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# SMART SURVEYORS FOR LAND AND WATER MANAGEMENT CHALLENGES IN A NEW REALITY



**e** WORKING WEEK 2021  
**20-25 JUNE**

Elsayed AMMAR

Paper ID-11162

Modern Photogrammetric Manned Airborne Imaging Sensors

Wednesday 23.06, 15:00-16:30

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## INTRODUCTION

The traditional old aerial film cameras

**Digital imaging sensor technology**

Charge Coupled Device  
(CCD) sensors

Complementary Metal-Oxide Semiconductor  
(CMOS) sensors

Area array large format

Linear array push-broom

Area array Large format sensors

CMOS sensors parameters mentioned in the technical data sheets demonstrated by the manufacturers

B/H ratio current modern CMOS sensors are determined, which are not published before

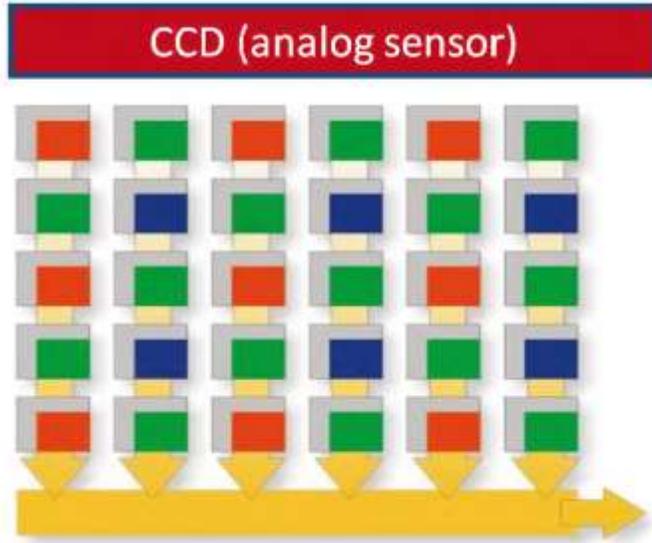
It is suggested to rotate the length of the sensor to be in the flight direction instead of the width to almost duplicate B/H



## IMAGING SENSOR TECHNOLOGY

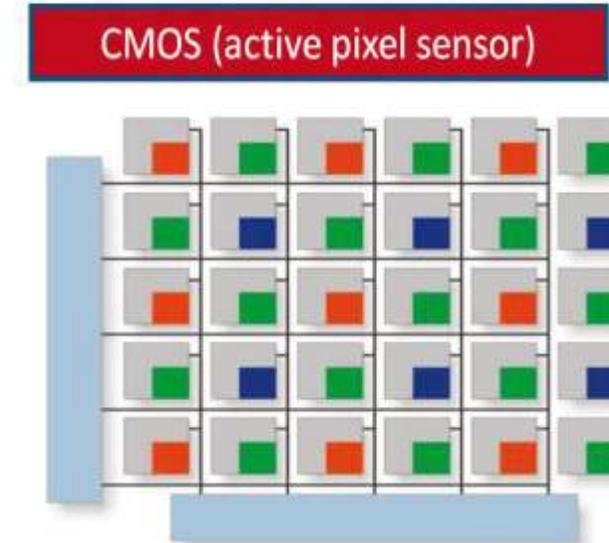
Reflected light which enters digital cameras is collected via:

### Charge Coupled Device, CCD



Principle of the interline transfer of CCD sensor  
A/D conversion outside of the sensor

### Complementary Metal-Oxide Semiconductor, CMOS



Principle of the interline transfer of the CMOS sensor  
A/D conversion in the sensor

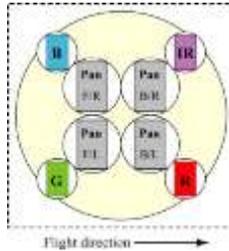


## Charge Coupled Device, CCD

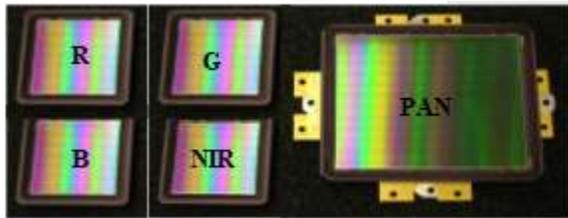
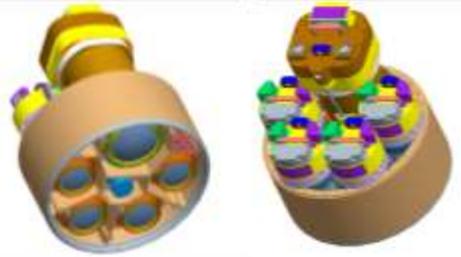
Today there are two construction strategies of CCD sensors:

### Area array large format sensors

The first generation of DMC, Z/I, Imaging

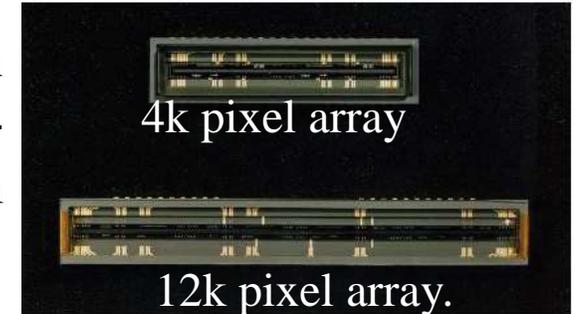


The second generation DMC II Z/I Imaging

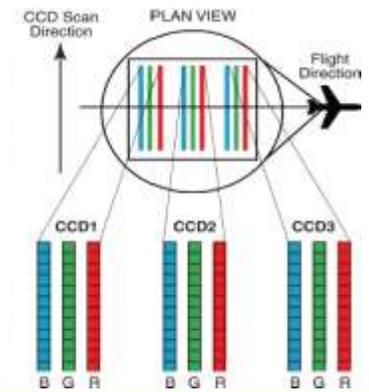


### Linear array pushbroom sensors

ADS series, First generation ADS40 three-line pushbroom scanner



The last generation ADS100 uses 20k pixel array





## Complementary Metal-Oxide Semiconductor, CMOS



Leica Geosystems DMC III  
PAN area array ultra large CMOS  
391MP with 3.9  $\mu\text{m}$  pixel size  
26112 x 15000 pixels



The Phase One PAS 880  
280MP nadir and four  
150MP oblique cameras;  
20,000x14,000 pixels



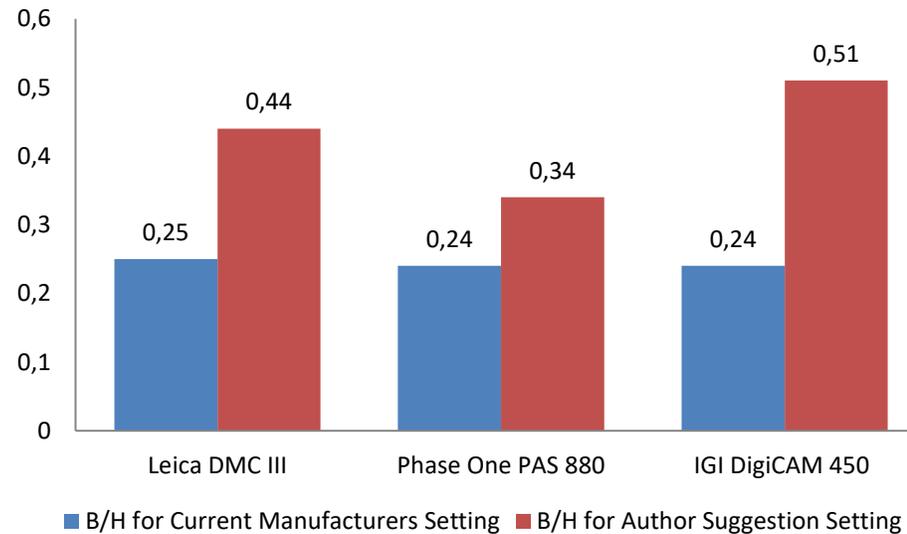
The IGI DigiCAM-450  
very large CMOS RGB sensor  
30,460 x 14,100 pixels,  
with a pixel size of 3.76 $\mu\text{m}$

This affects the simulation of geometry of their images to that of the traditional square format film cameras and also affects the value of the B/H ratios of each of them which is not published although it is a main parameter for photogrammetric topographic mapping.



## Determination of Base to Height (B/H) Ratio

|                                              | Leica DMC III | Phase One PAS 880 | IGI DigiCAM 450 |
|----------------------------------------------|---------------|-------------------|-----------------|
| <b>B/H for Current Manufacturers Setting</b> | 0.25          | 0.24              | 0.24            |
| <b>B/H for Author Suggestion Setting</b>     | 0.44          | 0.34              | 0.51            |





## CONCLUSION

From the above sections it can be concluded that; The disadvantages of CCD linear array manned airborne photogrammetric sensors, such as Leica ADS100 are small field of view and low resolution, which makes it difficult to meet the demand of large-scale topographic mapping. The rectangular format of the modern large format CMOS sensor does not simulate till now the square format of the film camera. This affects the base height ratio which is an important factor for photogrammetric topographic mapping.

This situation will remain until the following technologies appear; On board storage capabilities are advanced to the level that can store or record data of 800 MP or more in part of second and CMOS sensor manufacturing technology will be able to produce a square large format sensor of 20150x20150 and more to simulate the square format of traditional film camera.

Digital Cameras manufacturers may consider rotating the current available CMOS sensors to make the length of the sensor in the direction of flight to enhance the base height ratio of the system.