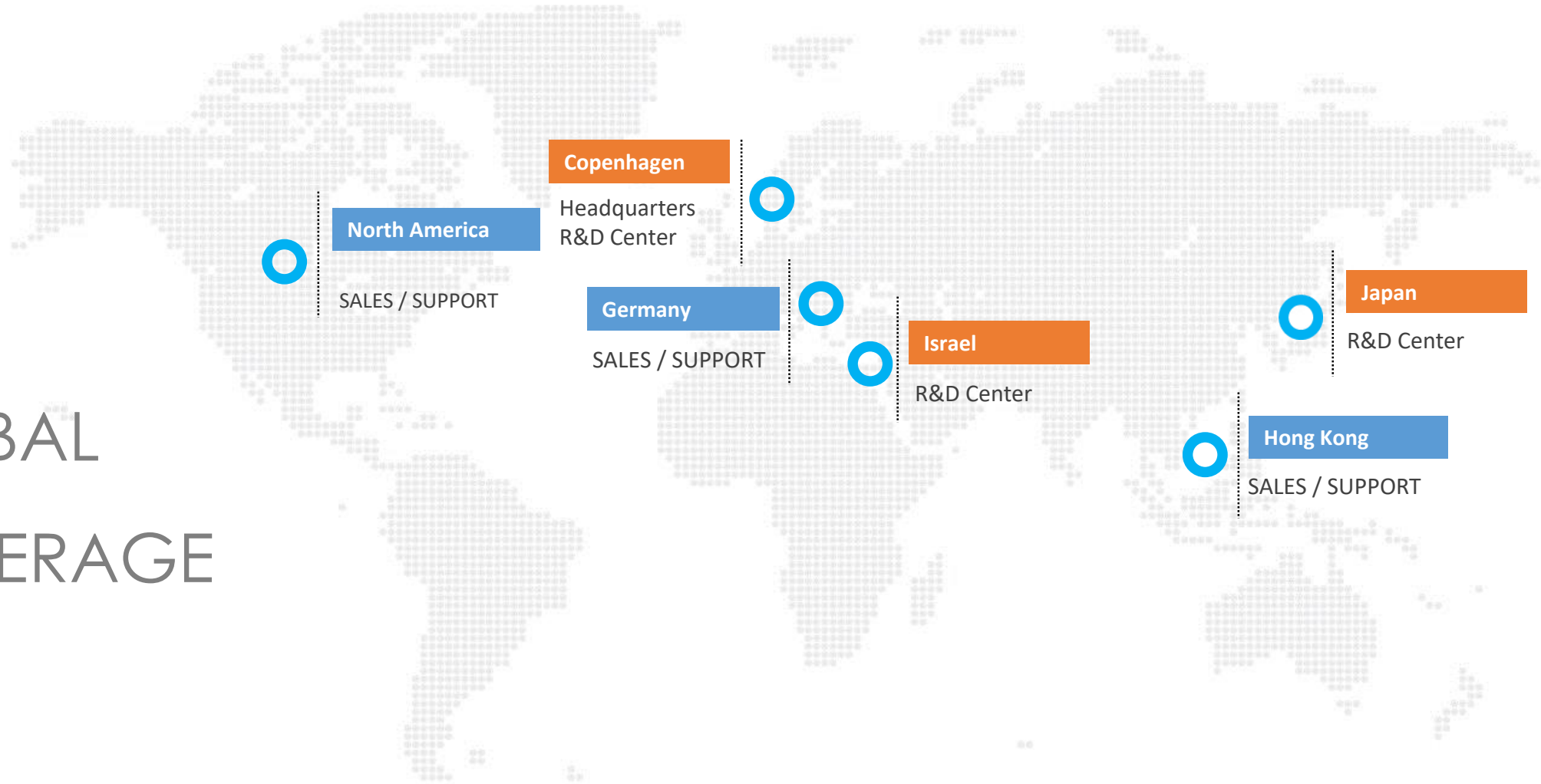




PHASE ONE INDUSTRIAL

New Generation of Aerial Cameras

GLOBAL COVERAGE



Global coverage incl.
50 distribution & service partners

Phase One Aerial Survey Products



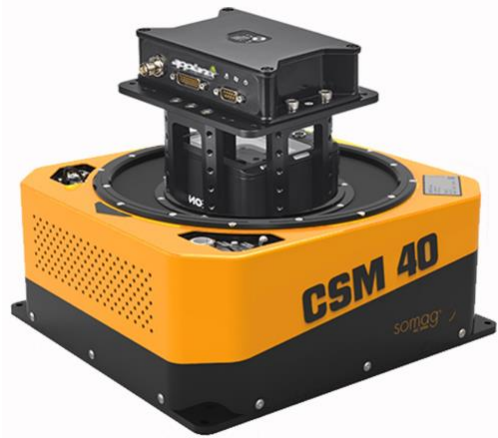
iXM-RS105F / iXM-RS100F



iXU-RS1900



Machine Vision
iXM-MV150F / iXM-MV100



PAS 100MP / PAS100MP 4-band



PAS 190MP / PAS 190MP 4-band



iXM50 / iXM100 with drone DJI M600

New lenses for high GSD



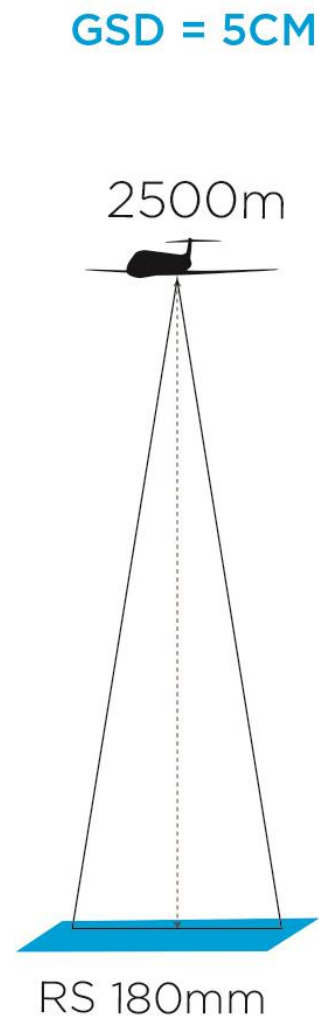
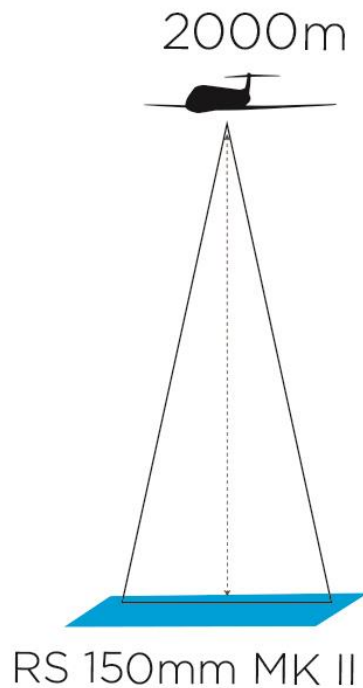
RS 300mm AF for cameras
iXM-RS 150F / iXM-RS 100F
iXM-100 / iXM-50



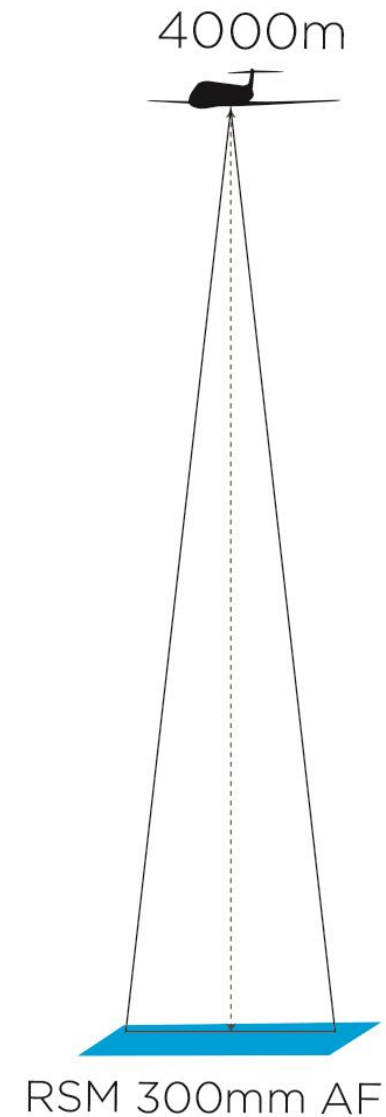
RS 180mm AF for cameras
iXM-RS/ iXU-RS



RS 150mm MKII for cameras
iXM-RS 150F / iXM-RS 100F



GSD = 5CM



RS 300mm AF for objects inspection



RS 300mm AF for cameras
iXM-RS 150F / iXM-RS 100F
iXM-100 / iXM-50

RS 300mm AF for:

1. Urban aerial survey with high GSD
2. Ground objects long range inspection
3. Long range security and surveillance



RS 300mm for object inspection, security and surveillance

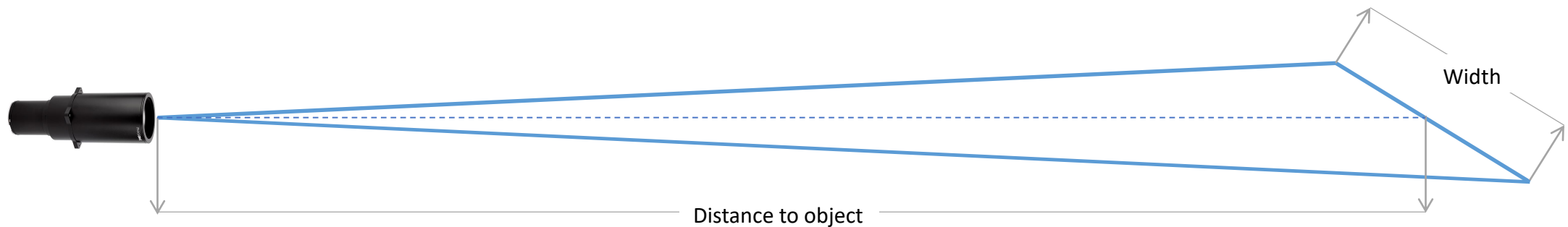
Distance to object depending on GSD

GSD (cm)	1	2	3	4	5
iXM-50					
Distance to object (m)	570	1140	1710	2280	2850
Width (m)	80	160	240	320	400
iXM-100					
Distance to object (m)	800	1600	2400	3200	4000
Width (m)	120	240	360	480	600
iXM-RS100F					
Distance to object (m)	650	1300	1950	2600	3250
Width (m)	120	240	360	480	600
iXM-RS150F					
Distance to object (m)	800	1600	2400	3200	4000
Width (m)	140	280	420	560	700



Face recognition example

Operational requirement	Horizontal pixels/face	Pixel size on target (mm)	Distance to object (m)	Width (m)
Identification (challenging conditions)	80	2	159	28
Identification (good conditions)	40	4	318	57
Recognition	20	8	636	113
Detection	4	40	3175	565



PAS190MP Aerial Survey System



Phase One 190MP Aerial System



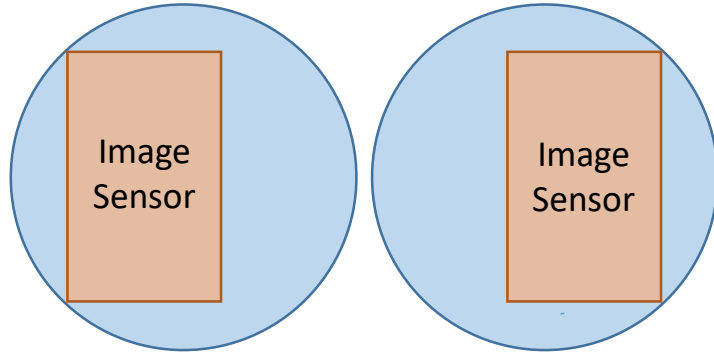
iXU-RS1900

Camera Type	iXU-RS1900	iXU-RS1900 4-band
Camera Specifications		
Lenses type	Rodenstock	
Number of lenses	2	3
Focal length (mm)	90	90 & 50
FOV (across / along flight line, deg)	45.7 / 33.0	
Aperture	f/5.6	
Exposure principle	Leaf shutter	
Exposure (sec)	1/2000 to 1/125	
Image capture rate	1 frame every 0.6 sec	
Light Sensitivity (ISO)	50-6400	
Dynamic Range (db)	>84	
Spectral characteristics	R,G,B	R,G,B, NIR
Sensor Specifications		
CMOS pixel size (µm)	4.6	
CMOS array (pix)	11,608 x 8,708	
Analog-to-digital-conversion (bit)	14	
Frame / Image Specifications		
Frame geometry	Central projection	
Image size (pixel)	16,470 x 11,570	
Image volume (MP)	190	
Color	RGB	RGB, NIR, CIR, 4-band
Pansharpen ratio	N/A	1:1.8
Typical image size (MB)	570	760
Image format	Phase One RAW, TIFF, JPEG	
Complete Set		
iX Controller	up to 6 separate USB3 ports	
Pilot monitor for navigation	Yes	
Operator monitor for camera management	Yes	
Gyro-stabilizer	SOMAG DSM400	
INS/GNSS	Applanix, NovAtel, ...	
Operational Specifications		
Power Consumption	180 W	
Dimensions (L x W x H)	46x43x37 cm	
Weight	30 kg	

