live, in-situ monitoring of particles & microorganisms in all liquid environments
Real time, in-situ imaging

The HoloSea uses a laser and camera to image, count, size and characterize objects within the sample area - in any body of water. Image objects from 5.0 μm to 2 mm.

The FluoroSea uses three colour LEDs and size data from the images collected, to classify algae and alert the user if the cell count reaches a particular threshold.

"These innovations will make imaging & analysis more powerful, flexible, productive & easier to accomplish"

Microscopy Today
Applications

for deeper insights

Oceanography
Aquaculture
Algae Monitoring
Research
Municipal Water
The HoloSea

The HoloSea allows you to quickly and easily observe micro-organisms and particles.

User control
Remote commands of major operations using either a supplied Camera Remote Control utility or through 3rd party software.

Real-time
Real-time, in-situ observation of particles and micro-organisms in all aquatic environments.

Portable
Lightweight, easy to deploy, rugged.

High Flow Capabilities
Can be towed up to 8 knots and handle water speeds of 4 m/s due to a sub microsecond laser pulse duration.

Fast Tracking
Up to 22 images per second to capture tracking dynamics of fast moving objects.

Go Deeper
Functional from surface - 500 m. Up to 5500 meters in custom models.
Software

Faster
Image based rapid particle detection up to 22 frames per second

Larger Sample Volume
Detect more particles than with traditional microscopy.

More Control
Particle detection criteria includes size, threshold and shape (round & non-round).

Instantly count & size particles or microorganisms for statistical analysis
Explore the Volume
The image plane is displayed in real time, and can be moved throughout the volume with a click.

Reproducibility
With access to the raw data & the ability to digitally re-focus holograms after collection the user can reanalyze data as needed.

Imaging Class
Develop publication quality images quickly, include color palates and scales.

Full Contrasts
Holography gives phase information, allowing for quantification of image information; capable of resolving information well below the wavelength of the light.

Analyze & explore objects in free-flowing environments
Automated Reconstructions
With Stingray, let the software find the objects in the volume, and have them presented in a list.

Image Classifier
Develop a database of classified images, and train the software to automatically recognize the images in future reconstructions using deep neural networks.

Automatic morphology detection & classification
A new generation of accuracy beyond bulk fluorometers

The combination of individual cell fluorescence signals and image-based cell sizes opens many doors. Go beyond chlorophyll and get detailed indices of abundance from discrete taxonomical groups.

Early and accurate detection of algal blooms

The world’s first submersible fluorescence microscope provides decision makers essential data to take corrective actions before a harmful outbreak occurs.

Live in-situ fluorescence data

The FluoroSea and Jellyfish software allow users to collect and view near real-time, in-situ specific fluorescence data. The system requires no pumps or sample preparation and will act as a first line of defense in gathering information without any critical time lags.

Knowing is half the battle
Fluorescence signals detected for each organism
Image-based data collection means the detected fluorescence signal can be attributed to individual organisms in the sample.

Customizable for taxonomic groups across the globe
Users can enter characteristic fluorescence ratios and sizes for taxonomic groups of different interest for automated classification with Jellyfish software.

Instantly count & size particles or microorganisms for statistical analysis
Autonomous Module

Power your microscope & remotely log data

The Autonomous
Designed for longer deployments, or areas where connecting a cable from the Submersible Microscope to a computer will not do.

Programmed Control
The Module is programmable using user friendly software, setting the camera frame rate and timing for the duration of the deployment. Hours of data can be collected remotely, and downloaded afterwards for analysis. Fiberoptic connection allows control from miles away.

Power Solution
The onboard battery system is designed to operate with the onboard computer of the Autonomous, and power the HoloSea or FluoroSea. Batteries are rechargeable, and there are several power configuration options available.

Depth Setting
Autonomous Modules capable of 2000 meter deployment are the standard.
### Speciation HoloSea S6

<table>
<thead>
<tr>
<th>Specification</th>
<th>Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optical Resolution</td>
<td>1.5 µm</td>
</tr>
<tr>
<td>Recognition Resolution</td>
<td>20 µm</td>
</tr>
<tr>
<td>Laser pulse duration</td>
<td>Minimum of 0.5 µs</td>
</tr>
<tr>
<td>Tow rate</td>
<td>8 knots</td>
</tr>
<tr>
<td>Point source wavelength</td>
<td>405 nm</td>
</tr>
<tr>
<td>Power</td>
<td>&lt; 5 Watts</td>
</tr>
<tr>
<td>Power requirement</td>
<td>120/240 VAC</td>
</tr>
<tr>
<td>Communication</td>
<td>13 pin SubConn Ethernet connector</td>
</tr>
<tr>
<td>Data transfer</td>
<td>Gigabit Ethernet</td>
</tr>
<tr>
<td>Computer operating system</td>
<td>Windows 7 64-bit or later</td>
</tr>
<tr>
<td>Hologram size</td>
<td>2048x2048</td>
</tr>
<tr>
<td>Frame rate</td>
<td>22 fps</td>
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<tr>
<td>Sample space</td>
<td>15 mm</td>
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<tr>
<td>Sample volume</td>
<td>~100 µl per hologram</td>
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<tr>
<td>Size</td>
<td>92 mm x 351 mm</td>
</tr>
<tr>
<td>Weight in air (water)</td>
<td>2.6 kg (0.5 kg)</td>
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</tbody>
</table>

### Specification FluoroSea F1

<table>
<thead>
<tr>
<th>Specification</th>
<th>Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optics</td>
<td>5X long working distance objective</td>
</tr>
<tr>
<td>LED wavelengths</td>
<td>405 nm 505 nm 530 nm</td>
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<tr>
<td>Power requirements</td>
<td>120/240 VAC</td>
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<tr>
<td>Communication</td>
<td>13 pin Sub Conn Ethernet connector</td>
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<tr>
<td>Data transfer</td>
<td>Gigabit or 100 Mbit Ethernet</td>
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<tr>
<td>Computer operating system</td>
<td>Windows 7 or later</td>
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<tr>
<td>Frame size</td>
<td>2048 x 1088, 2/3” format</td>
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<tr>
<td>Measurement cycle rate</td>
<td>0.3 Hz to 0.001 Hz</td>
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<tr>
<td>Sample volume</td>
<td>0.15 µl</td>
</tr>
<tr>
<td>Size</td>
<td>126.2 mm x 670.39 mm</td>
</tr>
<tr>
<td>Weight in air (water)</td>
<td>8 kg (0.3 kg)</td>
</tr>
<tr>
<td>Deployment Depth</td>
<td>10m cable provided, pressure rated from 0–100m</td>
</tr>
</tbody>
</table>
The Submersible Holographic Microscope from 4Deep is the best tool I’ve encountered for microscopic imaging from autonomous platforms. It’s small size and fast sample rate allows me to collect impressive stacks of phytoplankton and marine snow particle images. Their customer service is unparalleled. I am extremely satisfied with their products and service.

Melissa Omand Ph.D.
Assistant Professor
Graduate School of Oceanography
University of Rhode Island

First & foremost, 4Deep is interested in developing the tailored product that will work towards customer needs, which is very rare in current business environments.

Zoran Ljepović
Director QA
Wine Microbiology & Sanitation
Constellation Brands

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