Coral Macro Camera
Concept Design Review

September 2020

System Objective

Take close-up images of coral and sponges at least once per hour for a 1 year duration deployment.

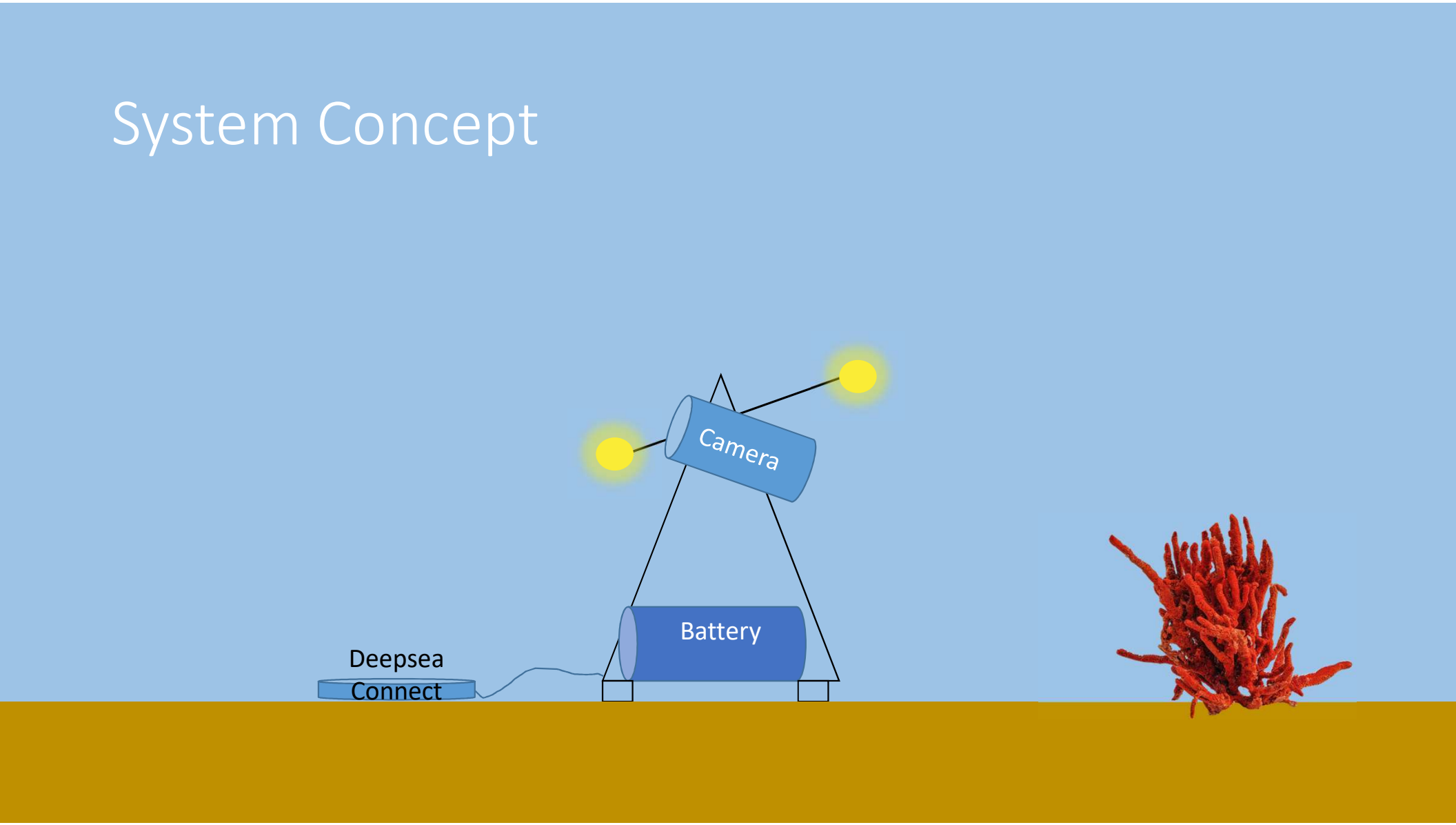
Outline

1. System Requirements
2. System Concept
3. Block Diagram
4. Electrical Concept Design
    1. Battery size calculations
    2. ROV comms concept
5. Mechanical Concept Design
    1. Camera Housing
    2. Battery Housing
    3. Housings TBD
        1. Strobe Ballast
        2. Laser/Wifi Power and Control
6. Operational Considerations
7. High Risk elements
8. Other
    1. Camera selection
        1. Resolution
        2. DOF
        3. FOV
        4. Image storage calcs

