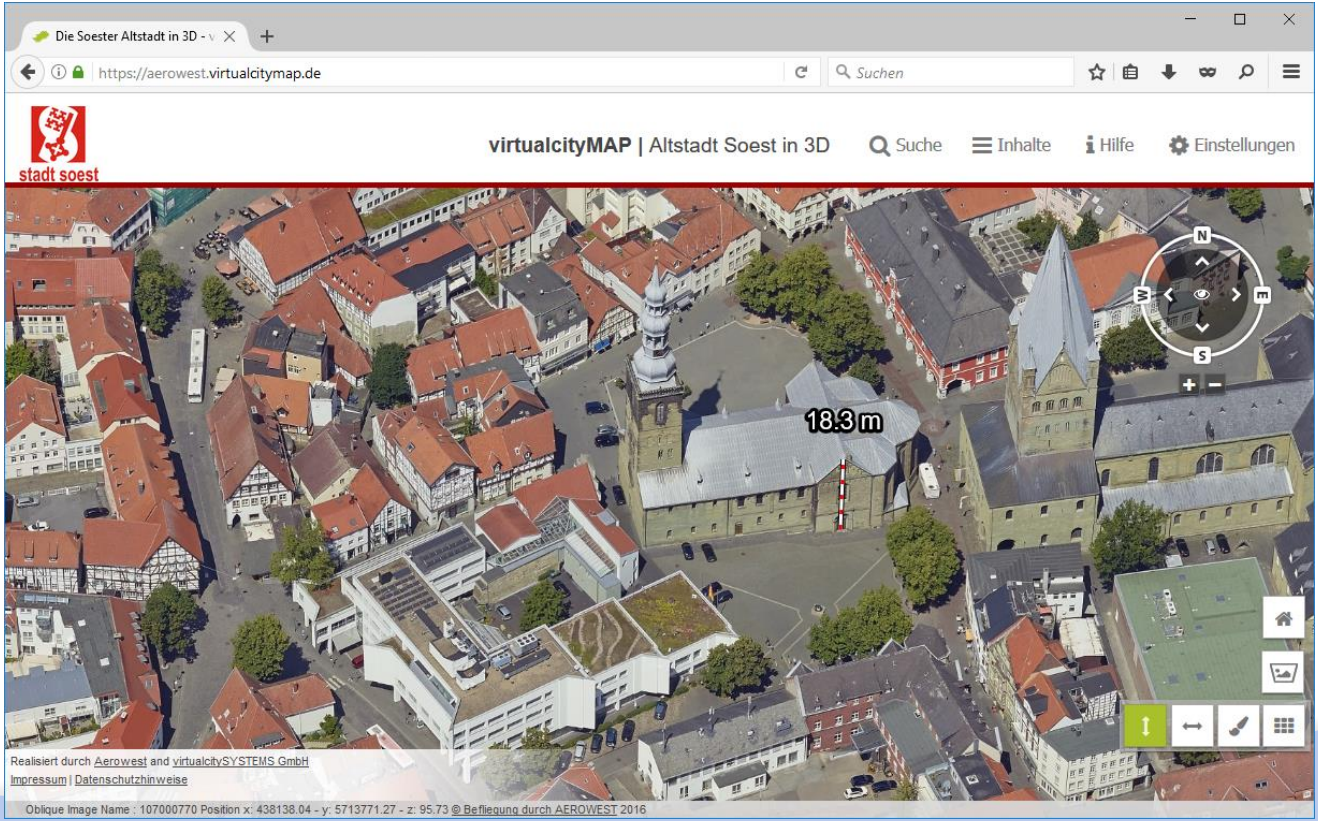

IGI UM Applications: *virtualcityMAP / Pointcloud*

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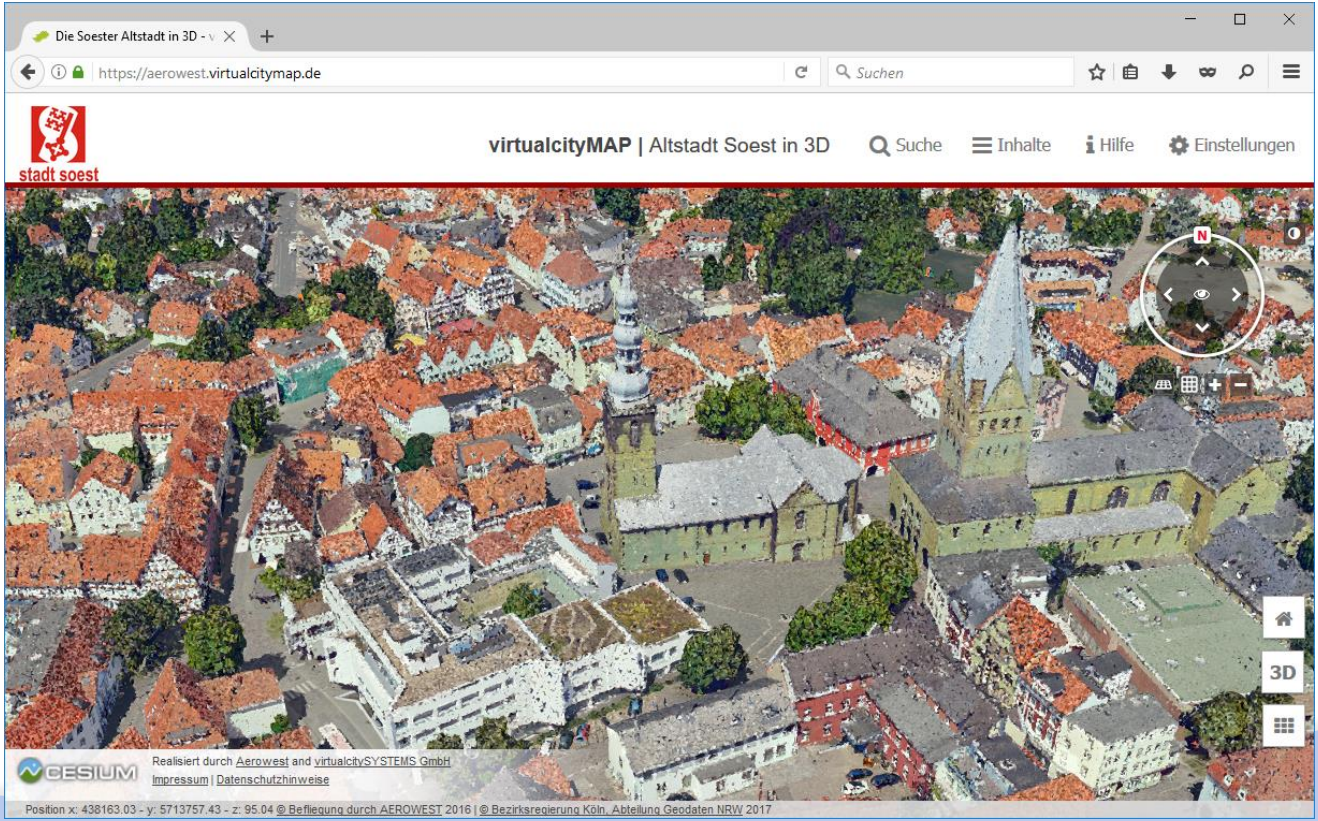

