ISPRS GEOSPATIAL WEEK 2019

IGI
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Calibration and Orientation of Modular Multiple Camera Systems

Enschede, 13.6.2019

www.igi-systems.com

Agenda

- Modular Camera Systems
- Increase Pixel Count/Quality Control
- Image Examples
- German Open Skies Camera Systems

Modular Camera Systems

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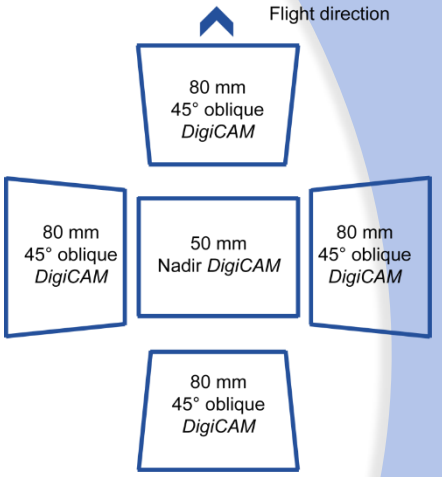
Oblique aerial cameras

- Five images covering the nadir view & fwd/back/left/right
- Angles around 45° widely used

Nadir aerial cameras with increased images size

- Combination of multiple cameras with different viewing angles



Camera Module DigiCAM 150

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150 Mpixel BSI-CMOS

Back Side Illuminated sensor

Based on Phase One IXM-RS150 F

0.5s Image repetition

83db 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

Increase Pixel Count: Shift vs. Tilt

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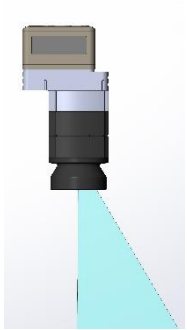
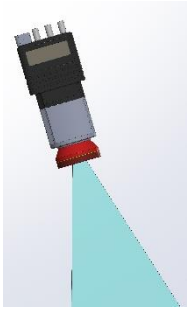
Shift



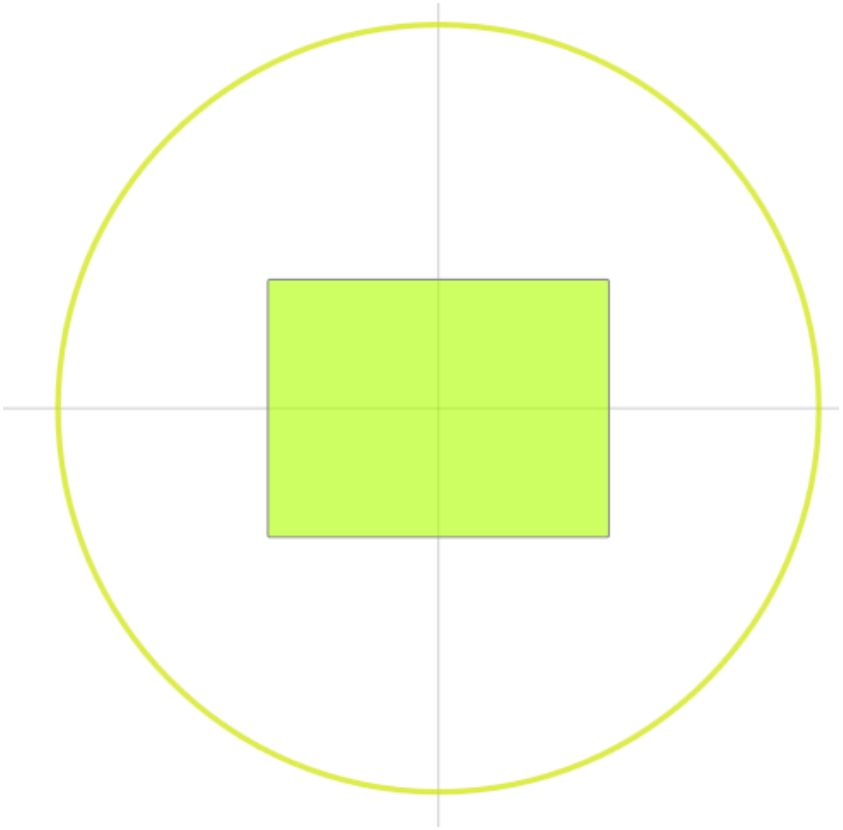
- Homogeneous resolution
- Rectangular footprint
- Large circle of illumination necessary / reduced optical quality in the corners
- Special camera construction / reduced versatility

Tilt



- Inhomogeneous resolution
- Distorted footprint
- Smaller circle of illumination possible / improved optical quality in the corners
- No special camera construction needed / optimal versatility

Quality Control: Circle of Illumination



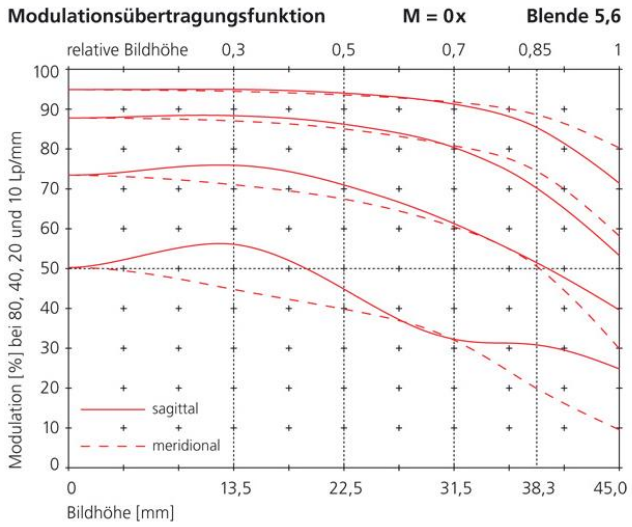
RODENSTOCK 90mm lens

- Extremely large image circle (“circle of illumination“).
- Excellent image quality in the edges of the images.

