A User's Perspective on Current Jason II Operations **May 21, 2006**

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The following is meant to serve as user feedback and constructive criticism for the Jason II operation, based on my experience using the vehicle during the 2006 Submarine Ring of Fire expedition. My perspective is as a first time user of Jason II, although I have over 10 years of experience using other ROV's, including Jason I, ROPOS, and Tiburon.

First some well-deserved praise: The cruise was a terrific success due in large part to the reliability and performance of Jason II and the diligence and dedication of the Jason team. The SRoF06 science party greatly appreciates the long hours and hard work of the Jason crew during the cruise. Their skill operating the vehicle allowed us to obtain excellent samples and incredible video in some very dynamic and challenging environments. Nevertheless, as a member of DESSC, I feel it is my responsibility to provide some feedback from the perspective of a science user and to highlight areas in which the Jason operation could be improved.

NAVIGATION:
The hardware and software that Jason uses to navigate is a bizarre combination of high-tech state-of-the-art, and the archaic and obsolete. Specifically, the doppler-based navigation which allows closed-loop control of the vehicle is superb and extraordinarily useful, whereas the transponder-based long-baseline (LBL) navigation systems are absurdly primitive and woefully out of date. The LBL hardware in the control van is so old that as components fail, spares have to be cannibalized from the backup hardware, putting the whole operation at risk. The LBL navigation software that is used is running DOS 6 and is so limited that even though multiple transponders are deployed, the software can only use two at a time to calculate a vehicle position, instead of using all available acoustic ranges to reduce the position error! This situation is simply inexcusable, in my opinion, and should have a high priority for being remedied. Modern deep-sea navigation systems exist: ROPOS uses Windows-based software developed by Jim Illman (a software engineer based in Seattle) and acoustic hardware made by Edgetech. Tiburon uses a short-baseline navigation system that works well down to at least 2500 m.

VIDEO:
Video is one of the most important data products for many science users, but the quality of the Jason video is not high. This was the first cruise on which Jason had a 3-chip camera for science use. The camera performed reasonably well, but there is much room for improvement:
1) The 3-chip camera is capable of delivering high-quality "component" video, but Jason only brings up lower-quality SVHS video. Thus, Jason is not taking full advantage of the 3-chip camera. The difference in quality between component and SVHS is significant for the purposes of obtaining broadcast quality video recorded on DVCAM or BETA tapes.

My understanding is there is more capacity on the Jason fiber optic cable, so I don't know why this is not being done.
2) There should be the capability to adjust the white balance of the camera during a dive.
3) The current position of the 3-chip camera (behind the basket and below the syntactic foam) does not seem optimal. For example, the view from the pilot's camera often seemed superior. The view from the 3-chip camera is often blocked by items in the basket (for example the new suction sampler). Also, because the camera angle is low, and its position is back behind the basket, the area of the seafloor in view is relatively far away in front of the vehicle. Consequently, the lighting seems poor and the contrast and color are often washed out. Objects in view are just too far away from the camera and the lights. One thing that might help is if the Jason 3-chip camera could move forward and backward (perhaps controlled by the pilot). This is a capability that the ROPOS 3-chip camera has and it allows the camera to look down at objects, reducing both the distance and the oblique angle from which they are viewed. This is particularly important for getting good close-ups of small features or animals with better color resolution.
4) Currently, the 3-chip camera has an auto-exposure (or auto-iris) setting that consistently over-exposes the video. Consequently, users are forced to take the camera out of auto-exposure mode and adjust the iris manually. But this is very problematic because the brightness levels are constantly changing, and consequently too often the video is either overexposed or underexposed. The auto-exposure settings in the camera should be adjusted so that they can be used and the camera iris does not have to be continuously adjusted manually.
5) Exacerbating the situation above, the flat-panel monitor used to display the 3-chip video in the Jason control van is inadequate and needs to be replaced. The poor quality of the monitor (muddy, washed-out colors, fuzzy resolution, and an inaccurate representation of the brightness of what is being recorded) made it very difficult to get a good exposure using the manual iris control. Basically, the view on the screen was not a good representation of the video that was being recorded. Often we found that video that looked OK on the monitor during a dive was later discovered to be poorly exposed when the tapes were reviewed after the dive. This is a very serious problem that compromises one of the most important science data products. Replacement of the 3-chip display monitor in the control van should be a high priority.
6) Another problem related to the issues above is the jitter of the data overlay on the screen whenever the 3-chip video is overexposed. The data overlay is optional, but is very useful, so we usually had it on. Many times we encountered dynamic events that would have made for extraordinary video highlights, but these events also tended to have rapidly changing brightness, and the quality of the video would often be ruined by the overlay jumping around on the screen. I cannot believe that there is not a solution to this problem. If the 3-chips auto-iris is fixed perhaps this would be less problematic.
7) There should be an easier and quicker way to enable and disable the overlay on the 3-chip video. In the browser-based overlay server there is an overlay color setting (0-255) that is supposed to accomplish this, but we found that a setting of 0 made the characters only a very faint gray, instead of making then disappear altogether. So to make the overlay really disappear, the video logger had to manually disable each data overlay item

individually, which was more complicated and took more time. A setting that can quickly and easily toggle the overlay on or off should be added to the overlay controls.