IGI UM Applications: *virtualcityMAP* / text. Mesh

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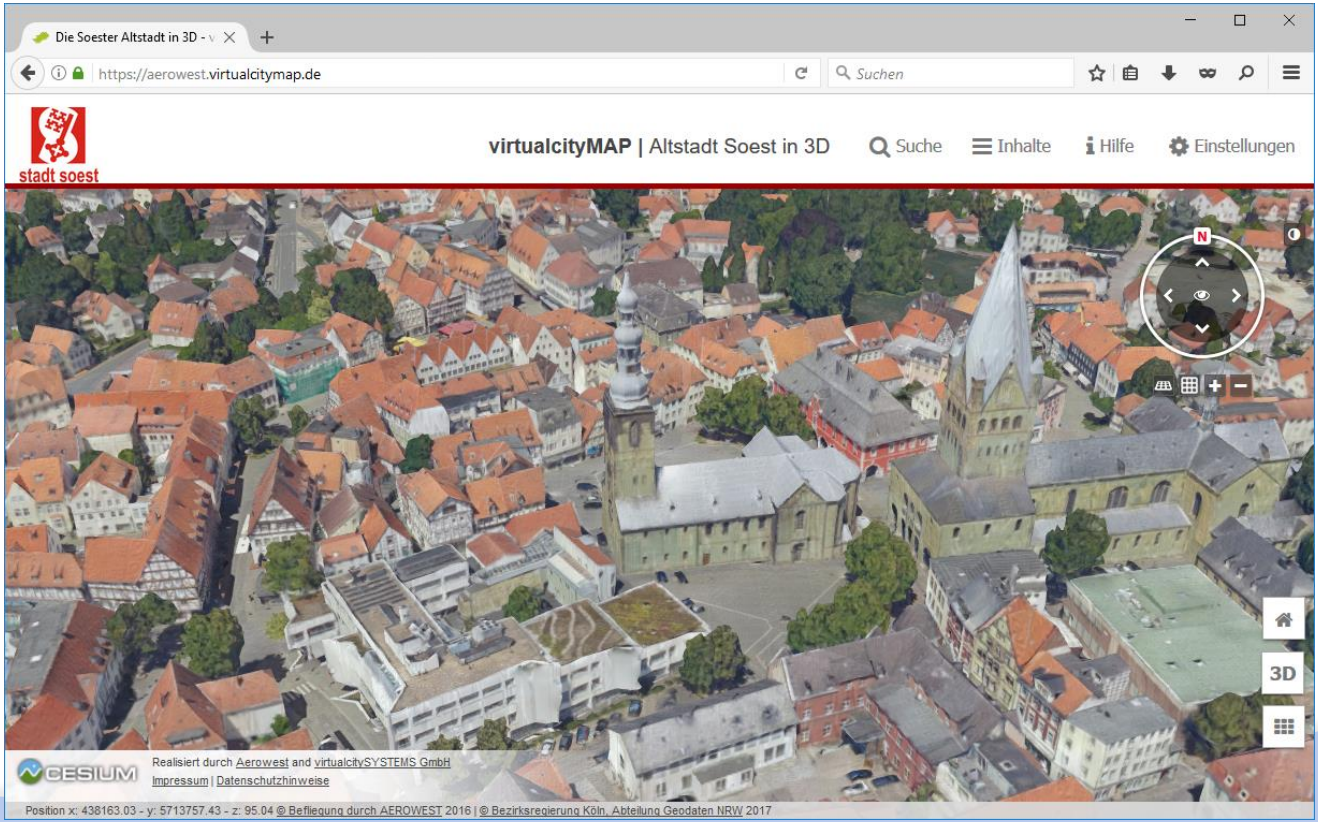