Quality Control: Choose the right lens

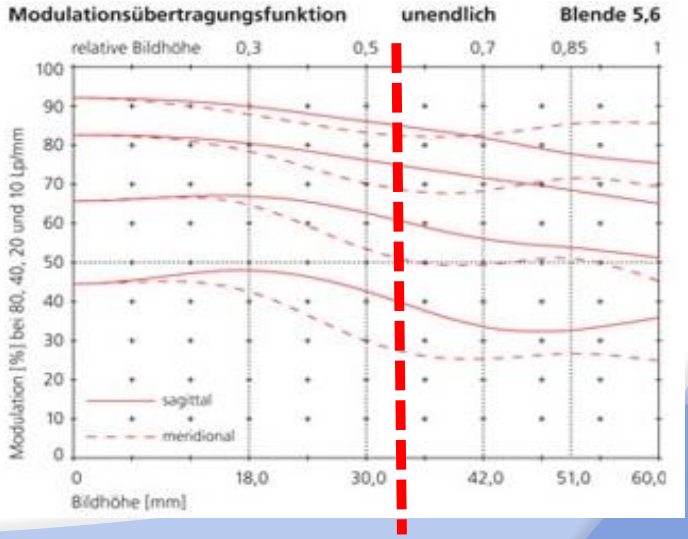
Example of a good lens for aerial cameras
Rodenstock Digaron-W 50mm