AUDIO

1) There should be a capability to record the voice of the science watch-leader in the control van on the audio channels of the 3-chip video during a dive. I was frankly shocked to find out before the cruise that this was not available with Jason, because it is routinely done with both ROPOS and Tiburon. Voice audio recorded in realtime during a dive can be an extremely valuable source of information to science users, because it provides a context of what was happening during a dive that is not necessarily recorded in the written log. Also it can greatly enhance the value and impact of video that is used for education and outreach purposes. This is one area where I felt the Jason group displayed a lack of interest and cooperation in something that we expressed as being important to us before the cruise. I was told this could not be done, because Jason usually recorded digital data and time code on the audio channels instead of voice. Fortunately, the Jason group data archivist who sailed with us (a non-WHOI employee) was more open-minded and worked with me at sea to set up microphones and cabling that I brought on board to enable the input of voice audio into the science DVCAM video recorder. Science users should have the option of recording voice with the video.

DIGITAL STILL CAMERA:

High-resolution digital still images are another very important science data product, because they provide much more detail than can be obtained from video alone. However, there is much room for improvement here as well.

1) One of the key issues with digital still cameras on deepsea vehicles is the extent to which the user has control over the camera's settings remotely. We found that the controls for the Jason DSC were very limited with little capability to change the parameters, which resulted in many poor quality images. A more comprehensive user interface with the camera is needed. Also, a comprehensive manual for the camera and its settings is needed for users that really need good DSC imagery.

2) One of the main problems was that the automatic exposure setting yielded poor results. We experimented with changing the exposure settings in auto mode but because it was simply a method of trial and error, it took many dives to improve the images, and only to a limited extent.

3) Another serious problem was that the automatic focus did not work properly when the camera was zoomed. All photos that were zoomed in more than half way were out of focus. Consequently it was impossible to get close-ups of small objects with the camera. This is a serious short-coming.

4) The problems above were compounded by the fact that the DSC monitor in the Jason control van displayed a very poor quality image that made it impossible to judge if an image was in focus or had correct exposure settings. This is something that is critical to improve.

5) Another problem is that the image resolution could not be set at the highest resolution because the images are stored locally in the camera and this limits the number of images that can be stored. This is not a problem with the digital camera on ROPOS, which has a

way to upload images periodically from the camera in order to clear the memory. Such a capability should be considered for the Jason DSC.
6) It would be useful to have lasers mounted directly on the DSC to provide scale.
7) We found that the DSC was rarely pointed at the area where we were working, and because the DSC does not have pan & tilt, we had to move Jason to frame DSC pictures. This greatly limits the potential usefulness of the DSC. If it is possible to mount the 3-chip camera and the DSC on the same pan & tilt mechanism, that might be a good solution.
8) We noticed that some of Chuck Fisher's DSC images (taken with his own camera on Jason) were on the ship's network and were of very high quality. Perhaps some lessons for improving the Jason DSC can be learned from how Chuck Fisher's DSC camera was setup on the vehicle. Likewise, we have gotten very good results using the ROPOS DSC camera.

VIRTUAL VAN LOGGING SYSTEM:
1) The logging system should include the dive number in each record so that individual dives can be parsed or exported separately (right now a whole cruise gets all lumped together in one big file).
2) There should be a way to edit or delete previously logged records.
3) There should be an option to only display EVT records (and ignore ASNAP records) to facilitate scrolling back through the log file in search of a specific events.
4) The search function does not seem to work at all.

PAYLOAD:
We ran into payload limitations often during our dives - what science gear we could have on the vehicle at the same time, and how many samples we could take during a dive. Apparently this is because Jason II does not have as much net buoyancy as it used to because of the weight of gear that has been added recently. If there is anyway to further increase the buoyancy of the vehicle so that it has more payload capacity, that would be very beneficial to science users.

MEDEA:
I found Medea a very frustrating part of the Jason operation. Because there is such a short leash between Jason and Medea it effectively means that you have to move the ship almost everywhere Jason goes. Consequently, the pilots have to spend a lot of their attention on staying close to Medea, which sometimes distracts them from the science tasks at hand. I much prefer the longer leash available with the ROPOS and Tiburon operations, which allows the ROVs much more freedom to move on their own (within a radius of about 100 m). This freedom to move makes the science operations more efficient. Perhaps there are some good engineering reasons for having Medea (diving deep?), but it's frustrating from a user perspective.

CONTROL VAN LAYOUT
It's interesting to compare the layout of the control rooms of Jason, ROPOS, and Tiburon (see Figure 1). In the ROPOS and Tiburon setups, the science watch leader has a seat next to the pilot where they can direct the dive and control the science cameras. This

facilitates communication between the science team and the pilot during a dive, so that all requests come through the watch leader. In the Jason control van, in contrast, the science party is relegated to the "back seat". This is a subtle point, but is perhaps symbolic of the way attention to Medea sometimes trumps the participation of the science user.

Once again, I want to emphasize that my experience with Jason II during the SRoF06 cruise was overwhelmingly positive and I felt the vehicle and its crew were great. My purpose here is to look for things that could be improved from the perspective of a science user. There may be good engineering reasons for some of the issues I have raised, and I know there are many difficult trade-offs between competing factors in the design and operation of a complex vehicle like Jason. Nevertheless, I hope that these comments will spur further improvements to an already outstanding vehicle.