IGI UM Applications: *virtualcityMAP / text. LOD2*

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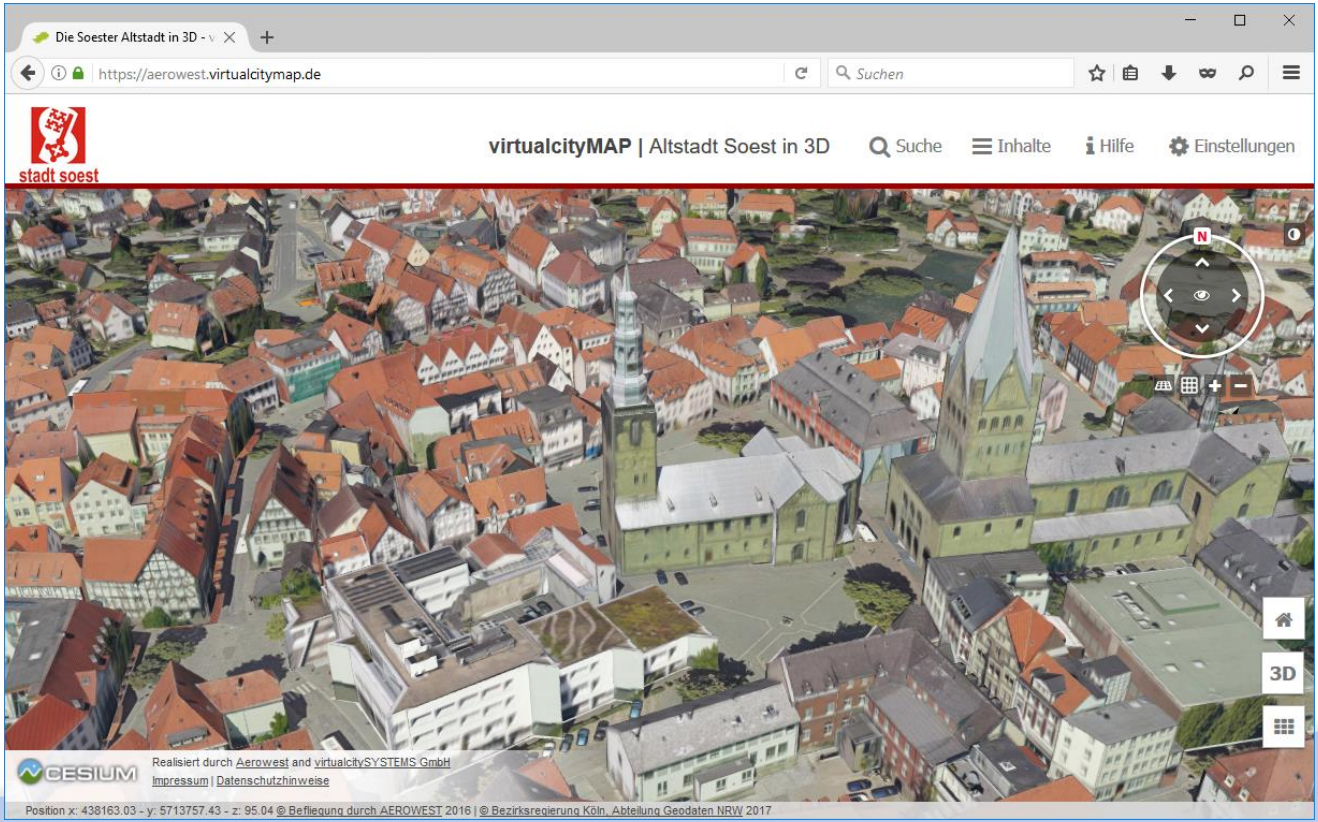