Usually the full image circle is used

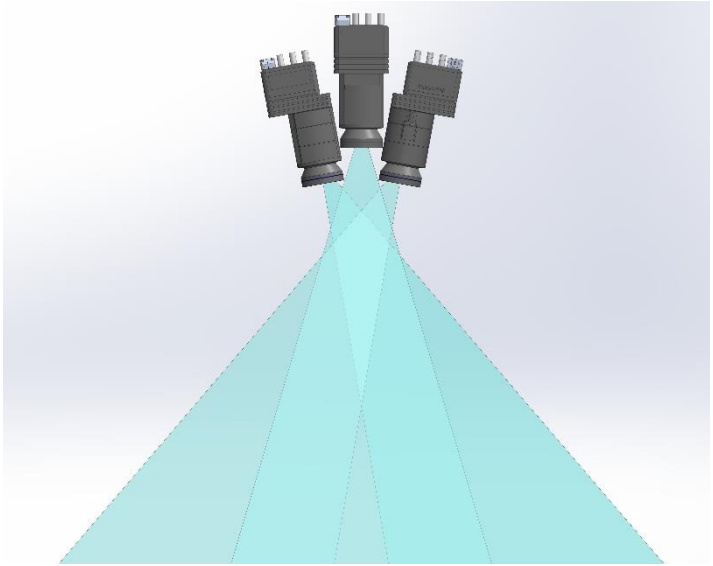


The IGI UrbanMapper uses the
Rodenstock Digaron-SW 90mm

Practically no MTF drop in the used area

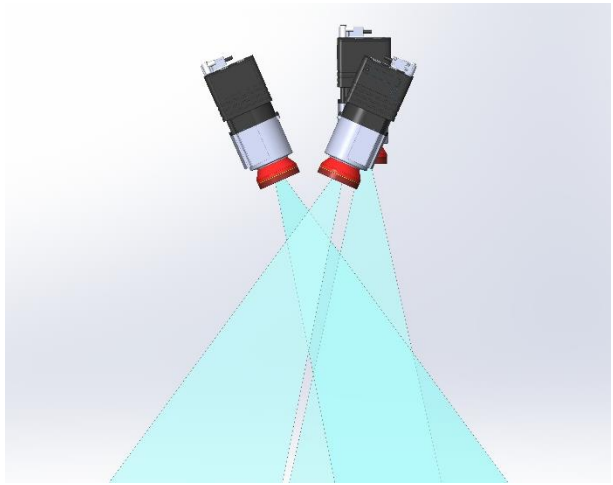


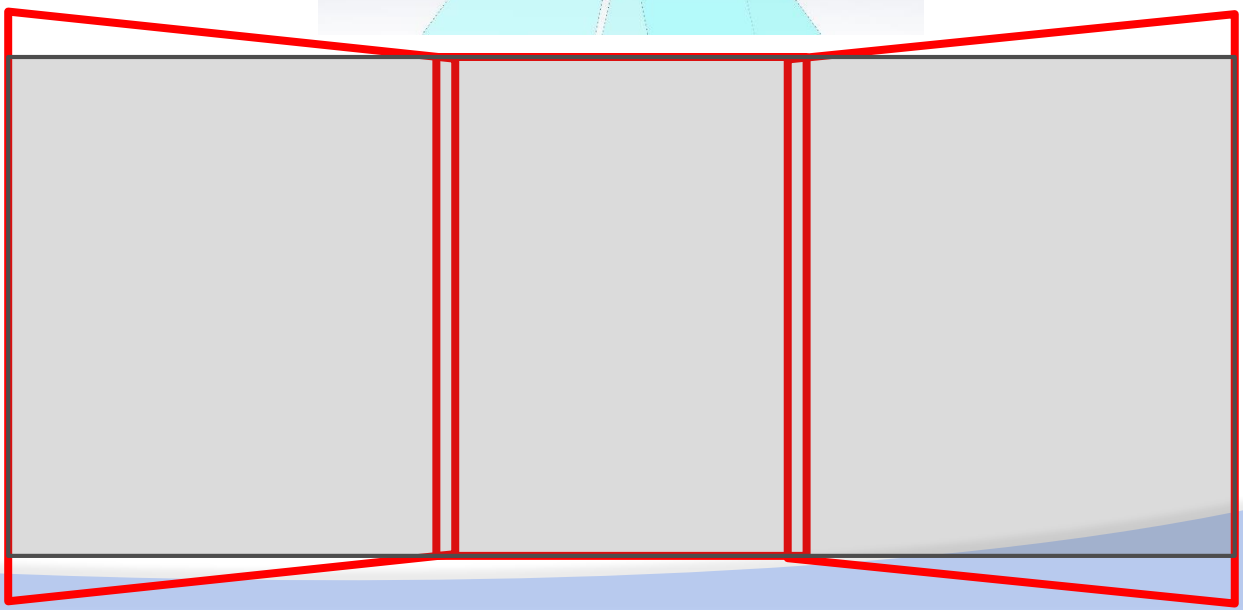
Shift



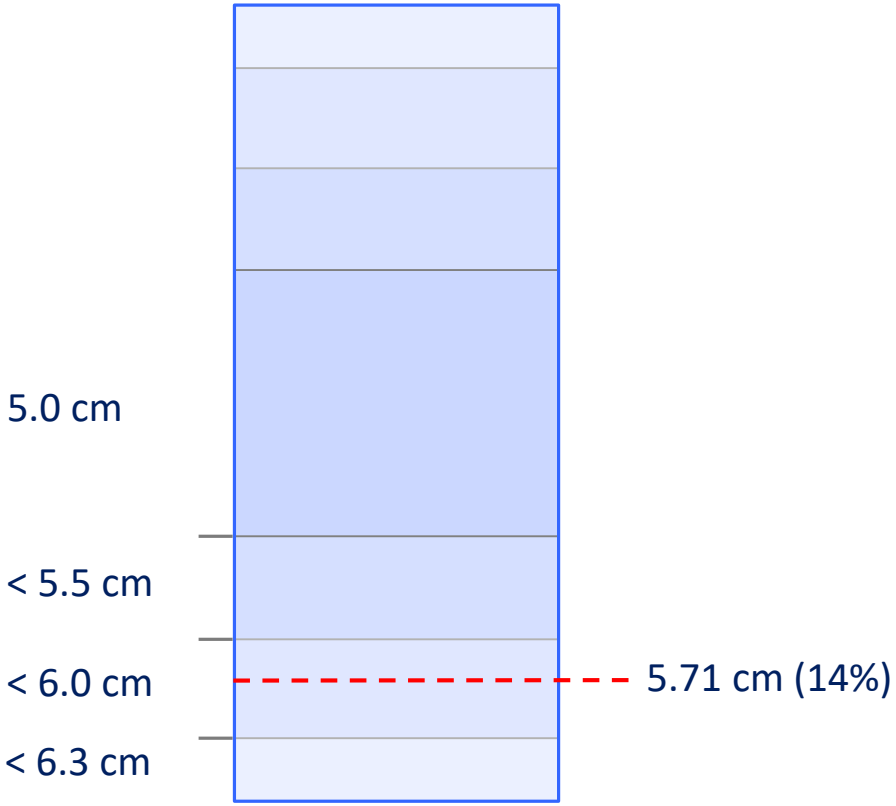
In this example:
shift + small tilt for maximum FOV

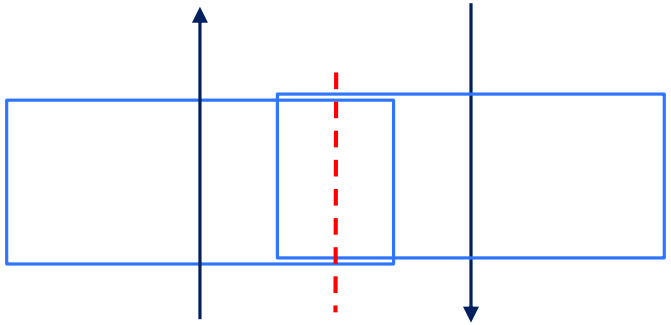
Tilt





Tilt, example *IGI UrbanMapper*





30% side-overlap

IGI UrbanMapper / Dual-DigiCAM– Stitching Process

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- Same process for shift and tilted systems
- Prerequisite: careful geometrical calibration of the single camera modules using in-situ methods
- Stitching in IGI IPS (Image Processing Software)
  - Point-matching in the overlapping image areas
  - Adjustment of selected parameters, depending on camera-configuration
  - Radiometric adjustment minimal
  - Check of the stitching quality
  - Processing possible “image-by-image” or for a full set of images
- Result: Geometrically and radiometrically homogenous images