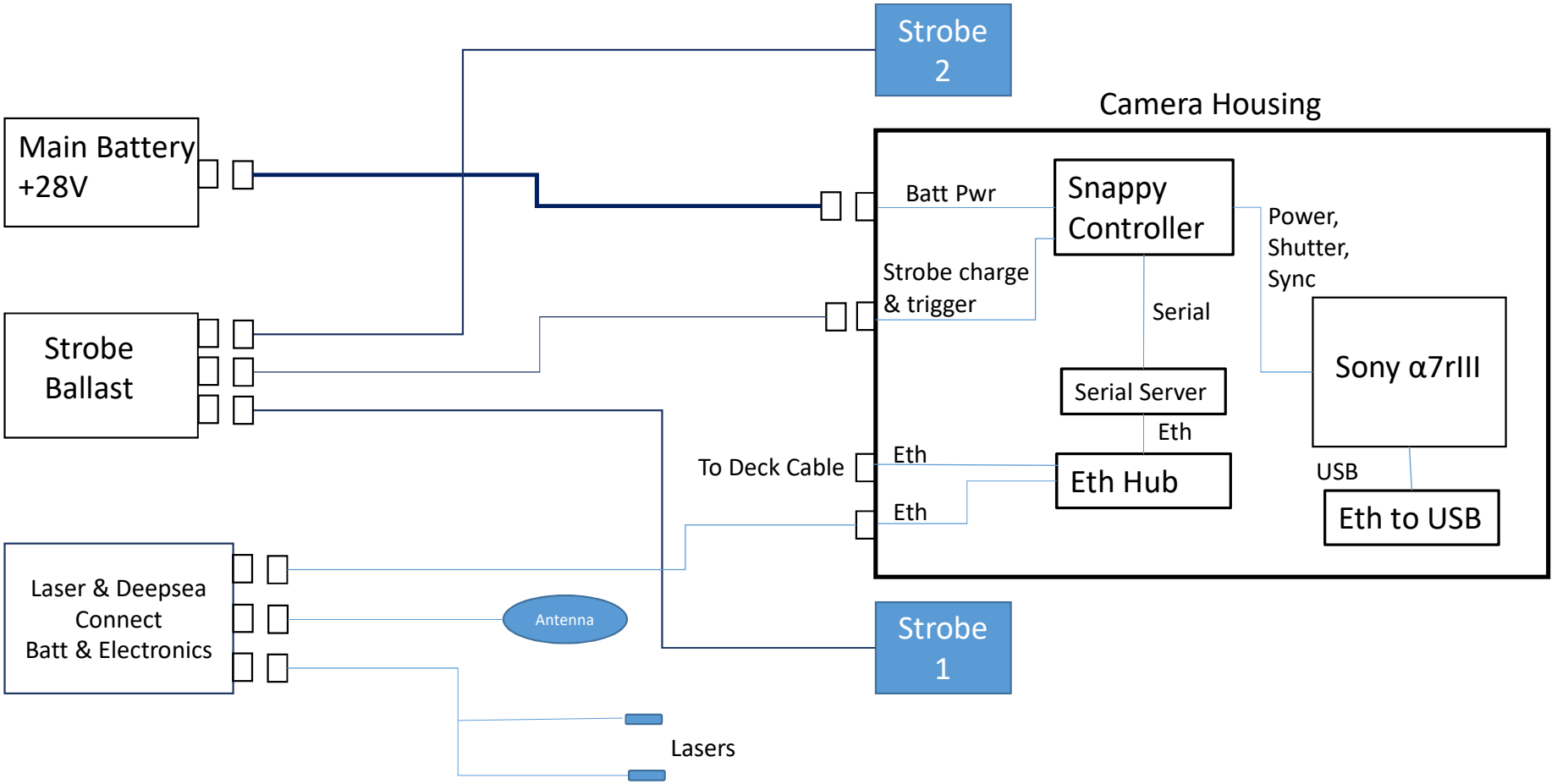
System Requirements

1. Depth rating: 3500 m
2. Deployment duration: 1 year
3. Minimum image frequency: 1 per hour
4. Still images only, no video required
5. Desired FOV: 20 cm x 20 cm
6. Smallest object to resolve: 250 um desired
7. Height of tallest target: 1 mab
8. Camera system must be positionable by ROV
9. Color images required
10. Max horizontal distance from target: 1 m
11. Must be deployable from both ships – prefer ROV deployed system vs. elevator