IGI UrbanMapper – Images “Dortmund City”

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Camera System	*IGI UrbanMapper*
Flight operations	AEROWEST, Dortmund, Germany
Weather conditions	Scattered clouds
Flying height above ground	620m (block) 370m / 960m (some additional photos)
Flying speed	130kn (67m/s)
GSD	370m: 1.9cm / 2.7cm (nadir / average oblique)
	620m: 3.2cm / 4.5cm
	960m: 4.9cm / 6.9cm
Overlap (nadir block)	forward overlap: 80%
	side overlap: 84%

Demo data-set available !

-> sales@igi-systems.com

IGI UrbanMapper – Images “Dortmund City”

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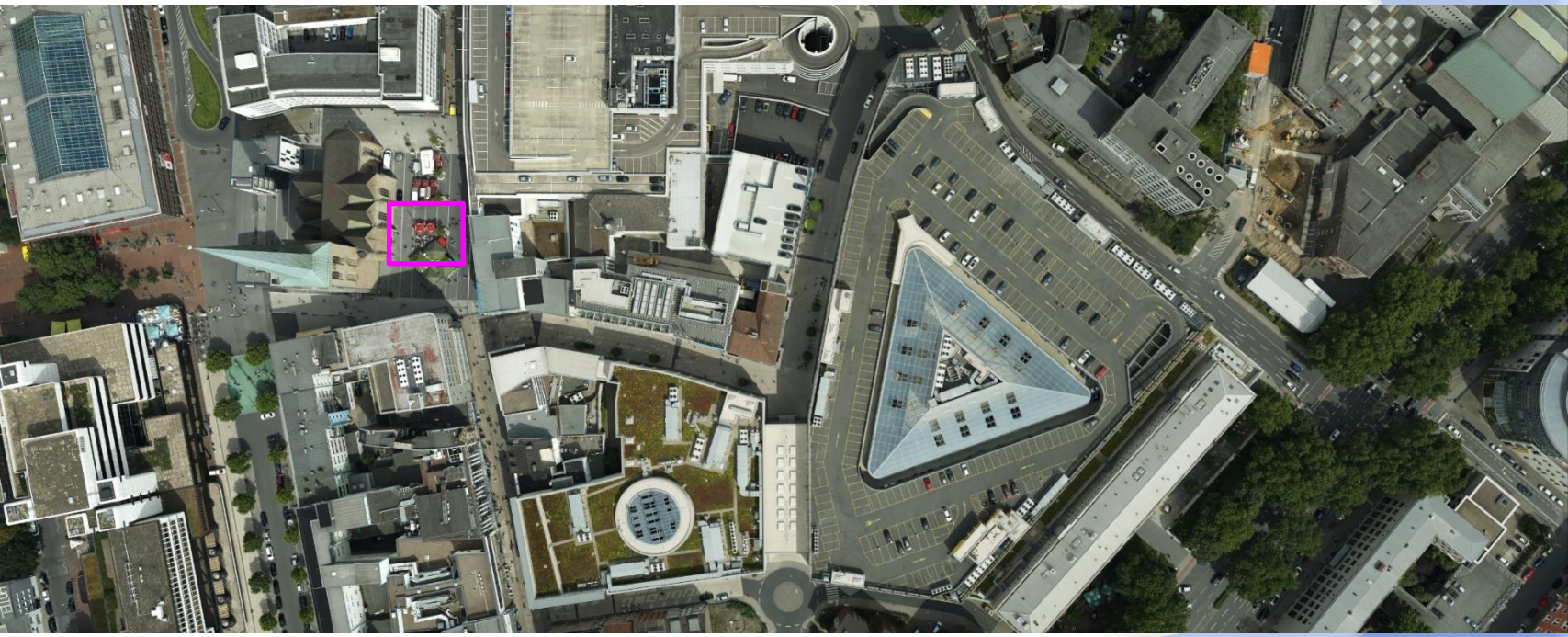