IGI IPS – Image Processing Software

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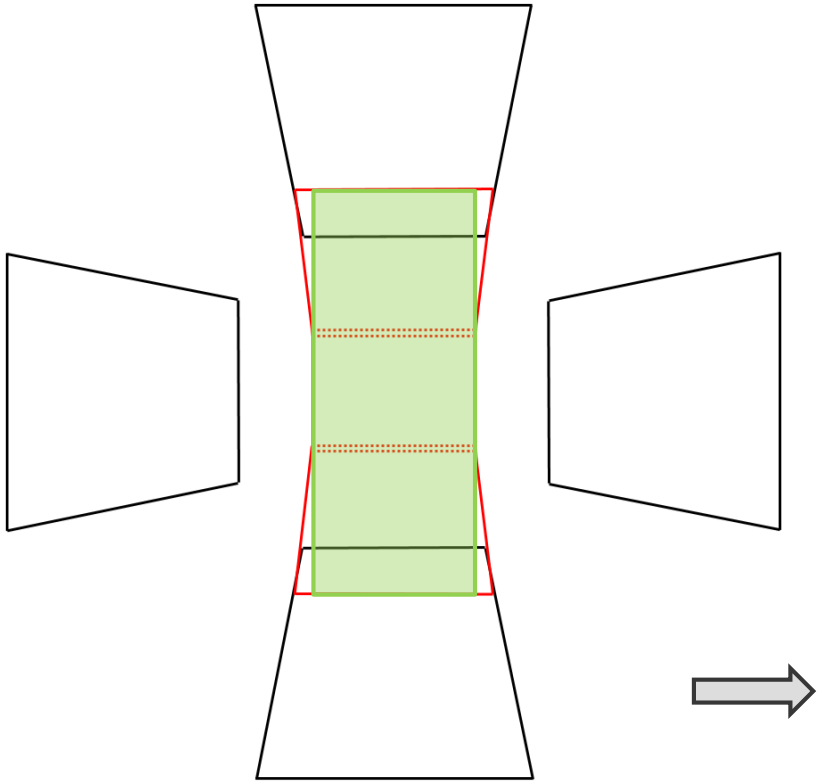
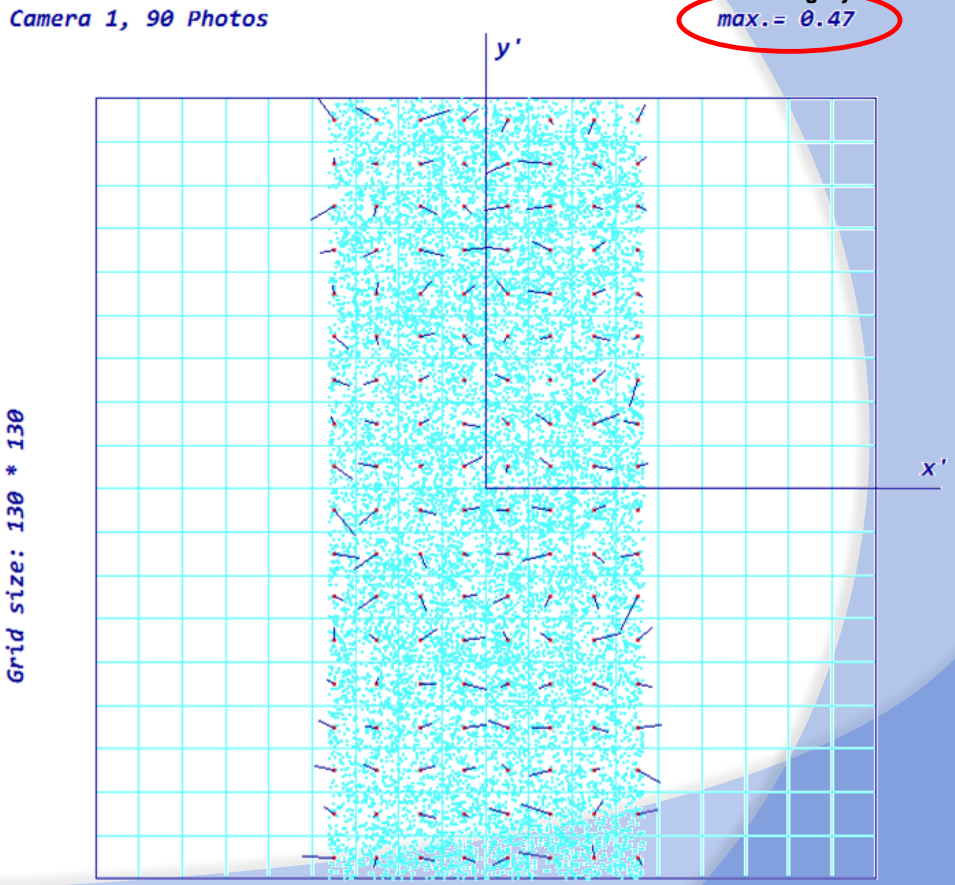
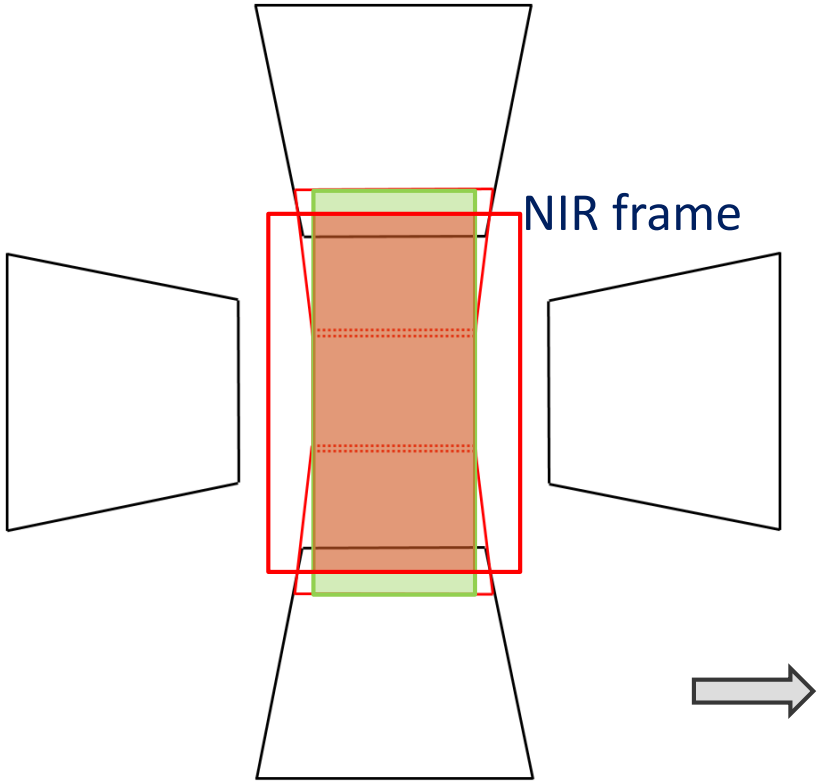
Level	Description	Remarks
0	Raw unprocessed images	*.3fr for Hasselblad based systems *.iiq for PhaseONE based systems
1	Raw images including processing settings	*.fff for Hasselblad based systems Not needed for PhaseONE based systems
2	TIFF images without geometric corrections	The images can be processed in 8 bit or 16 bit color depth. Useable for Dense Point Matching.
3	TIFF images with applied geometric corrections	The distortion is corrected. Useable for Dense Point Matching.
4	Stitched large format images	This level is available only for cameras with a large format nadir view that is composed of more than one camera module.
5	CIR or 4-channel images	This level is available only for cameras with a combination of overlapping RGB and NIR camera heads.