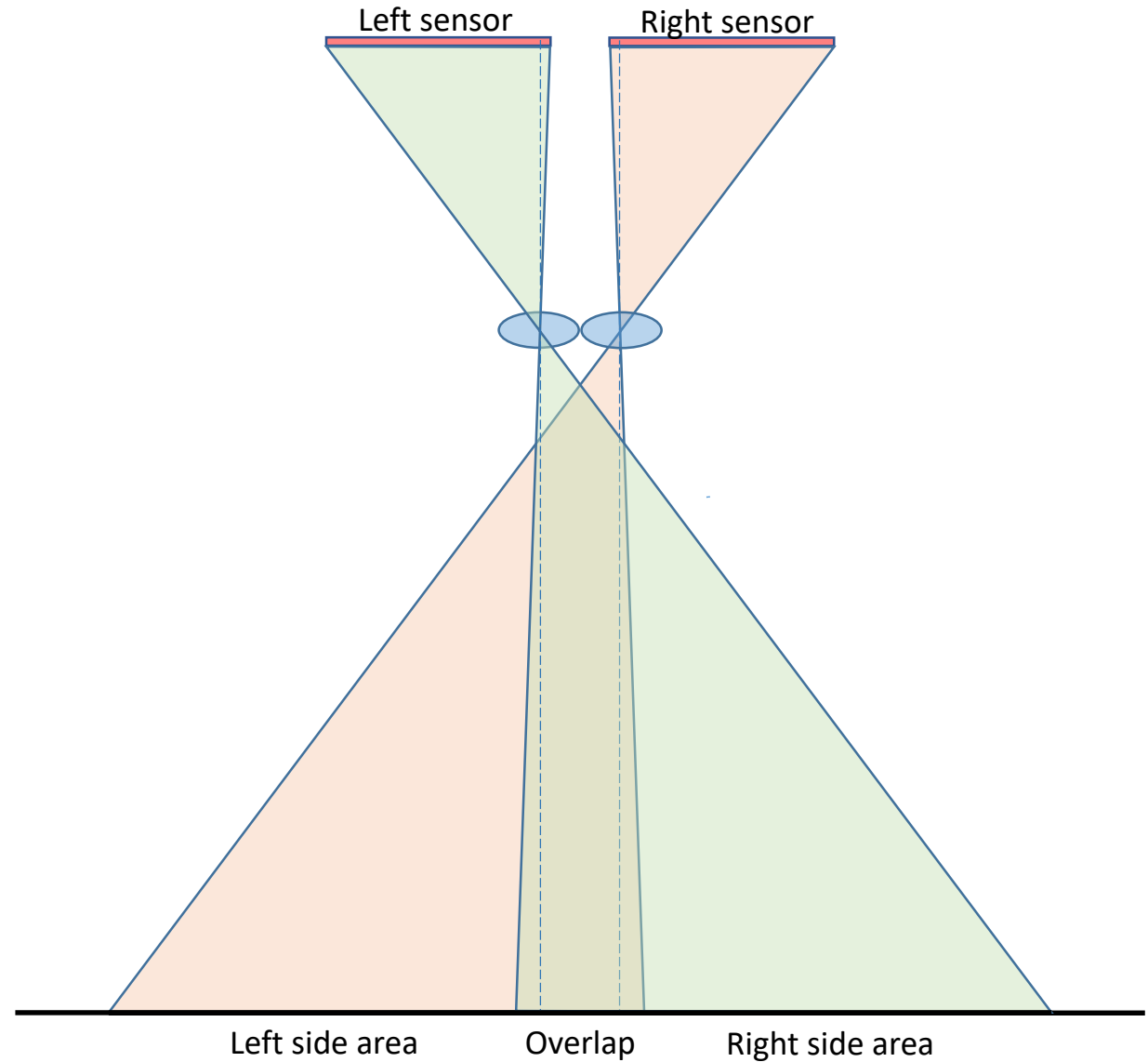
iXU-RS1900 optical principles

Left lens

Right lens



iXU-RS1900



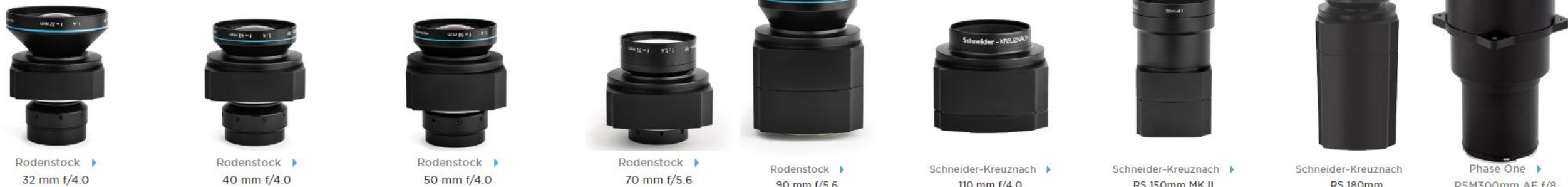
iXM-RS150F & iXM-RS100F



Camera	iXM RS150F	iXM RS100F
Sensor size	150 MP 14204x10652	100 MP 11608x8708
Dynamic range	83dB	84dB
Pixel size	3.76µm	4.6µm
Light sensitivity (ISO)	50-6400	
Capture rate	2 fps	
Lens mount	Phase One RSM	
Data interfaces	USB3, Ethernet 10G	
Data storage	XQD card	
Synchronization speed	50 microseconds in an array of cameras	
IR cut-off filter	Yes	
Connection to pod	4xM4 bolts	
Power input	12 - 30 VDC	
Max. Power consumption	16W	
Weight (excluding lens)	1000 g	
Dimensions (excluding lens)	9 x 9 x 9.1 cm	
Temperature	-10°C to 40°C	
Humidity	15% - 80% (non-condensing)	

https://industrial.phaseone.com/iXM-RS_150F_Camera.aspx

Lenses for iXM-RS



Focal length	32	40	50	70	90	110	150	180	300
Minimum focusing range	Infinity								
Shutter speed max	1/2500	1/2500	1/2500	1/2500	1/2000	1/2500	1/2500	1/2000	1/2000
Exposure control	1/3 f-stop increments								
Aperture range	f/4-f/22	f/4-f/22	f/4-f/22	f/5.6-f/22	f/5.6-f/22	f/4-f/22	f/5.6-f/22	f/6.3-f/22	f/8-f/32
Aperture range	86	67	67	58	72	58	86	67	86
Total length [mm]	181	170	177	175	218	185	257	283	328
Weight [gr]	970	730	800	580	1150	620	1150	1400	1900
FOV (long side) [deg]	79.7°	67.4°	56.2°	41.8°	33.0°	27.3°	20.2°	16.9°	10.2°
FOV (short side) [deg]	64.1°	53.2°	43.7°	31.9°	25.1°	20.6°	15.2°	12.7°	7.6°

<https://industrial.phaseone.com/Lenses.aspx>

iXM100 & iXM50



Camera	iXM 100	iXM 50
Sensor size	100 MP (11664x8750)	50 MP (8280x6208)
Dynamic range	83dB	84dB
Pixel size	3.76µm	5.3µm
Light sensitivity (ISO)	50-6400	100-6400
Capture rate	3 fps	2 fps
Lens mount	Phase One RSM	
Data interfaces	USB3, Ethernet 10G	
Data storage	XQD card	
Synchronization speed	50 microseconds in an array of cameras	
IR cut-off filter	Yes	
Connection to pod	4xM4 bolts	
Power input	12 - 30 VDC	
Max. Power consumption	14W	12W
Weight (excluding lens)	630gr	
Weight (including 80mm lens)	1100 g	
Dimensions (including 80mm lens)	9 x 9 x 16.4 cm	
Temperature	-10°C to 40°C	
Humidity	15% - 80% (non-condensing)	

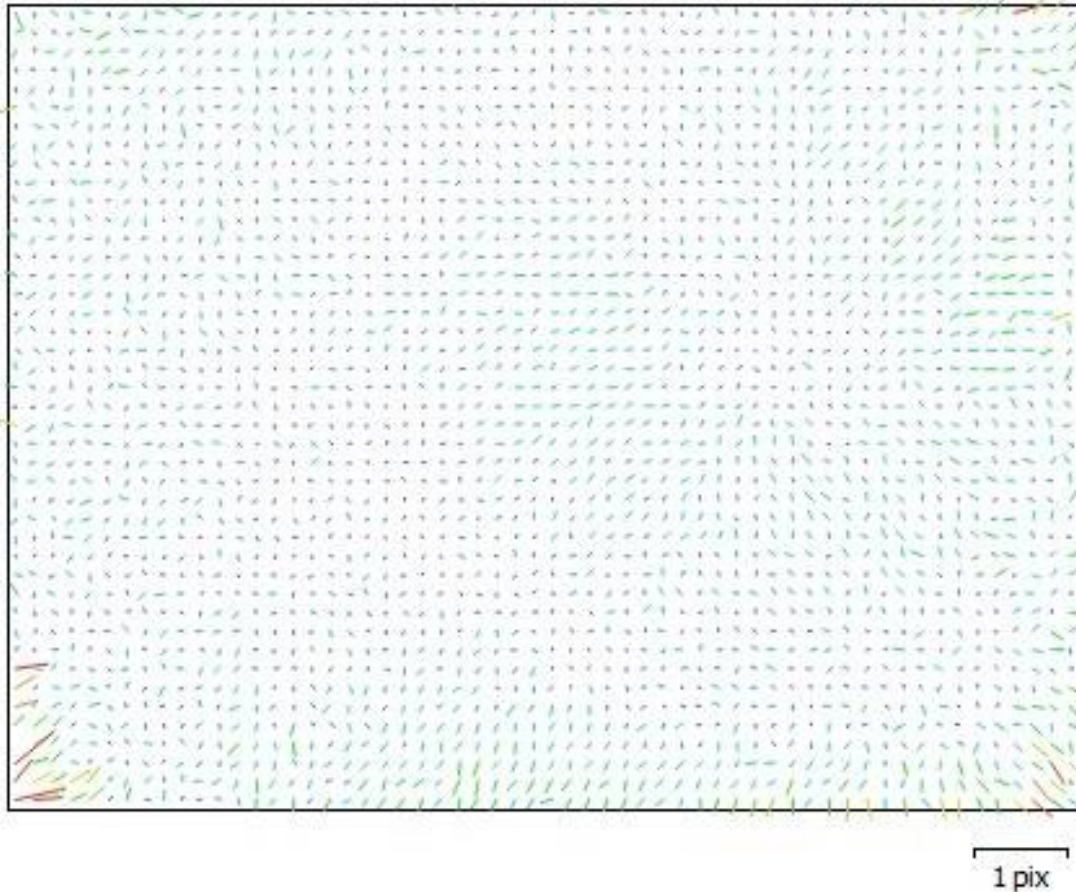
https://industrial.phaseone.com/iXM_Camera_Series.aspx