h= 370m GSD=1.9cm

IGI UrbanMapper – Images “Dortmund City”

h= 370m GSD=1.9cm

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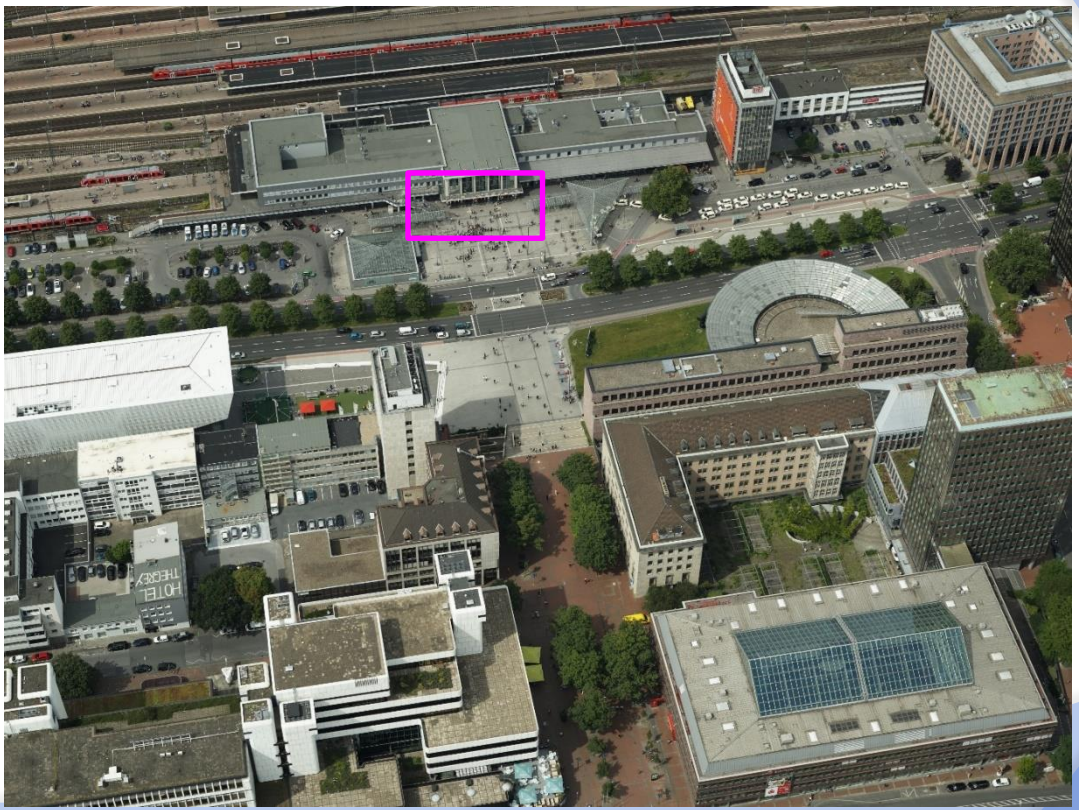