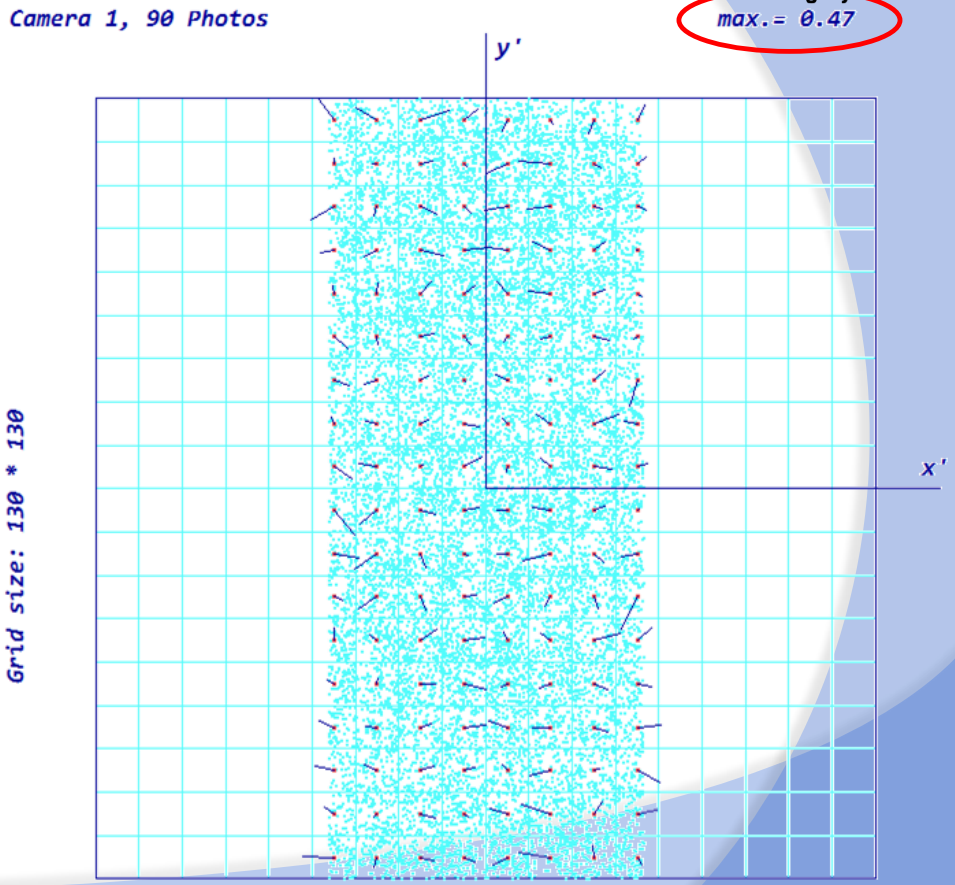
IGI UrbanMapper – Stitching Process





IGI UrbanMapper – Stitching Process





IGI UrbanMapper-2

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- Same concept as IGI UrbanMapper
- Upgrade of single camera modules is possible

Increased resolution

RGBI: 30,460 x 14,100 pixels

Ex-RGB: 34,500 x 14,100 pixels

Oblique: 14,204 x 10,652 pixels

➡ **2 GPixel / sec**

Example: “Dortmund City”

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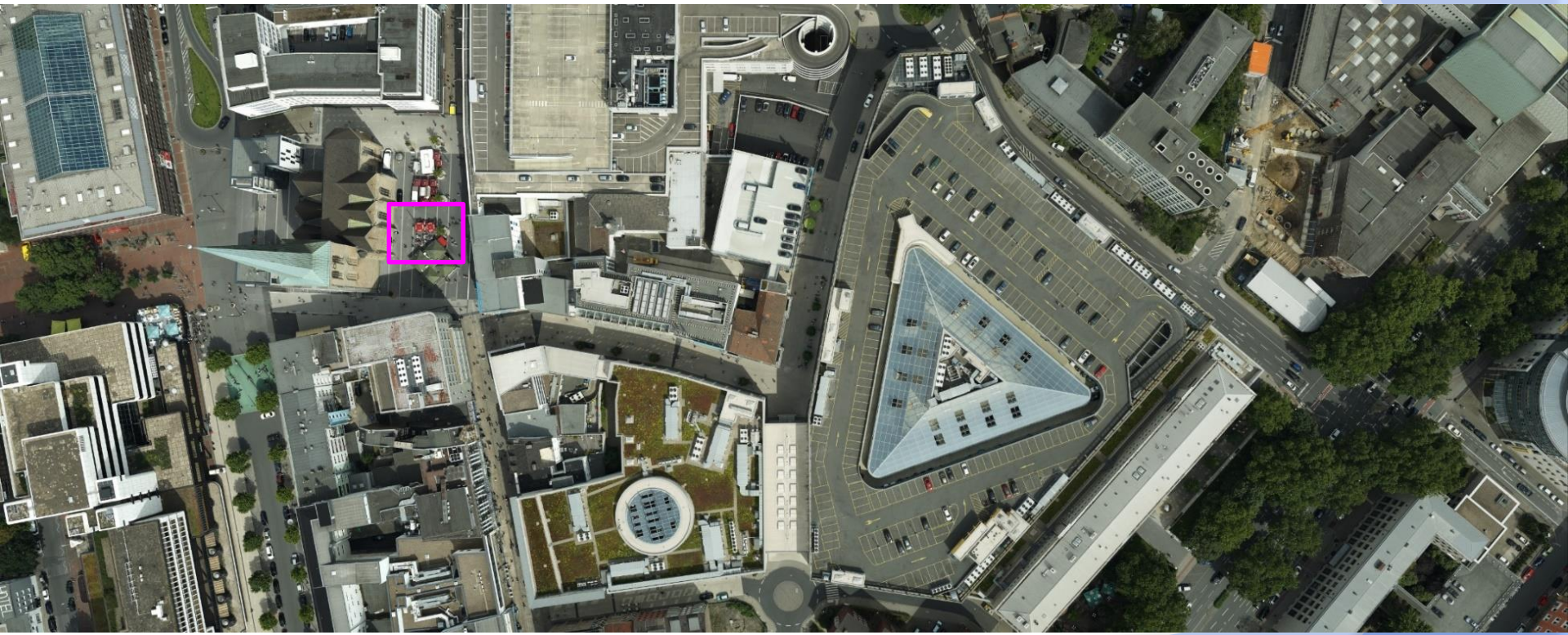