RSM lenses for iXM100/50



Focal length	35 f/5.6	80 f/5.6	80 AF f/5.6	150 AF f/5.6	300 AF f/5.6
Minimum focusing range	∞	∞	3m до ∞	10m до ∞	10m до ∞
Shutter speed max	1/2500			1/2000	
Exposure control	1/3 f-stop increment				
Aperture range	f/5.6 - f/22			f/8 – f/32	
Filter diameter [mm]	58			86	
Total length [mm]	77.5	97.5	97.5	132.5	328
Weight [gr]	540	470	630	744	1900
FOV (long side)	63°	30.4°	30.4°	17.1°	8.4°
FOV (short side)	49.4°	23°	23°	12.9°	6.3°
https://industrial.phaseone.com/Lenses.aspx					

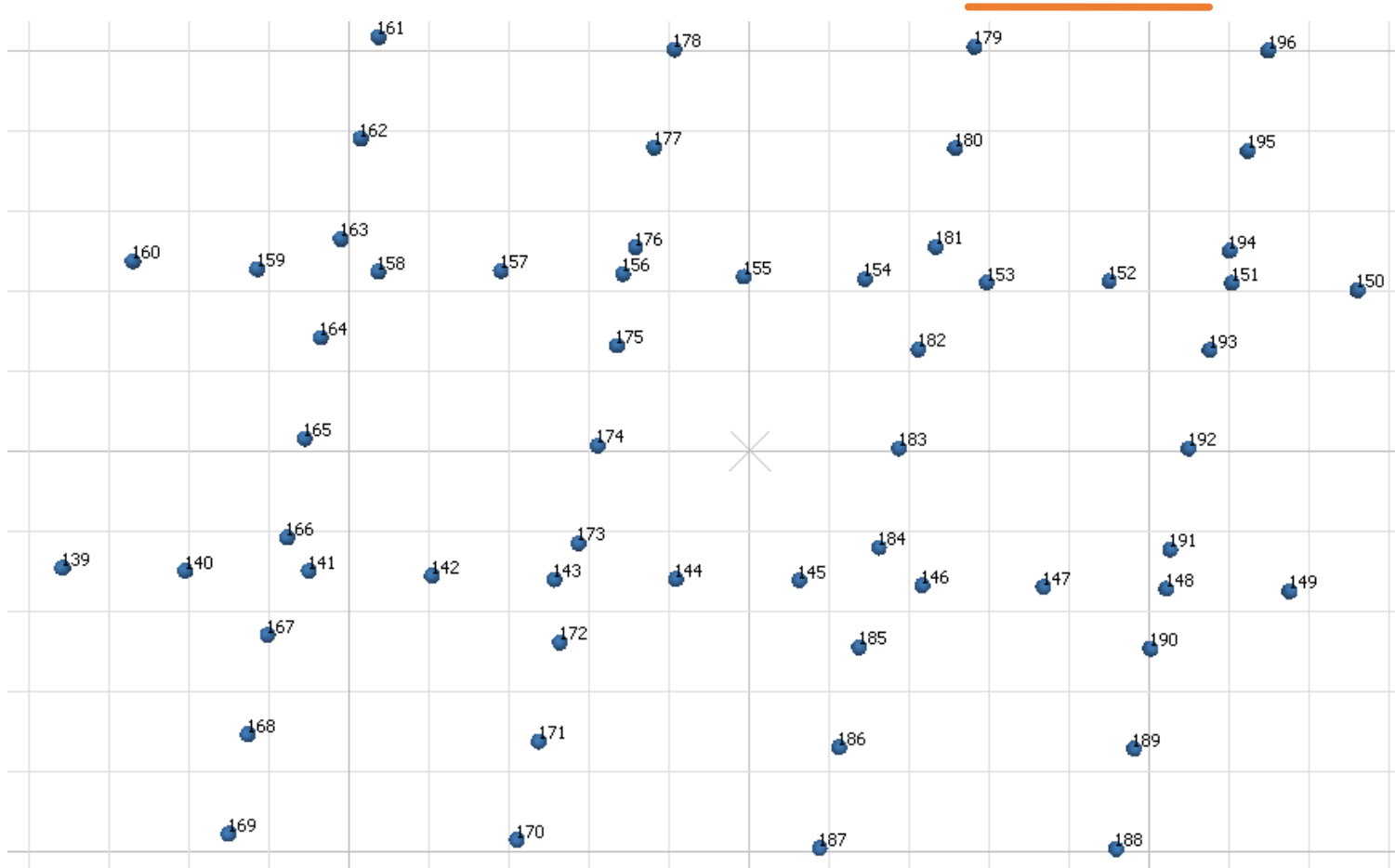
iXM-RS100 Camera Model



Sensor resolution (μm)	3.76
Sensor width (long side, pix)	14,204
Sensor height (short side, pix)	10,652
Focal length (mm)	35
Maximal distortion after correction (pix)	< 0.5

- The distortion model of the camera iXM-RS100 with 35 mm focal length fully corresponds to a standard Brown-Conrady symmetric radial distortion model
- Images captured with the camera may be easily transformed to undistorted model with a maximal residual less than 1 μm .