h= 370m
mean GSD=2.7cm

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mean GSD=2.7cm

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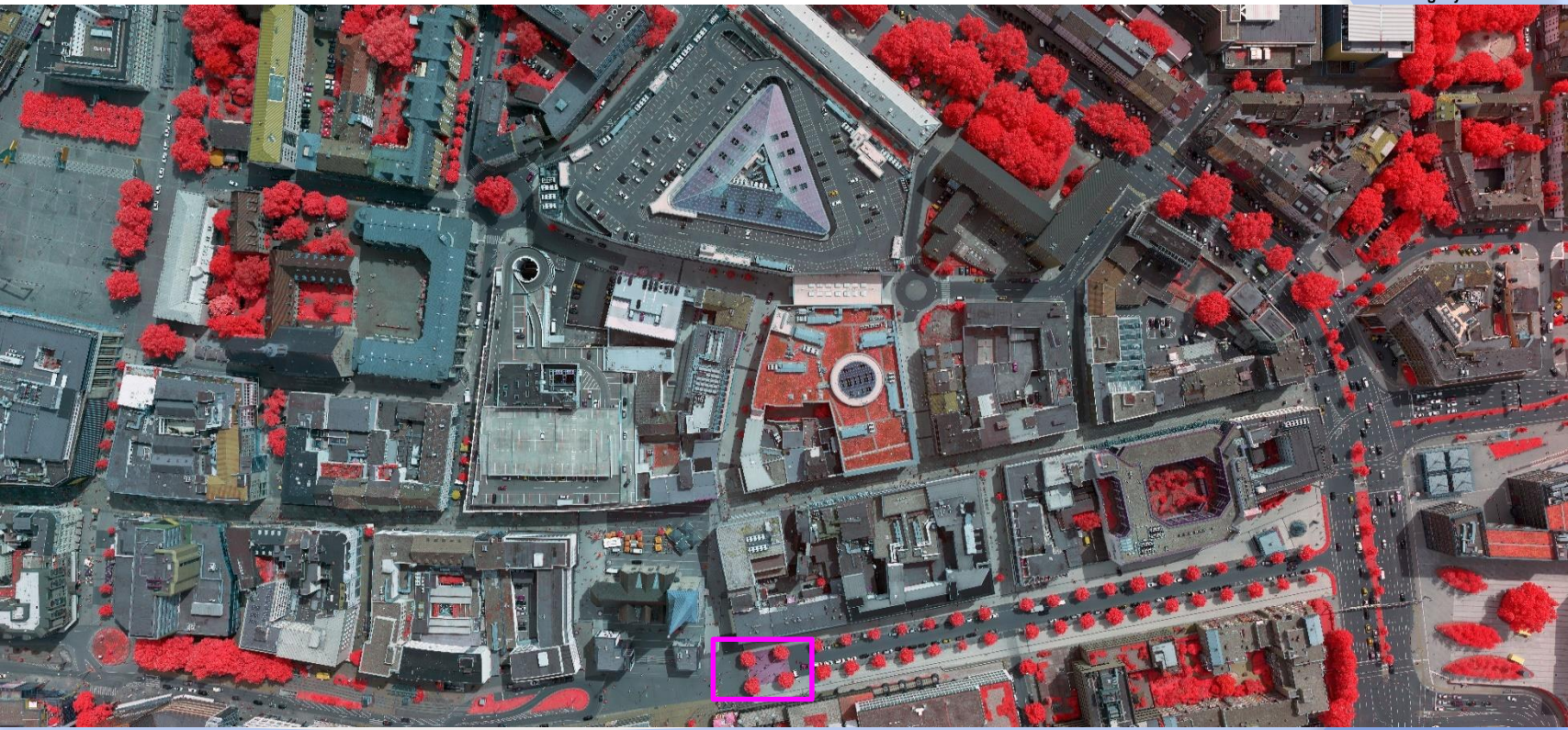

h= 370m GSD=1.9cm

IGI UrbanMapper – Images “Dortmund City”

h= 370m GSD=1.9cm

IGI UrbanMapper

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- The *IGI UrbanMapper* incorporates 8 x 100 Mpixel CMOS camera-modules with high sensitivity and dynamics, which enables the design of a new generation of aerial cameras.
- The *IGI UrbanMapper* combines a large format aerial camera & oblique camera within one system – 2-in-1.
- Optimal workflow for the production of true-orthophotos, 3D stereo digitization and automatic, high accurate 3D city model creation.
- The advantages of modularity are fully preserved.