System Concept



System Electrical Concept



Component Details

1. Camera: Sony a7rIII
    1. Mirrorless digital camera
    2. 35 mm full frame sensor
    3. 42 Mpixel
    4. 5” x 3.78” x 3”
2. Strobes:
    1. Paul Roberts custom LED strobes
    2. X lumen for X size puck
    3. Requires capacitor bank
3. Controller: Snappy
    1. PIC based board used in DiSCO and Smith time-lapse systems
4. Lasers – 2 crossing for positioning
    1. Ocean imaging systems DeepSea Lasers used on MBARI’s ROVs
    2. Paul M will develop flashing circuit to help position

Battery Pack Details

- We will use a primary Li pack.
- Minimum number of DD cells for one picture an hour with an estimate X illumination: 24 cells
- We propose a 36 DD cell pack, which is 2/3 the size of our existing battery pack, this will give us extra capacity for the future
- The positioning lasers and the deepsea connect will run off separate battery packs designed to last a couple days, as both functions will only be needed during deployment

Comms with ROV

- We are looking into using Deepsea Connect as a way to communicate via Ethernet between the camera and the ROV
- This would enable us to change shutter speed, aperture, and gain in situ
- Bench testing with the camera will be conducted shortly
- This will require an interface to the ROV and to the camera, but both should be straightforward