Aerial Survey flight with PAS190



Flight characteristics

Flight altitude	3,600 feet
-----------------	------------

GSD	5.6 cm
------------	---------------

Distance between strips	550 m
-------------------------	-------

Side overlap	40%
--------------	-----

Forward overlap	70%
-----------------	-----

Frame size	922 x 646 m
------------	-------------

Ground speed	130 knot
--------------	----------

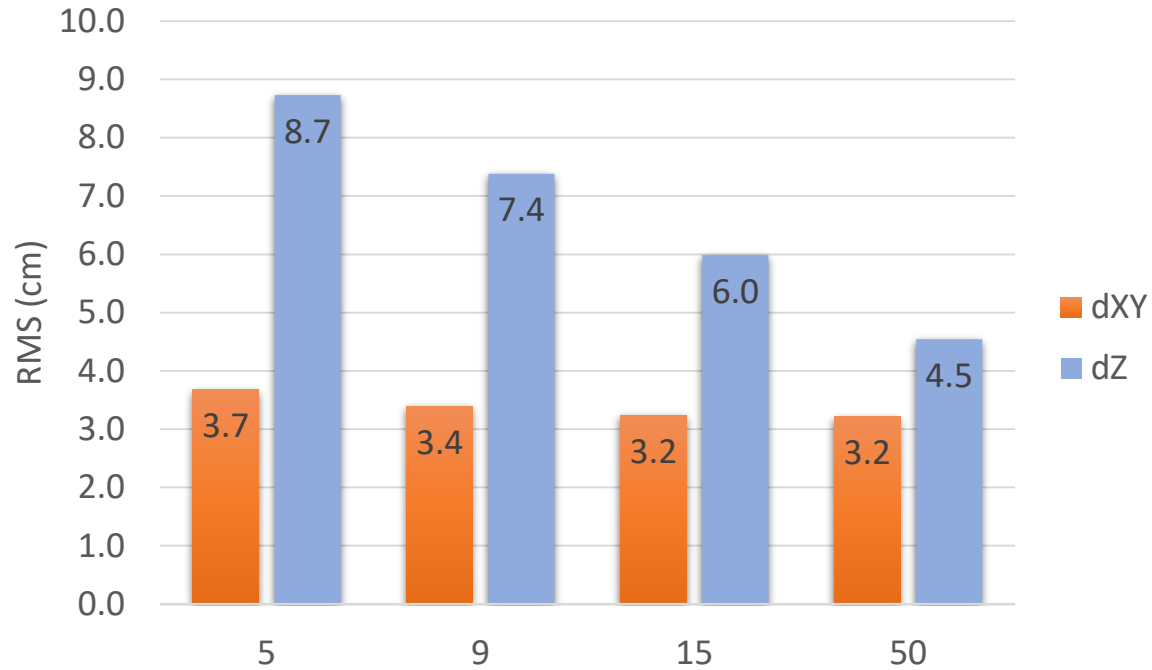
Strips SN	4
-----------	---

Strips WE	2
-----------	---

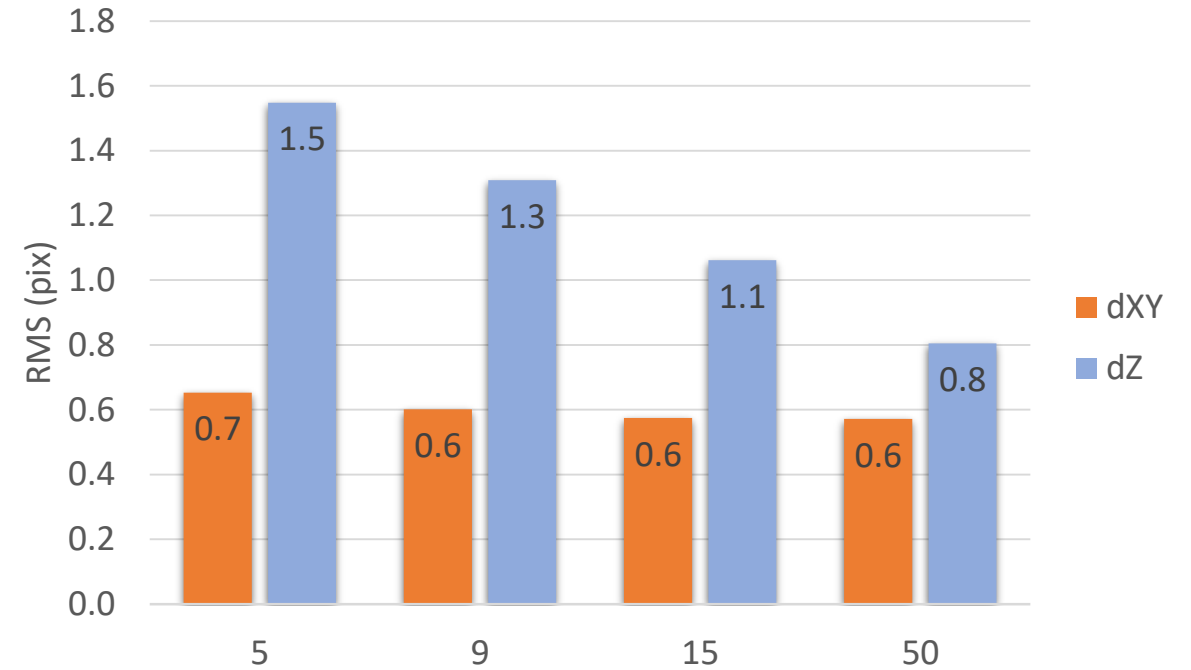
Number of images	58
------------------	----

Accuracy summary

Check points residuals per GCPs (cm)



Check points residuals per GCPs (pix)



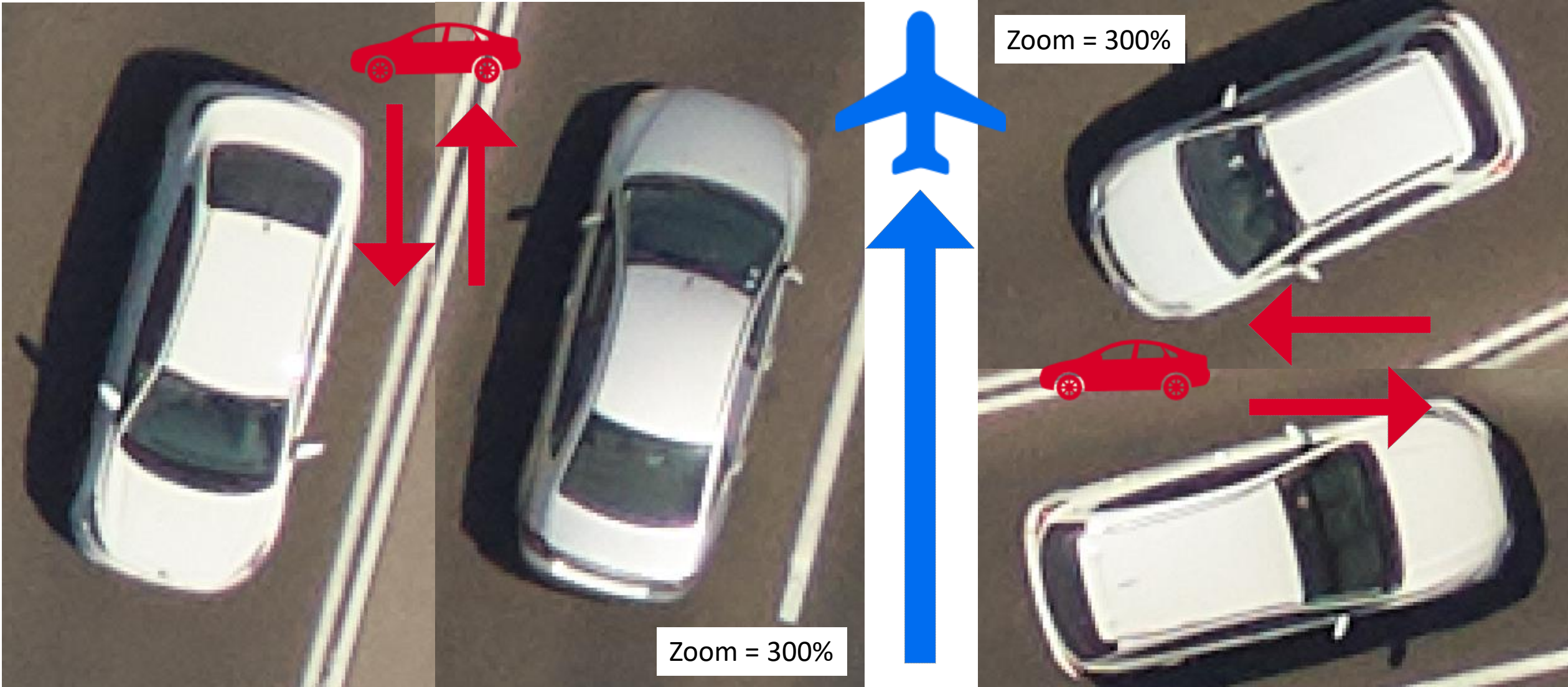
1. The planimetric accuracy of the block on Check Points is always at the level of 0.6-0.7 pixel independently on the number and configuration of GCPs.
2. The altimetric accuracy of the block on Check Points starts from 8.7 cm (1.5 pix) with 5 GCPs and reaches 6.0 cm (1.1 pix) with 15 GCPs.

BCT (Blur Control Technique) vs FMC

Blur Control Technique – eliminates the motion blur by short exposure time, which is enabled by using high-speed shutters (up to 1/2500 sec) and higher sensitivity (83dB) of the new generation of CMOS sensors.

Exposure time	Motion blur = 1 pix for GSD=5cm		Motion blur = 2 pix for GSD=5cm	
	Ground Speed		Ground Speed	
sec	km/h	knot	km/h	knot
1/2500	450	243	900	486
1/2000	360	194	720	389
1/1600	288	156	576	311
1/1250	225	121	450	243
1/1000	180	97	360	194
1/500	90	49	180	97

