Messe-Mentoring Conference Report
Oceanology International 2012, London, 12.3.-15.3.2012

Tom Kwasnitschka

I had the opportunity to visit the Oceanology International 2012 trade show under the supervision of Dr. Warner Brückmann. I took part in the Messe-Mentoring program, developed by the ISOS and the Technology Transfer of the Excellence Cluster "Future Ocean" to enable PhD students to make contacts with industry at scientific and commercial fairs.

Since an integral part of my PhD consists of method development and data analysis that is coupled to the hardware used on ROVs, AUVs and submersibles, I regularly experience shortcomings in my knowledge of functionality and even just availability of key technologies. My colleague PhD candidate Anne Sedlazeck of the MIP at Kiel University who is also conducting research on deep sea imaging systems accompanied me.

My primary objectives of the visit were:

- Acquisition of a general overview of hardware and accessory providers in the field of ocean science and technology
- A comprehensive survey and visual inspection of available deep sea imaging equipment
- Comparison of different underwater high precision navigation approaches
- Research on available post processing software for underwater navigation
- Establishment of a general understanding of cost of the individual components.

Although the successful continuation of my work will require mid-term investments, I did not visit the fair with the intent of purchasing equipment. I concentrated on equipment certified for use down to 6000m, which is the rating of our ROV Kiel6000 and our AUV Abyss. Below follows an account of the subjects I particularly focused on during booth visits and talks.

Deep-sea camera equipment

Based on a highly varying range of housing designs, my biggest surprise was that deep sea cameras can be purchased at comparatively low prices, starting at 7000€. The company Sidus offers such a system featuring dome port window at a form factor equaling a large water glass. The choice of materials and dimensions of many of the exhibited pressure housings suggests that many of the housings I have come to know previously may be over-dimensioned, increasing weight and price unnecessarily.

A wide range of products appears to be capable to deliver high resolution imagery at an optically acceptable quality, yet my special application of underwater photogrammetry requires an unparalleled level of accuracy minimizing the optical distortions induced by the thick pressure-proof glass shielding the cameras and their optics.

Three different approaches are taken by the manufacturers to design the window through which the cameras are looking:

- Planar port windows are flat pieces of glass of suitable thickness to withstand water pressure. The geometric warping problems inherent to the light refraction on the water/glass and glass/air interfaces are subject of the PhD thesis of my colleague Anne Sedlazeck. Some manufacturers (Kongsberg, Saab) offer

planoconvex glass ports that feature a convex shape of the port on the interior face of the window. This was a feature I did not realize before and I have yet to work out its implications.

- Dome Ports are hemispherical or hypospherical glass ports. If a camera lens is properly aligned to the spherical center of such a port, the image is not affected by refraction and the photogrammetric reconstruction can be carried out under the same prerequisites as on land. Unfortunately, alignment is critical and most manufacturers either do not state such engineering details or they are obviously not being met, judging from visual inspection of their products.
- Another possibility is to regard the spherical front window as yet another element of the actual lens and grind it specifically to meet the different refractive indices and the camera position relative to the port. This seems to be the approach of the company Insite Pacific. They offer two cameras, which differ in the choice of lens (fixed focus lens vs. powerful zoom lens) and the number of imaging sensors used (Bayer-Pattern vs. 3-Chips for the 3 primary colors). This approach demands a high degree of integration and careful optical engineering and appears to be the most promising of all products offered with respect to photogrammetric applications.

The National Oceanography Centre of Southampton displayed another very interesting product. A twin deep-sea camera system using planar ports and rather small housings feeds video data to a central hard disk recording device in a separate housing. The system is meant for AUV work and has been designed for both deep and very long missions. The remarkable aspect was the simplicity of the recording device, a microcomputer connected to a hard drive array.

Stereo Camera Systems

Two companies offer stereo camera systems: Kongsberg displayed a prototype which could not be further examined. Another company (…) presented two cameras of different size and image quality. All cameras try to stay close to human eye separation to achieve a natural representation of the scene for the pilots. All products furthermore require an additional multiplexing unit in a separate pressurized housing. The images are viewed on passive (polarizing) stereo screens. While such systems primarily serve to increase the effectiveness of manipulator operations, my personal impression was mixed, since a proper anticipation of spatial depth could not always be achieved. Rental of such a system should enable the pilots to conduct their own usability studies prior to purchase.