Mechanical System Concept

Battery Housing

Camera Housing

Tripod Concepts

Weights

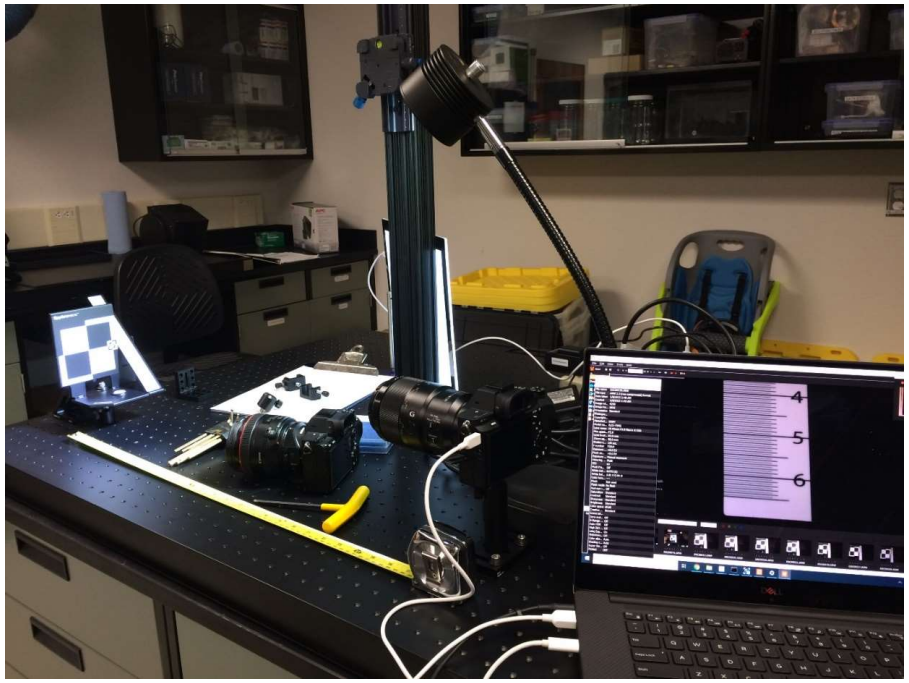
Operational Scenario

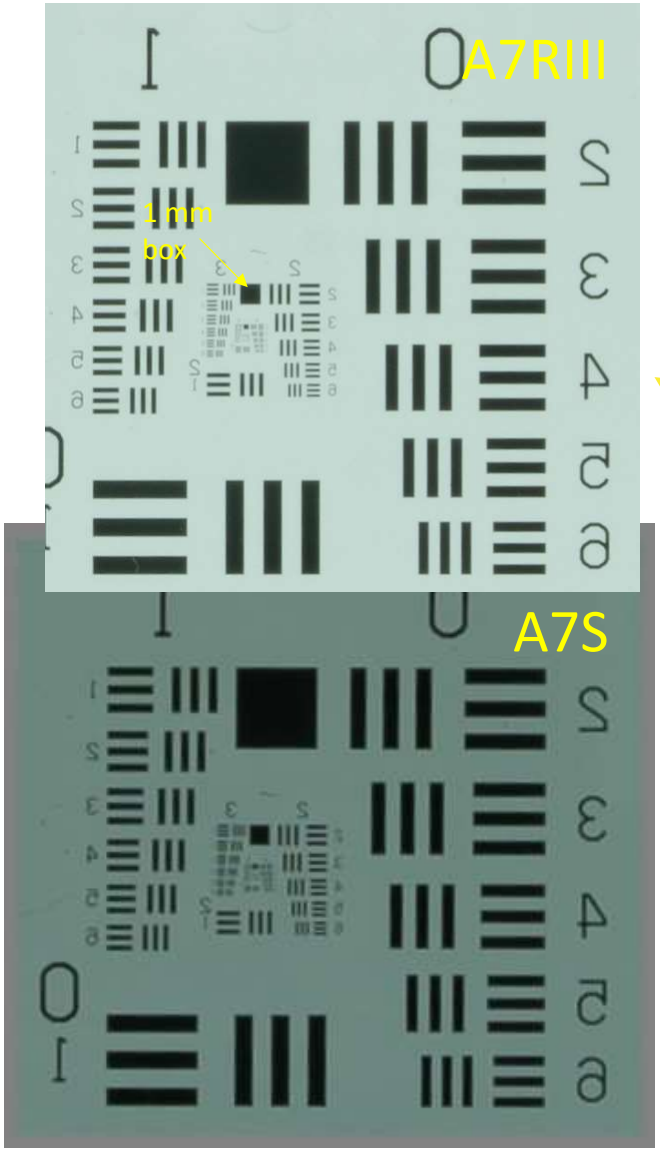
1. Carry unit down on ROV
2. Place unit on seafloor and unfold as needed
3. Position unit with ROV in front of target with help of crossing lasers
4. Pull out wifi antenna and place on top of antenna on front porch
5. Talk to system and confirm operation, adjust camera parameters
6. Start time-lapse mission
7. Replace wifi antenna near frame

Camera Selection and Specs

Camera Testing

- Compared two cameras wrt to resolution, DOF, and image quality:
  - Sony α7sII
  - Sony α7rIII
- Both were mirrorless digital cameras in house.
- Other comparable models:
  - Nikon Z7
  - Canon EOS R5



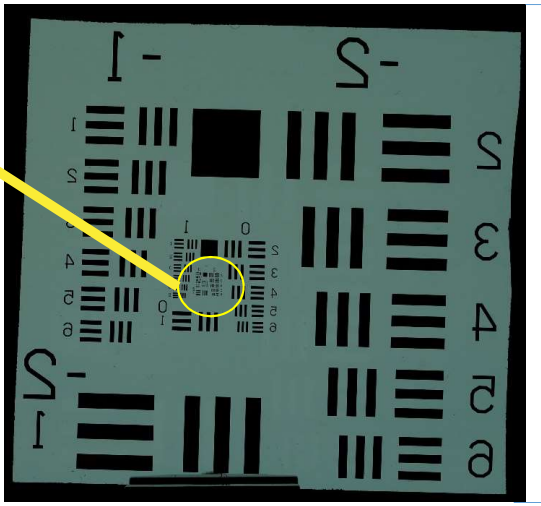


Resolution

The bottom line is that resolution is a key factor. A7RIII has the resolution to discriminate smaller objects. Obvious in the images to left.

