

1. Functional Requirements (General)

- 1.1. EyeRIS shall provide single-camera, single frame, 3D underwater imaging
- 1.2. EyeRIS shall be configurable for a range of particle sizes, particle concentrations, flow rates, and platform profiling speeds for a specific use case.
- 1.3. EyeRIS shall measure particle sizes in the range 250-10000 microns with a resolution of 100 μm
- 1.4. EyeRIS shall be able to bin particle sizes with 10% accuracy (min 100 particles per bin)
- 1.5. EyeRIS shall provide images sufficient for morphological identification of objects in the range 1 mm to 20 cm
- 1.6. EyeRIS shall provide a quantifiable imaged volume
- 1.7. EyeRIS shall provide direct color LED illumination, one for minimal animal disturbance [Red or Near IR]
- 1.8. EyeRIS shall provide adjustment of illumination direction as needed for application
- 1.9. EyeRIS shall be calibrated (in situ?) underwater with targets and particle fields

2. Functional Requirements (Cabled Instrument):

- 2.1. EyeRIS shall be controllable remotely
- 2.2. EyeRIS shall stream live video to a surface vessel
- 2.3. EyeRIS shall record data on an external high-resolution recorder on a surface vessel
- 2.4. EyeRIS shall operate to a depth of 4000 meters
- 2.5. EyeRIS shall be compatible with existing ROV power and communications
- 2.6. EyeRIS shall be deployable on a manipulator arm of an ROV

3. Functional Requirements (Autonomous Instrument)

- 3.1. EyeRIS shall record still image and video data locally
- 3.2. EyeRIS shall operate to a depth of 4000 meters
- 3.3. EyeRIS shall operate autonomously for the duration of an LRAUV mission
- 3.4. Shall record continuously or be able to go in a low power sleep mode
- 3.5. Shall have internal control of camera from a low-power MCU
- 3.6. Shall support vehicle ground fault detection
- 3.7. Shall be controllable with vehicle mission exec
- 3.8. Shall have a white light flash with illumination duration sufficient to minimize motion smear at maximum vehicle speed

4. Functional Requirements (3DPIV):

- 4.1. EyeRIS shall be able to resolve objects in the size range from 1-20 cm (x/y dimension)
- 4.2. EyeRIS shall be able to resolve objects in the size range 1-20 cm (z dimension)
- 4.3. EyeRIS shall measure fluid velocities from 1mm/s to 1 m/s

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5. Functional Requirements (3D(dt)R):

- 5.1. EyeRIS shall resolve features on the order of 1% of size on objects in the size range 1-20 cm (x/y/z).
- 5.2. EyeRIS shall resolve mucus and gelatinous structures (> 50% opacity)
- 5.3. EyeRIS shall be able to resolve objects in the size range from 1-20 cm (x/y dimension)
- 5.4. EyeRIS shall size targets with accuracy better than 5% x/y/z
- 5.5. EyeRIS may use auxiliary/multiple cameras to verify target measurements.
- 5.6. EyeRIS may use structured illumination to enhance surface reconstruction

6. Functional Requirements (Marine snow, plankton Imaging, CeNCOOS):

- 6.1. EyeRIS shall provide data that can be integrated into CeNCOOS workflows
- 6.2. EyeRIS shall provide raw camera data for still image capture for reproducing results
- 6.3. EyeRIS shall provide information to identify the type and size (equivalent spherical diameter is most common metric for marine snow particle size) of particles, including their location within the image, thus pixel/size dimensions, as well as for generating region of interest crops for automated object classification.