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“ Since the new *Alvin* would be equipped with fiber-optic cables, we wanted to take advantage of that expanded bandwidth and upgrade our imaging systems. When I started on the project in 2006, the ‘big new thing’ was high-definition video, which we thought would be great, allowing us to shoot video and also collect two-megapixel still images from the same camera. But by 2010, two-megapixel still images were old hat. The latest ‘big new thing’ becoming available were underwater digital SLR cameras that could take ten-megapixel still images and also shoot HD video. We chose that option for the new *Alvin*.

We still had to put the cameras into housings that could withstand deep-sea pressure to pass the stringent safety requirements for use with *Alvin*. The optimal housing would use a clear glass ‘dome’ end-cap for optimal clarity and light transmission. But a higher priority was to guarantee that the housing will not implode, endangering the sub.

Glass presents a problem because, as a randomly ordered, fine-grained material, its properties are not easily quantifiable. Our next-best options were an acrylic that could be machined into a hemisphere, but lacked the clarity of glass; or sapphire, a mineral with hardness close to diamond and excellent optical characteristics, but which was only available as a flat plate, not a dome. It was a tradeoff, and we decided to go with the sapphire window option. It would provide good optical clarity, with just a little distortion in the outer regions of each image, which we could accommodate.

The new sub has five high-def cameras—one above each observer’s forward viewport to record exactly what they can see; two cameras higher up on *Alvin*’s brow that provide a better overview of the seafloor ‘landscape’; and the new hybrid digital SLR/HDTV camera, initially mounted to point downward beneath *Alvin*’s basket to collect photos of the seafloor we pass over, which can be merged into photomosaics.

We also added a host of low-power LED lightpacks that can be directed to match each camera’s field of view and don’t put a huge drain on *Alvin*’s battery capacities. We were keen to see how the cameras and lights would work together at the seafloor when we finally dove in the new *Alvin* and were thrilled right off the bat. The imagery was immediately better than before, but we wanted to coax the very best out of the systems.

For subsequent dives, we added extra lights on each side of the sub beneath the viewports, but the *pièce de résistance* was adding a light on one manipulator arm. After dark, we turned on all the sub’s lights to see exactly where the pools of light were landing. I ended up dancing around on the deck, sticking my foot wherever I thought a future observer might see a starfish or vent or whatever—just to make sure that same area would get lit up brightly on all future dives.

Eventually, we will try putting the SLR camera on *Alvin*’s arm, to get exquisite still images and video closeups, which *Alvin* has never had before. For that, we have to work on a breakaway for the fiber-optic cable connecting the camera to the sub, in case we ever had to jettison that arm in an emergency, to ensure that one cable couldn’t cause a safety hazard. That’s coming. ▲



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