See the 1 mm box in both images. Easy to discriminate. In upper (A7R image, easy to see down to at least 0.1 mm. Great! Gets blurry in A7S at this scale

So, as long as we have the storage capacity, I'd vote for higher res. camera



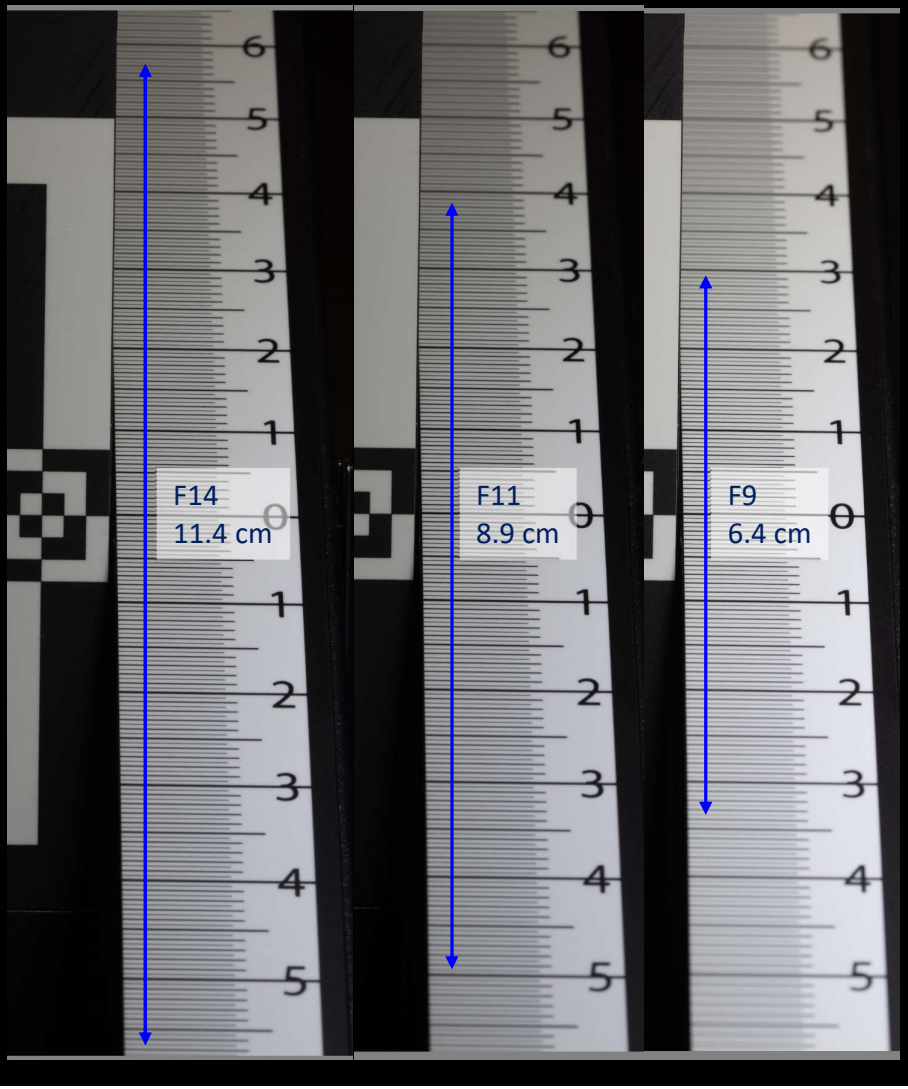
2"