h= 370m GSD=1.9cm

h= 370m GSD=1.9cm

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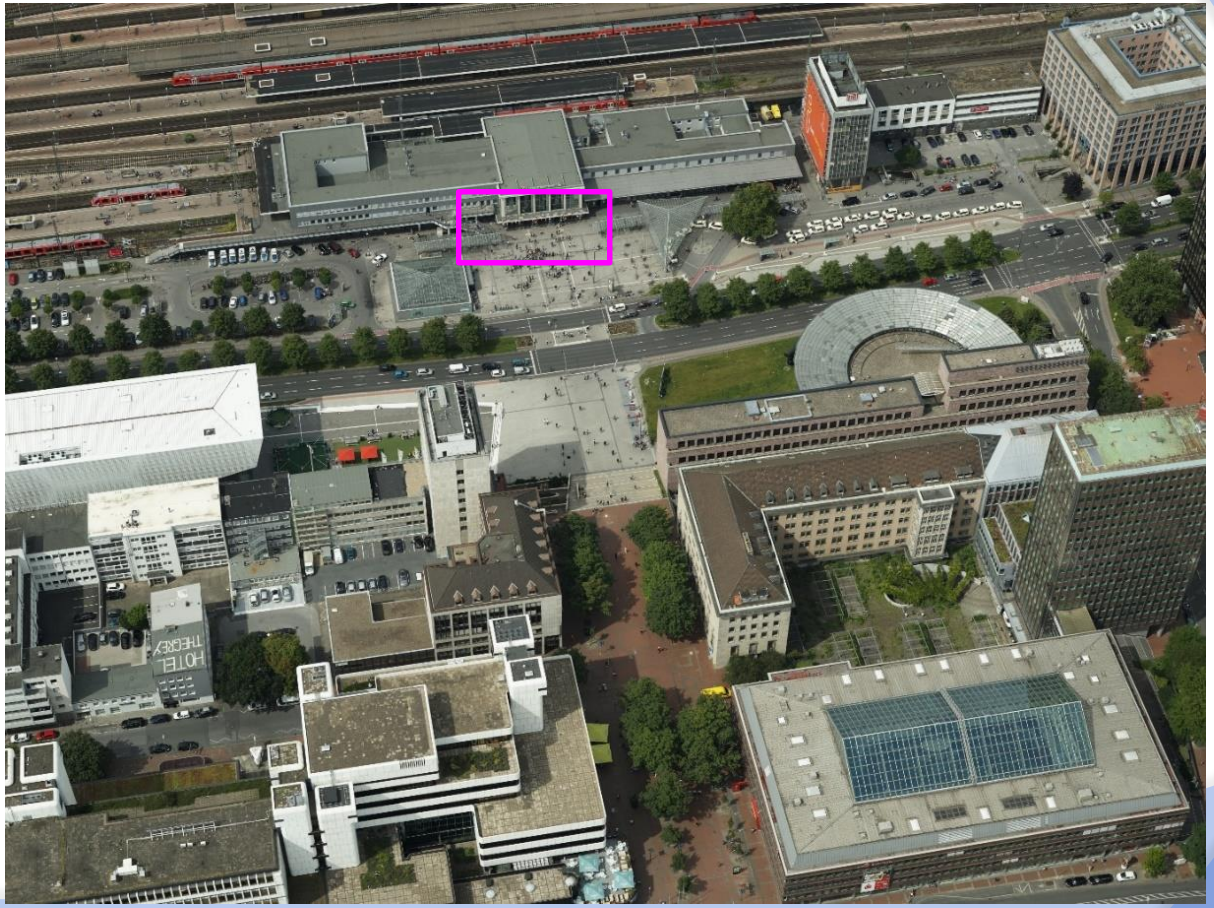
Example: “Dortmund City”



h= 370m
mean GSD=2.7cm


DB Hauptbahnhof
S
IGI
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h= 370m
mean GSD=2.7cm

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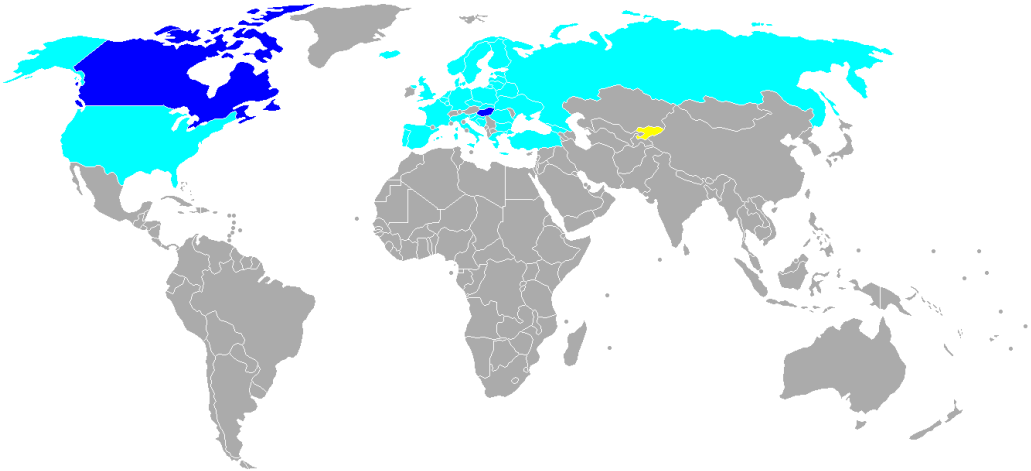
IGI Camera Systems for the new German „Open Skies“ Aircraft

The OPEN SKIES Treaty



The Treaty on Open Skies establishes a regime of unarmed aerial observation flights over the territories of its signatories. The Treaty is designed to enhance mutual understanding and confidence by giving all participants, regardless of size, a direct role in gathering information through aerial imaging on military forces and activities of concern to them.