Navigation

I am basing my navigation correction on a USBL and a DVL signal provided by the ROV telemetry, and was curious of an industry service that would improve the performance of our navigation relying only on the existing hardware. I visited the companies CDL, Sonardyne, McArtney and Ixsea to learn about their acoustic positioning systems. All of these systems offer a hardware based solution to integrate and weight a number of sensors into one navigation signal, but this solution is always tied to an expensive inertial navigation sensor which we do not own. At the moment, the next major advance may lie in the acquisition of such a sensor. Moreover, some manufacturers offer a sparse long base line navigation approach where only one transponder is moored on the seabed, and the accuracy of the control net increases during the dive as the transponder is queried from different positions.

Wen I specifically asked at our manufacturer Schilling with whom they work together for precise navigation, they redirected me to CDL who provide the hardware sensor integration but in turn redirected my to QPS who ingest the navigation stream to their Quinsy software package. Unfortunately, neither Quinsy nor Caris (or any other software solution of my knowing) offers the feature to synthesize a corrected vehicle position out of multiple sensors based on the individual data strings alone. In this respect, I did not gain constructive new ideas during the fair beyond the realization that our hardware may have to be expanded by an INS and a single transponder to comply with industry standards.

In my discussions with vendors, I did recognize a level of economic interest in our work. There are some first perspectives for the industrial application of microbathymetry based on visual data. It can be used for SLAM (Simultaneous Location and Mapping) applications as well as for the reconstruction of high detail, small-scale features such as structures of the oil and gas industry.

Microbathymetry
Several companies are active in the field of Microbathymetry. Many ROV vendors were featuring the BlueView sonar system, which does not provide texture since it is based on an acoustic design. A Texan company called Zupt is actively investigating a workflow that is identical to ours in many key aspects, but they have not conducted any field trials yet. Their main product is a refinement of USBL calibration based on INS data. While they do not rely on DVL navigation, I received the valuable suggestion to record the individual, raw transducer signals for each channel, in order to have maximum control of the signal processing in cases where the sensor may be compromised. Another active optical method is based on laser line scanning which is typically limited to 2-5m object distance. Many such approaches also lack color information.

DVL Sensors
I investigated the range of products in the field of Differential velocity logs (DVL) since I am lacking such a sensor for my current work using the Jago submersible. While all of our existing sensors are manufactured by RDI, two other competing companies offer smaller units at about half the price. Especially the smaller form factor is of great importance. RDI in turn offer a very compact single transducer design, which does not protrude from the superstructure, which is attractive but expensive.

Spatially related image databases
A big shortcoming of our current workflow is the circumstance that all image and video data is linked by a temporal coordinate, which makes the location of source material hardware dependent and time consuming. The software Adelie by Ifremer offers a link of imagery to ArcGis. Competing companies offer a workflow that allows encoding geographic positions along with video information, which can in turn be visualized using ArcGis. Our currently used software (Ofop) also offers such a link, but it conects imagery and map positions through a common time stamp.

Personal interests
I collected a large number of materials on syntactic foam used for floatation, which is a subject of private interest. I also received a contact to the head graphics programmer at QPS Fledermaus, in order to directly negotiate the possibility to add support of

immersive simulation environments for the Fledermaus software. This has been an ongoing effort for more than a year and I am happy to be able to proceed with this project on an executive level now. Another interesting stop was the inspection of wave glider systems, autonomous surface vehicles that are powered by solar and wave energy. In a collaborative project with WHOI we are currently investigating their use as communication relays for long range AUV work.

Synopsis

My primary goal was to get a general overview of deep-sea technology, and the fair served this purpose well. Although the fair hinted at the oil and gas industry, it did not seem to form the primary target market and I was unable to identify the primary target audience for this exhibition. Many big companies aimed at representative effects rather than product displays. The number of academic or technical talks was rather small since this is not the primary focus of the fair. Since this is a technological fair it pays off to have a firm schedule and a list of objectives well in advance. Asking specific questions helps to raise the attention of company representatives, and depending on the intent of the visit it may pay of not to initially reveal that “one still is a PhD student”. Proper dress code (casual business) is mandatory. Unfortunately the list of vendors does not fully reflect the available contacts since many representatives work for multiple companies or do not rent their own booth. Therefore it is important to make out key contacts and appoint meetings as early as possible, ideally on the first day.