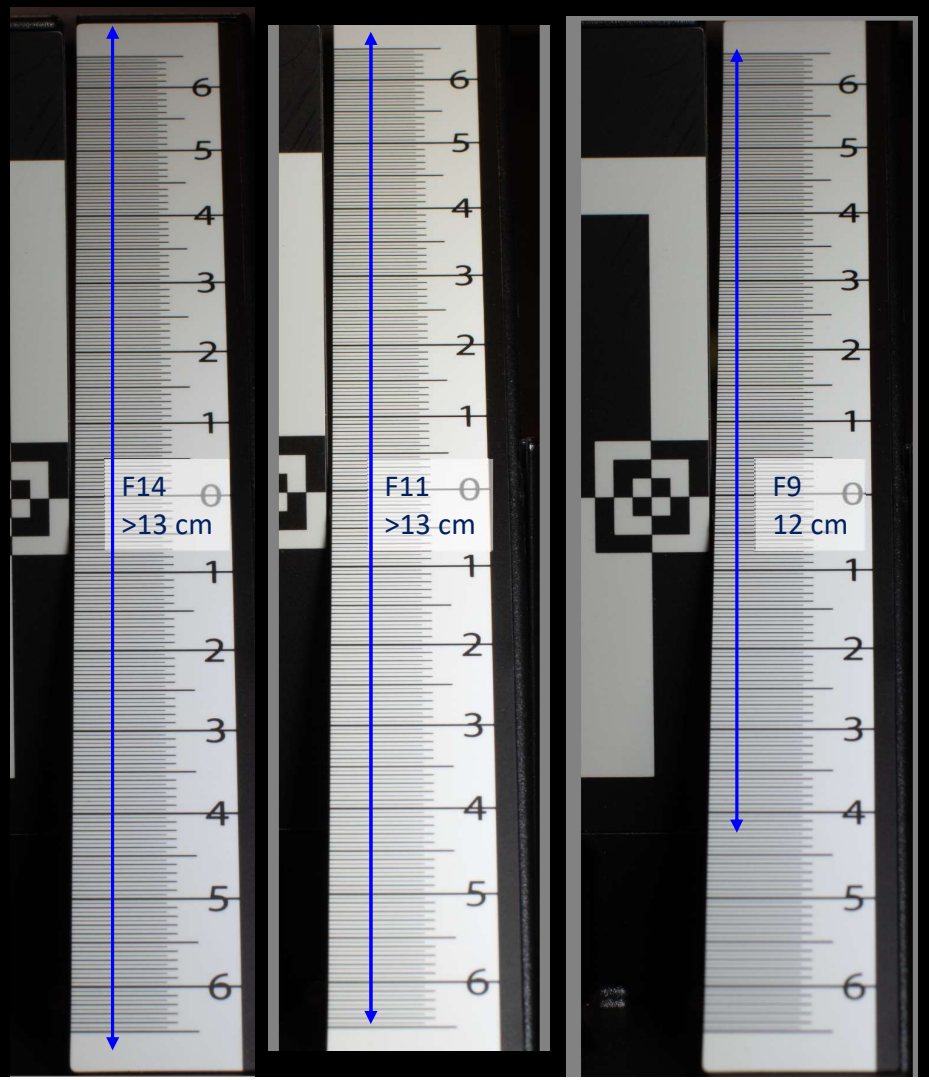
USAF Resolution Target