IGI History: KSZE, Wien & Helsinki; 1990

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IGI Sensor Management:

SMS-1,
Sensor Management System
11 different Sensors

BD/Z-84,
Operator Interface for
Zenit Z-84 PAN-Camera

German Open Skies Aircraft until 1997: Tupolev 154-M

Open Skies 2017 Airbus A-319

Ein A319 der Flugbereitschaft. Noch einen Flieger dieses Typs will die Bundeswehr für „Open Skies“ – Foto: Aldo Bidini / CC-Lizenz / Wikipedia

http://www.pivotarea.eu/2015/12/23/neuer-open-skies-flieger-fuer-die-bundeswehr/

German OPEN SKIES Aircraft Requirements

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Aerial Camera Equipment for three Flight Levels

1500m AGL - LOW
1500m AGL Thermal IR - LOW
3000m AGL - MEDIUM
6000m AGL - HIGH

Ground Sample Distance

optical images ≥ 0.30m
thermal images ≥ 0.50m

Maximum Field of View

DigiTHERM-OS-I / Flight Level LOW

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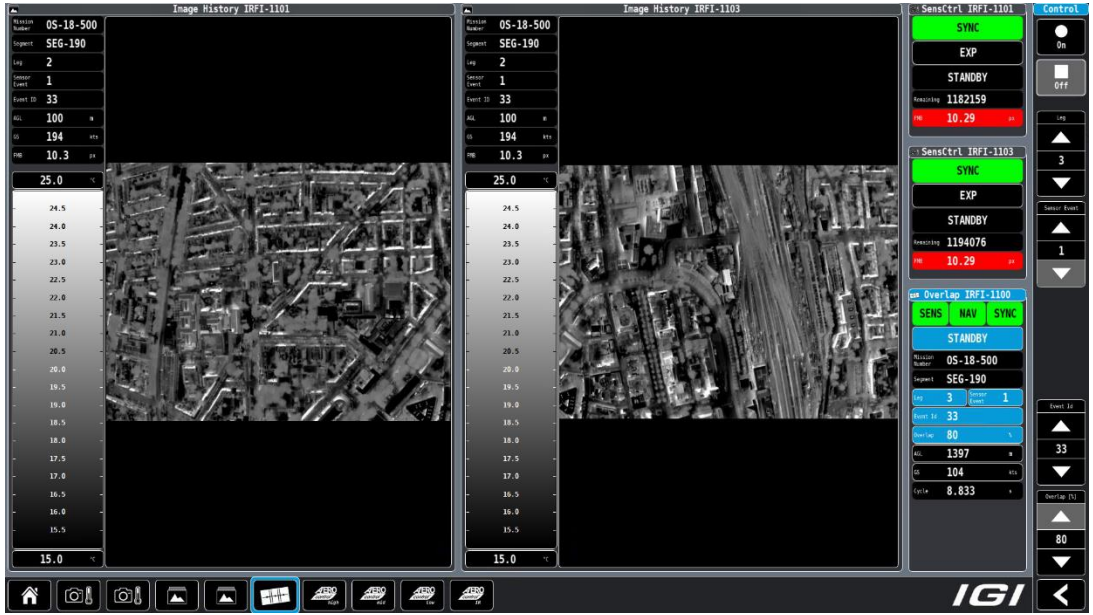
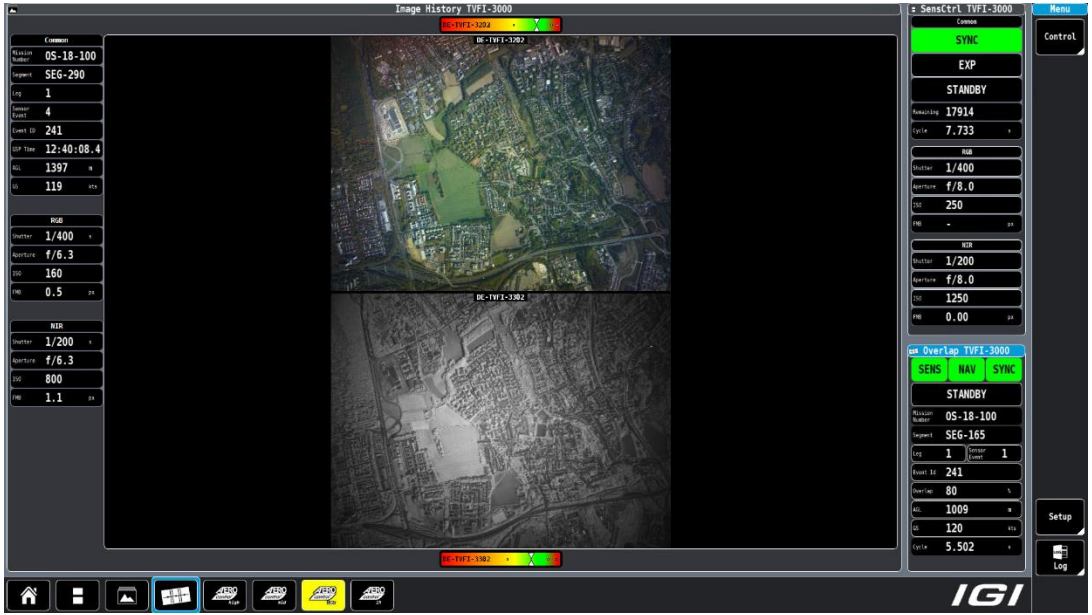