iXM-RS150F(50mm) Image Quality with BCT

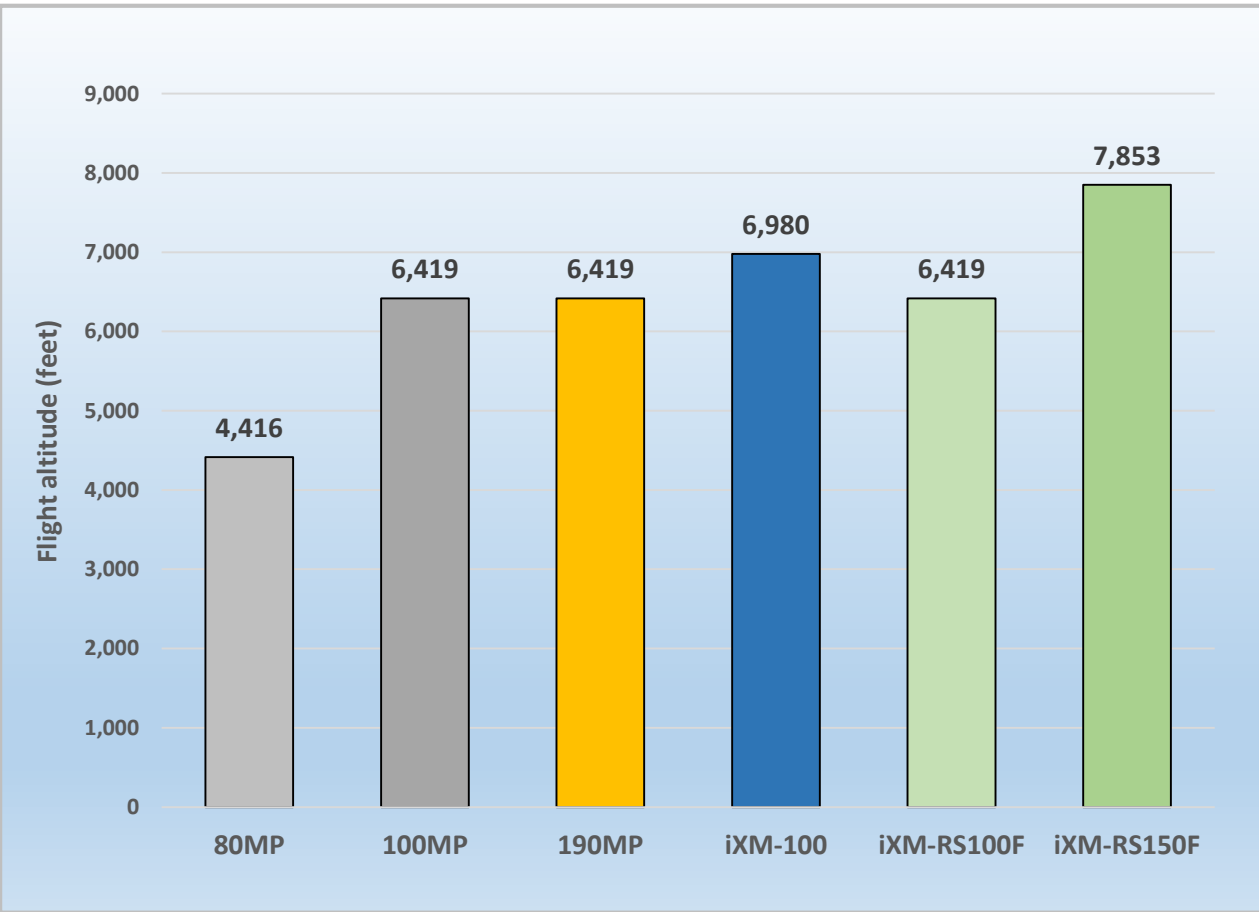


Altitude = 490 m (1,600 feet)
GSD = 3.7 cm

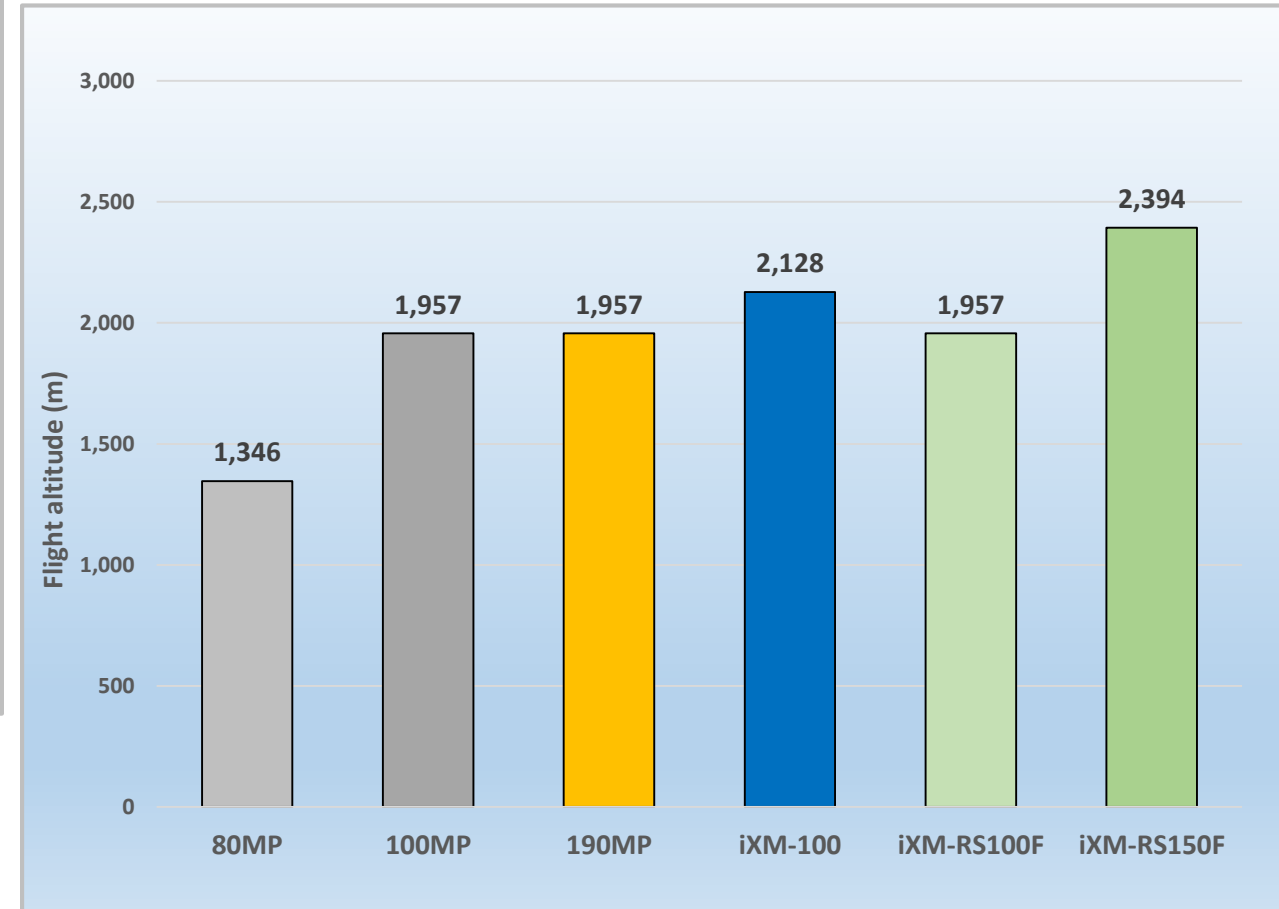
Plane speed: 90 knot (167 km/h)
Car speed: 65 knot (120 km/h)
Total speed: **155 knot (287 km/h)**

Shutter speed: 1/2500
ISO: 200
Aperture: f/5.6

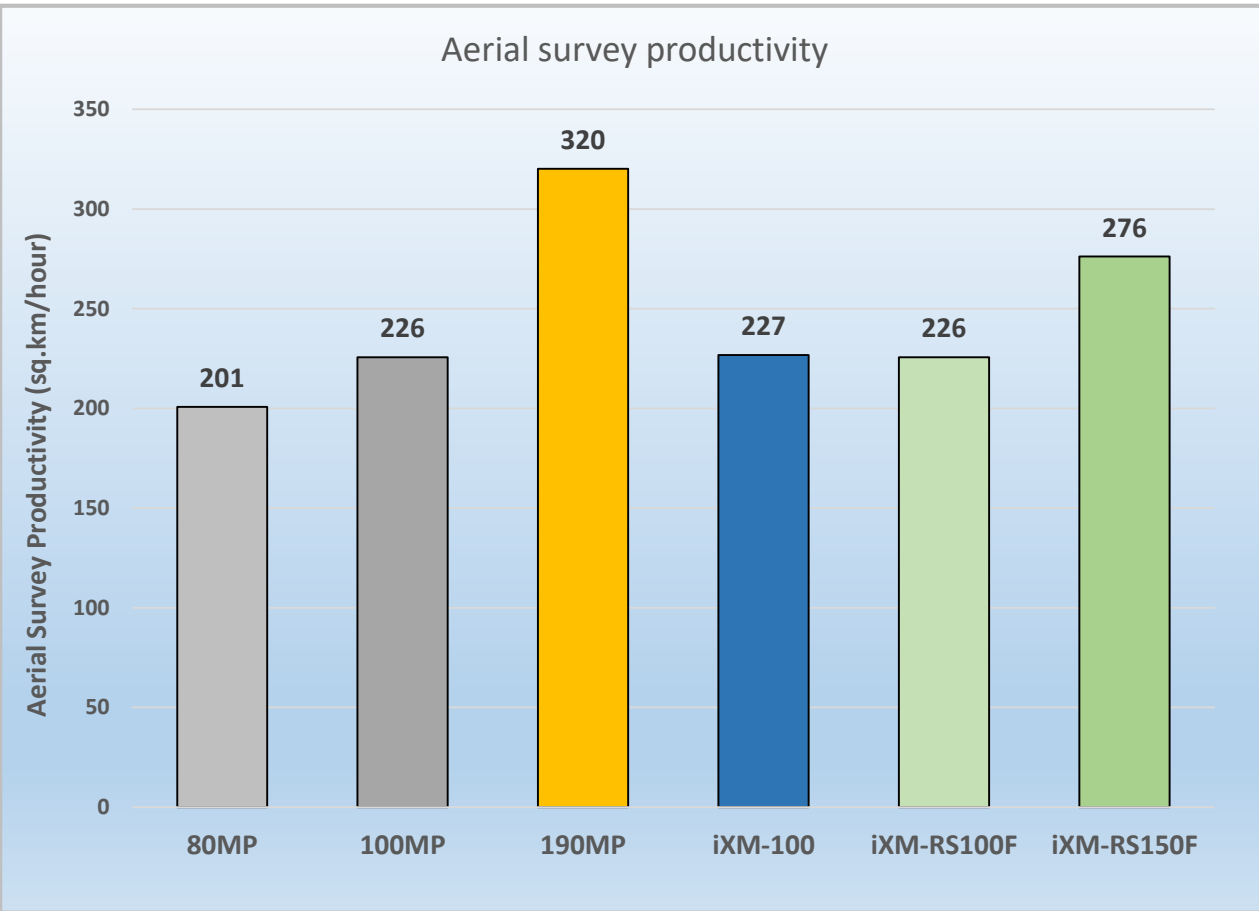
Flight altitude (F=90mm)