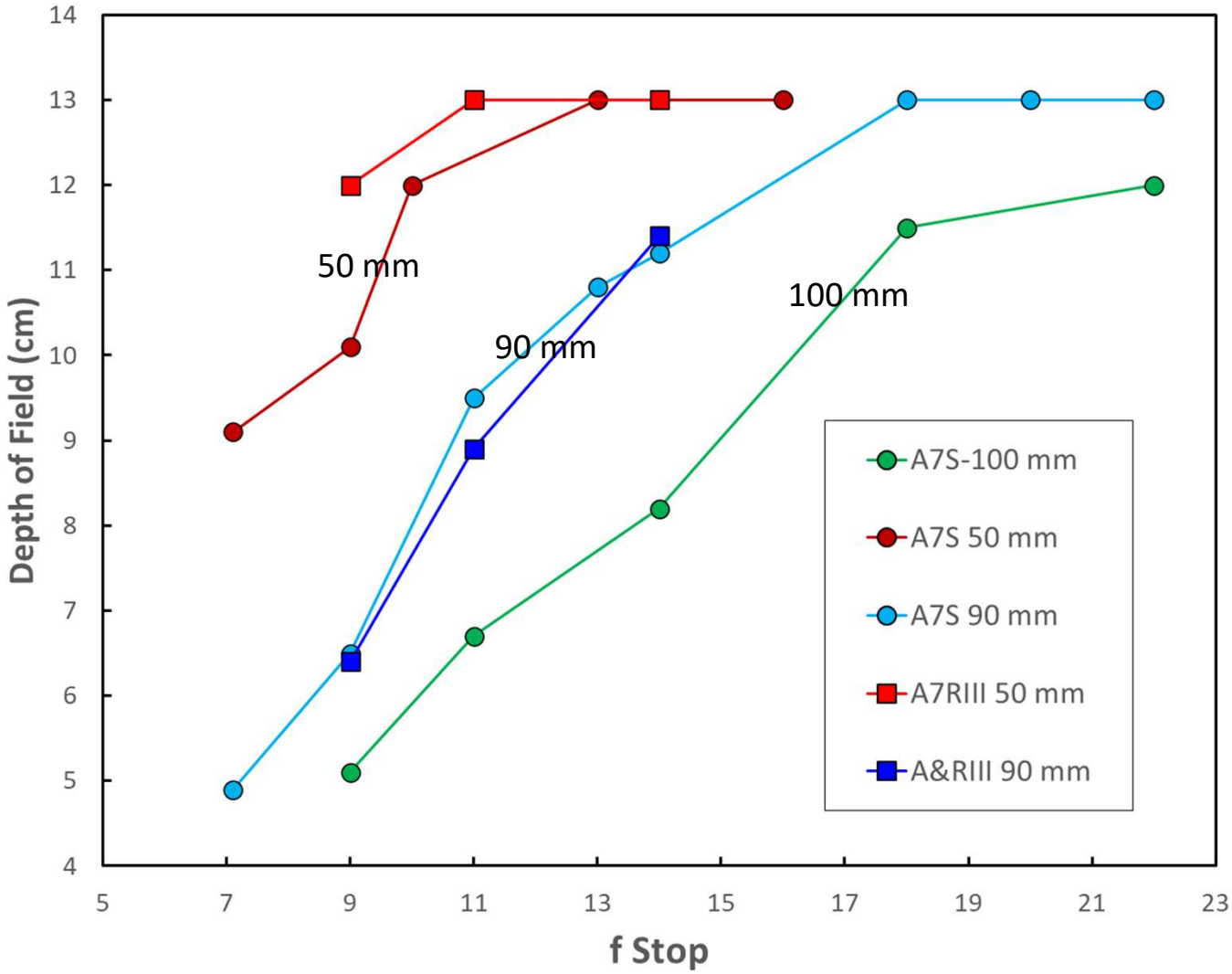
A7RIII 90 mm ISO 125

Depth of Field (cm)