Opening Angle	63.4° * 23.5°
Swath @ 1550m	1913 m
Forward Overlap @ **4 images/sec** & **225 m/s**	92 % (intentionally limited to 50%)

DigiCAM-OS-I / Flight Level LOW



Opening Angle	96.6° x 80.2°
Footprint @ **1550 m**	3477 m x 2608 m
Forward Overlap @ **1 image/sec** & **225 m/s**	91 %

DigiCAM-OS-M / Flight Level MEDIUM

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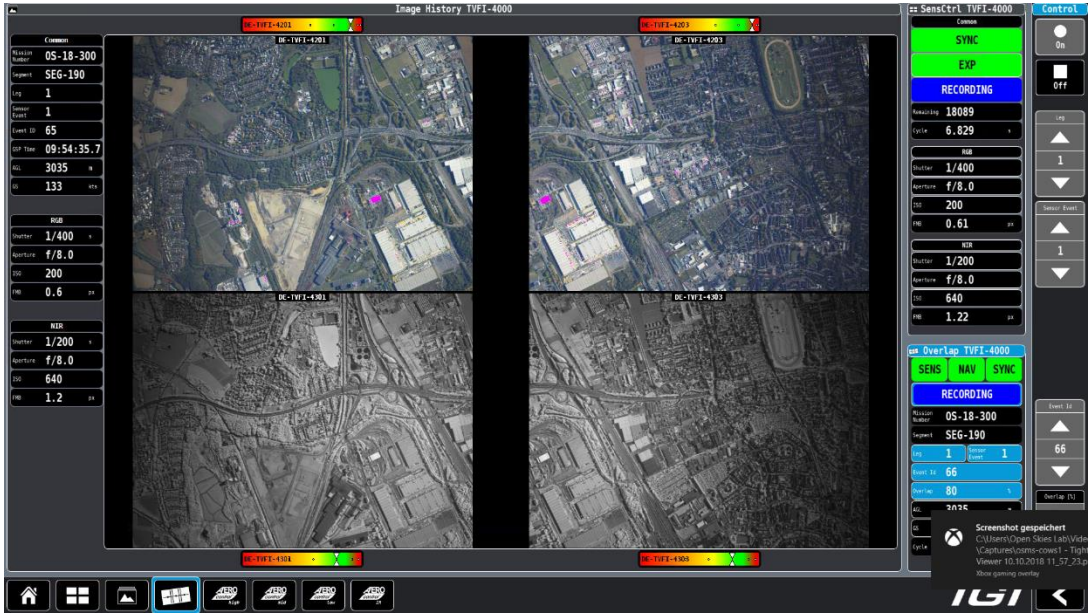

Opening Angle	85° x 42°
Footprint @ **3400 m**	6121 m x 2572 m
Forward Overlap @ **1 image/s** and **225 m/s**	91 %

DigiCAM-OS-H / Flight Level HIGH

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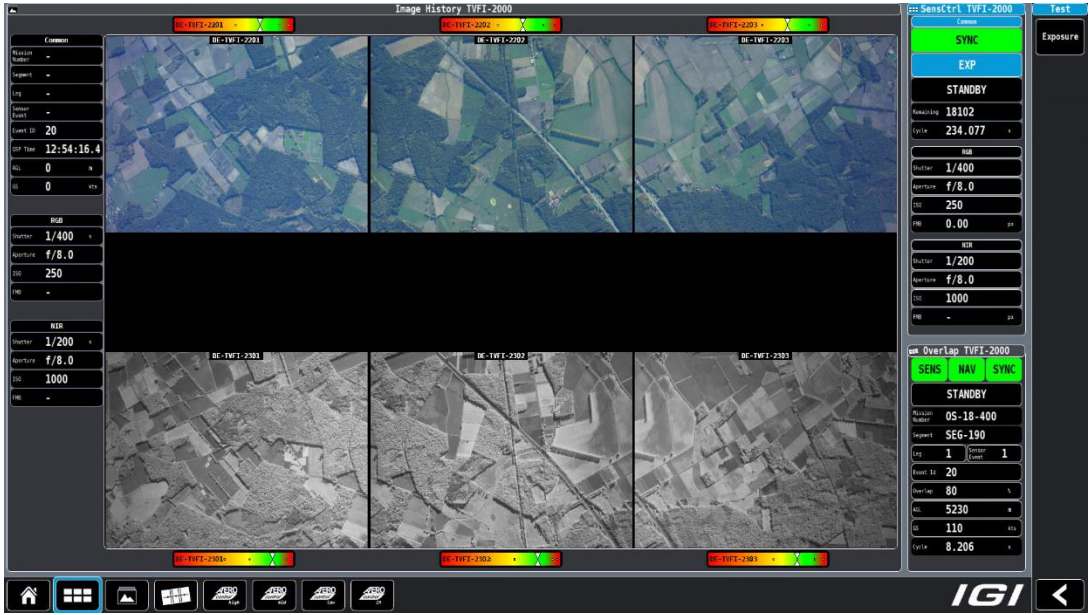

Opening Angle	81.1° x 25.1°
Footprint @ **5870 m**	10,045 m x 2,612 m
Forward Overlap @ **1 image/s** and **225 m/s**	91 %

DigiCAM-OS

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- Four independent camera assemblies operated in separate camera-holes
- Camera mount: Somag GSM4000
- Official introduction this month

OPEN SKIES

Thank you for your kind attention !

Enschede, 13.6.2019