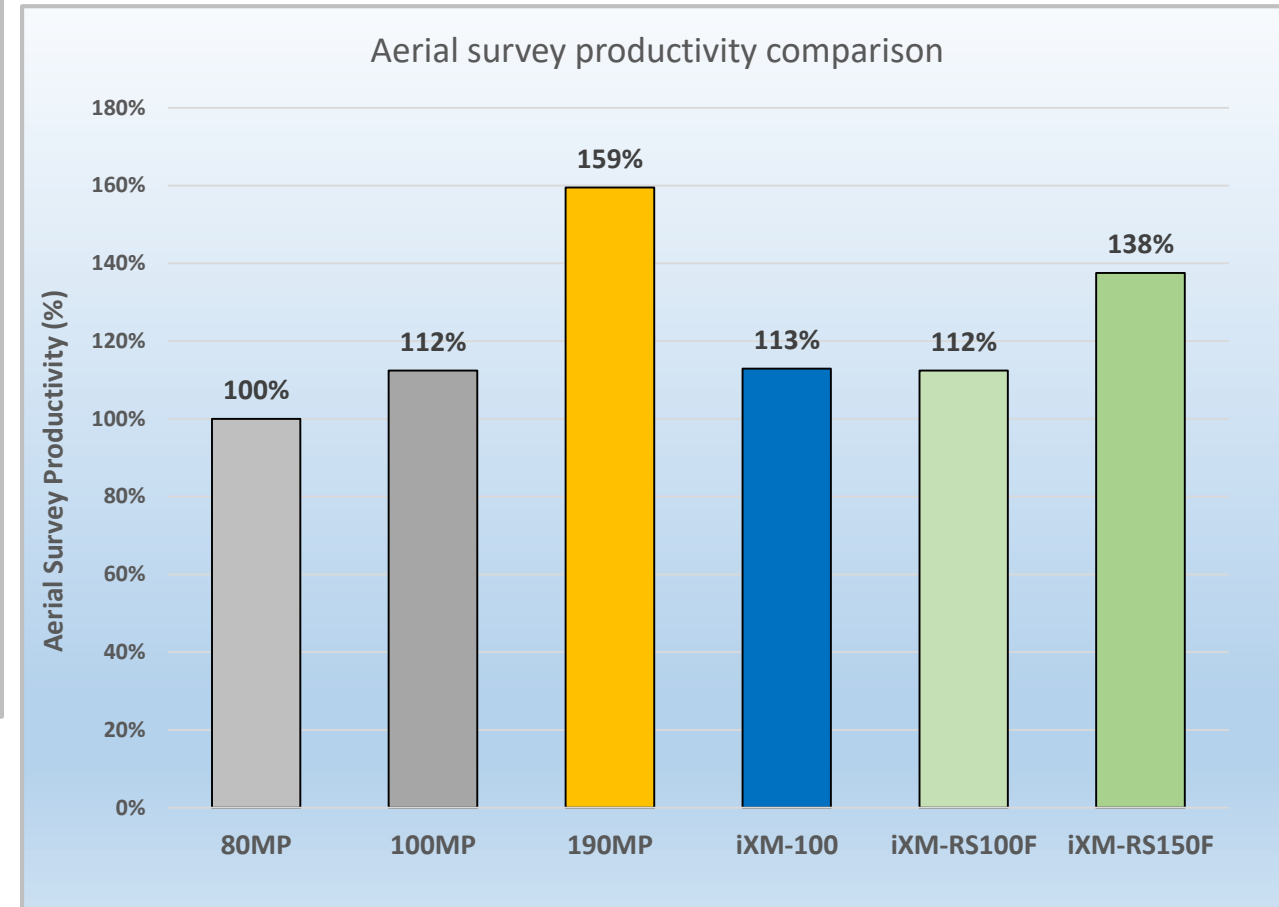
GSD = 10 cm



Aerial Survey Productivity



GSD = 10 cm
Side overlap = 30%



Number of Flight Lines/Total Flight Time

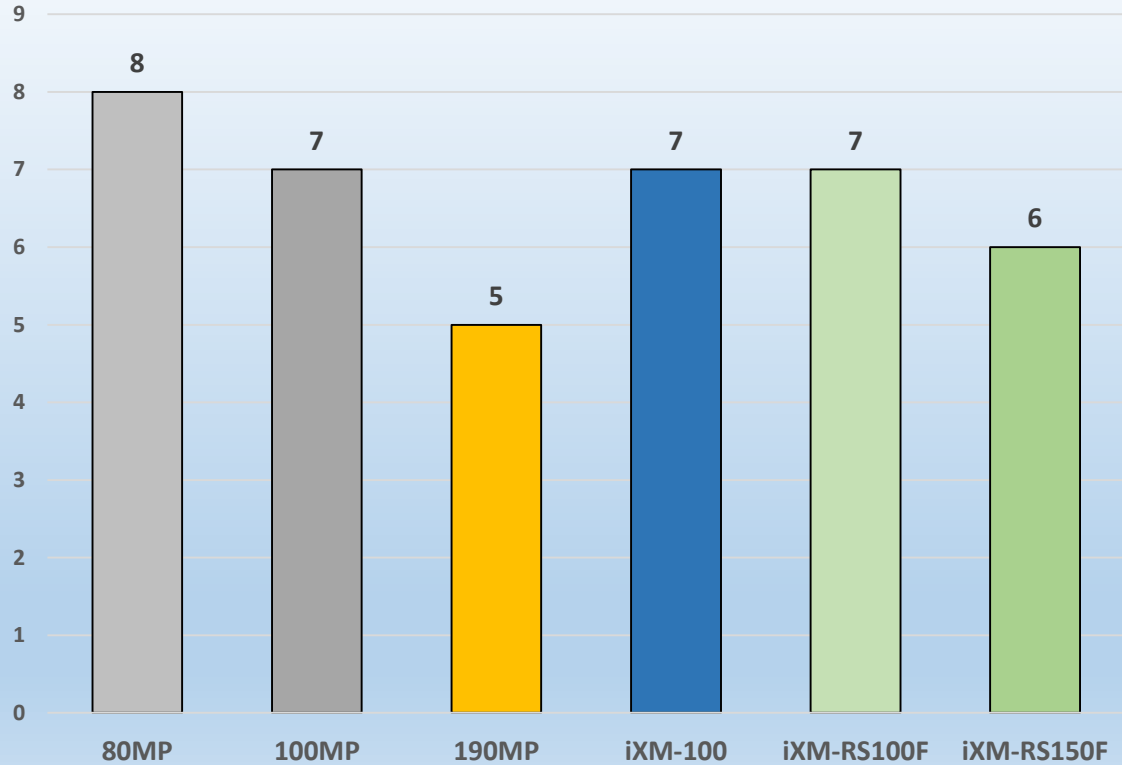
GSD = 10 cm

Side overlap = 30%

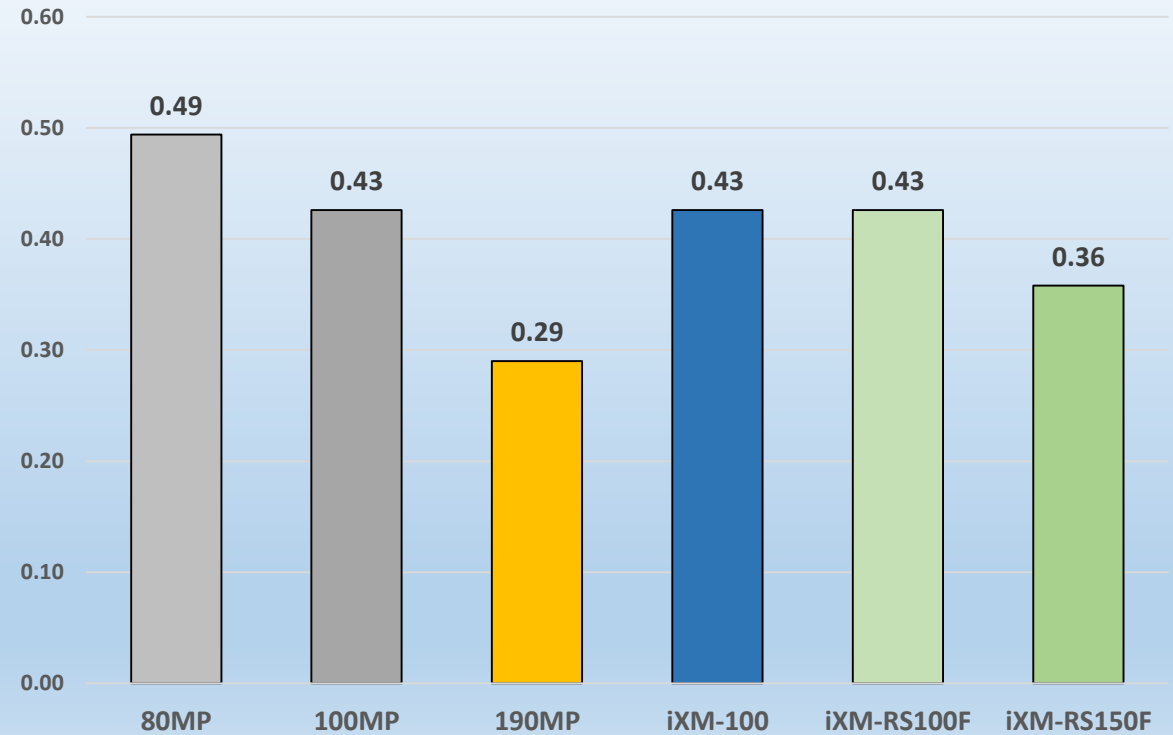
Area = 5 x 5 km

Ground speed = 150 knot /278 km/h

Number of Flight Lines



Total Flight Time (hour)



Drone flight - Very high resolution image



Camera – iXU-RS1000 (50mm)
GSD = 1.1 cm
Altitude = 120 m (400 feet)

Drone flight - Very high resolution image



Camera – iXU-RS1000 (50mm)
GSD = 1.1 cm
Altitude = 120 m (400 feet)

Drone flight - Very high resolution image



Camera – iXU-RS1000 (50mm)
GSD = 1.2 cm
Altitude = 148 m (500 feet)

Airborne flight - Very high resolution image



Camera – iXM-RS150F (150mm)

GSD = 2.3 cm

Altitude = 930 m (3,000 feet)

Airborne flight - Very high resolution image