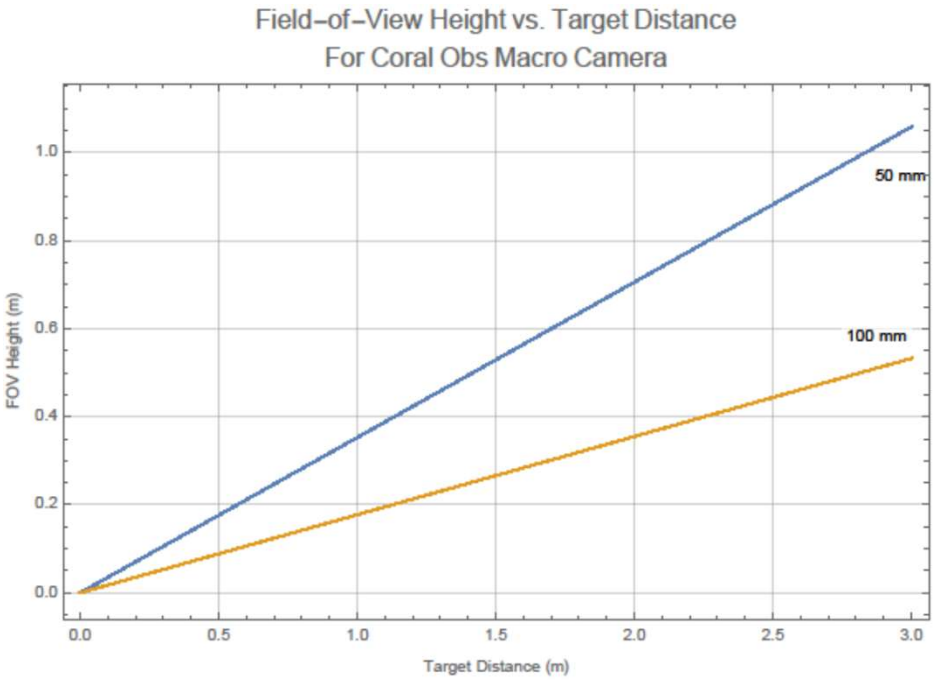
A7RIII 50 mm ISO 125

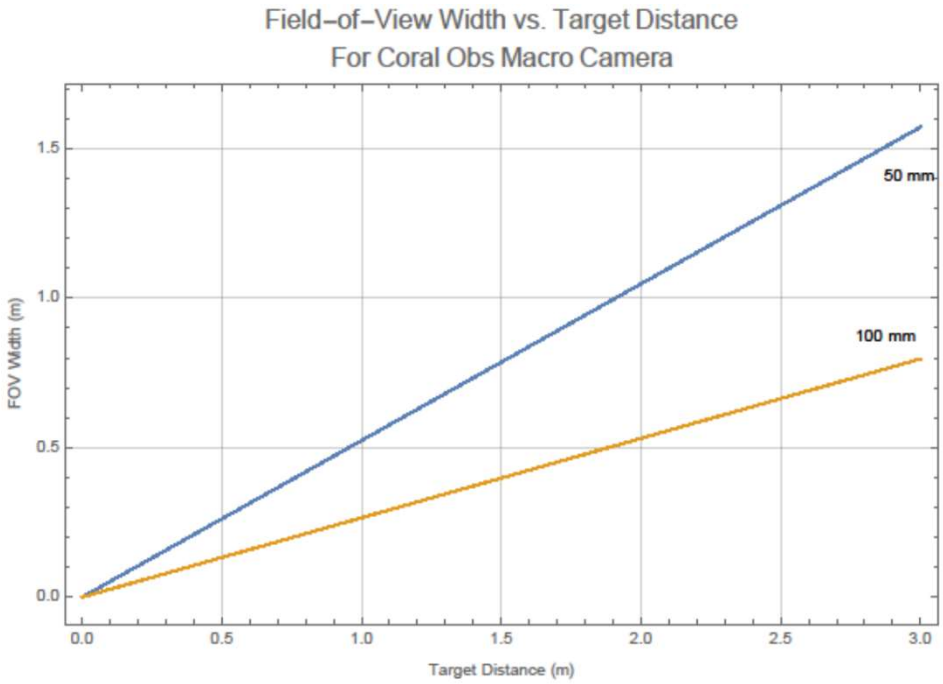





Depth of Field (cm)
f Stop
50 mm
90 mm
100 mm
A7S-100 mm
A7S 50 mm
A7S 90 mm
A7RIII 50 mm
A&RIII 90 mm

Calculated FOV vs Target Distance





Memory card calcs (A7RIII vs A7RIV)

The number of images that can be recorded on a memory card

The table below shows the approximate number of images that can be recorded on a memory card formatted with this camera. The values are defined using Sony standard memory cards for testing.
The values may vary depending on the shooting conditions and the type of memory card used.

[JPEG Image Size]: [L: 42M]
[Aspect Ratio]: [3:2]*1
(Units: Images)

a7RIII

JPEG Quality/ File Format	8 GB	32 GB	64 GB	256 GB
Standard	770	3100	6200	24500
Fine	520	2100	4200	16500
Extra fine	270	1050	2150	8700
RAW & JPEG (Compressed RAW)*2	130	520	1050	4200
RAW (Compressed RAW)	170	700	1400	5600
RAW & JPEG (Uncompressed RAW)*2	75	300	600	2400
RAW (Uncompressed RAW)	88	355	710	2850

a7RIV

JPEG Quality/ File Format	8 GB	32 GB	64 GB	256 GB
Standard	475	1900	3850	15000
Fine	320	1250	2550	10000
Extra fine	165	680	1350	5500
RAW & JPEG (Compressed RAW)*2	88	355	710	2850
RAW (Compressed RAW)	120	490	980	3950
RAW & JPEG (Uncompressed RAW)*2	51	205	415	1650
RAW (Uncompressed RAW)	62	245	495	1950

*1 When [Aspect Ratio] is set to other than [3:2], you can record more images than the numbers shown in the table above. (except when [RAW] is selected)
*2 [JPEG Quality] when [RAW & JPEG] is selected: [Fine]

A 1 TB card or two 512 GB cards would yield > 11000 images, our goal is 8760 (one per hour for 1 year)