Camera – iXM-RS150F (150mm)
GSD = 1.5 cm
Altitude = 620 m (2,000 feet)

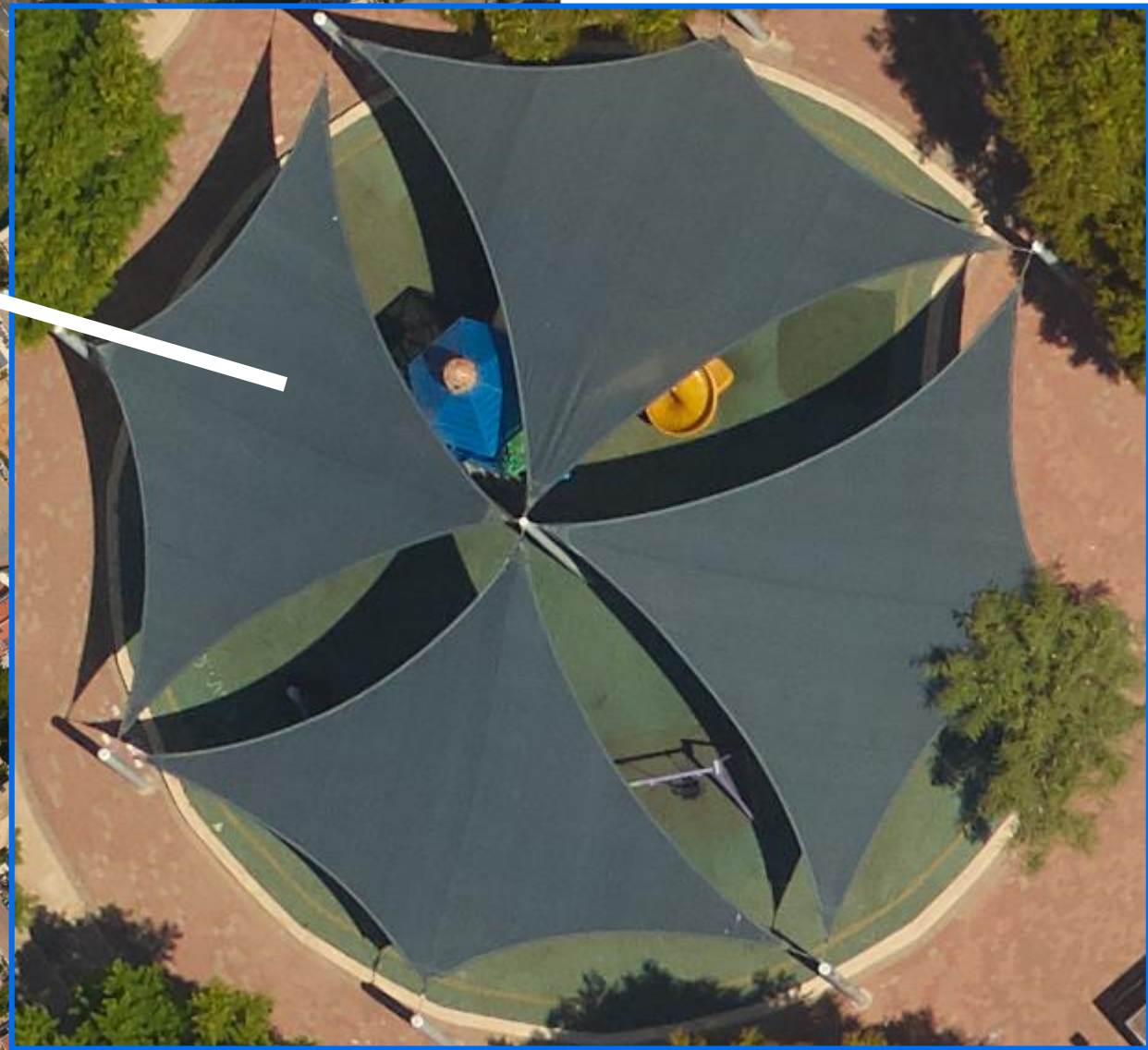
iXM-RS150F image

Altitude = 490 m (1,600 feet)

GSD = 3.7 cm

f = 50 mm

Frame area: 520 x 320 m



Power Lines Inspection



Wind Turbine Inspection



Conclusions

1. Phase One cameras are the only metric small and medium format mapping cameras
2. Phase One cameras are the only Dust & Water proof mapping cameras
3. PhaseOne cameras feature a very light weight and a small size
4. Phase One cameras have an interface for integration with UAV/Drones and GNSS systems
5. Phase One images transformed to undistorted images with a maximal residual less than 1 μm
6. Phase One images are of a very high resolution and high radiometric quality
7. Phase One images features the highest image coverage between small and medium format cameras



Thank you!

PHASE**ONE**
Specialty Imaging Solutions