Welcome

Welcome to the first issue of the ROBEX Newsletter. The objective of this newsletter is to provide information at a non-specialist level, not only to project partners but also to the general public. The formatting is optimized to enable school teachers and other educators to print each newsletter for an easy dissemination of the ROBEX science and technology in the classroom.
The ROBEX Newsletter is bilingual, with editions in both German and English. We intend with this to maximize the interest and participation of German educators, and allow for a greater awareness of the progress of ROBEX by the German public, while allowing for an easier international dissemination. ROBEX is an exciting project, and hopefully we will be able to hook you up on its achievements.

Flying Robots for the Deep Sea

C. Waldmann

The pure size of the world oceans poses an extreme challenge for scientific observations. With research vessels only "snapshots" of the complete picture can be taken. Therefore, the applications of independently working, movable robots have more and more been introduced into observing programs within the last decade. Derived from the so-called ARGO floats underwater gliders have been developed that extract energy for the forward motion from buoyancy changes (see explanation box).

Figure 1: The underwater glider MOTH in the 5 m deep test basin of MARUM

Figure 2: Preparation of the glider for the tank test

The hull design of an underwater glider is a determining factor for the later utility value. On one hand low drag resistance should be achieved, on the other hand the number of measuring devices that can be accommodated by the hull should be maximized. Low weight and high strength of the glider hull are also important, because these qualities contribute to a more efficient use.

From the technical requirements there is a lot of resemblance to aircraft construction. As the HGF alliance ROBEX is bringing together research groups from the area of the deep-sea research and the aviation and space a unique opportunity is offered to work together on forward looking, robotic systems.

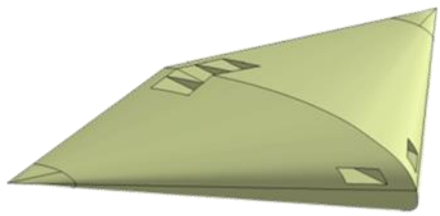

Figure 3: An alternative hull design of the DLR

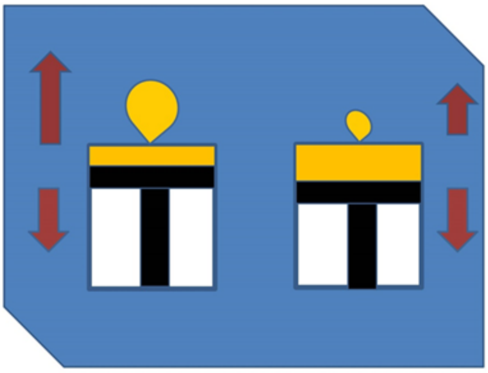

Figure 4: Principle of the buoyancy regulation

Properties of the Glider MOTH	
Max. diving depth	200 m
Weight in air	15 kg
Mass	2,5 x 1,0 x 0,1 m
Payload	8 kg
Horizontal speed	1 m/s

Within the framework of ROBEX so called flying wing concepts will be investigated that are already well known within aircraft construction. They open up new and unprecedented opportunities in regard to the integration of measuring devices for marine research. First tests in the MARUM test basin have shown that the chosen Horten flying wing design leads to a very stable flying behavior.

ROBEX First Training Workshop

P. de Jesus Mendes

The training of graduates and post graduates in multidisciplinary Environmental and Space Sciences was set as an important goal of the Alliance. The project is seriously committed to accomplish two complementary goals: professional development of scientists and young engineers, and assistance to the full-time and part-time staff.

The 1st Training Workshop (TW) was organized by Jacobs University Bremen, and took place in the DLR facilities in Oberpfaffenhofen, from the 22nd to the 24th of April 2013.

The goal of the workshop was to create an environment and mix of participants, to inspire a diversity of discussion and cross-fertilization of ideas.

The TW ran with the participation of twenty-two trainees from nine different partner institutions (AWI, DFKI, DLR, Jacobs University Bremen, GEOMAR, MARUM, TU-Berlin, TU-Dresden, TU-München). The training was carried out by eleven lecturers from six partner institutions (DFKI, DLR, Jacobs University Bremen, MARUM, TU-Berlin, TU-München,).

The TW consisted of a theoretical introduction to the Space Sciences, where the main technological challenges were presented to the audience. In addition, the lunar environmental conditions and properties were discussed, as well as the lunar interior. This introduction to Space Sciences was followed by a theoretical introduction to the Ocean Sciences. The general introduction to the environmental properties and conditions and to the technological challenges facing ocean scientists was complemented with a more detailed view on extreme environments, namely cold seeps and hot vents.

A session of interdisciplinary sharing and brainstorming followed, with a short presentation of individual expertise by the participants, and a discussion of the two main scientific questions and identification of technological challenges faced in ROBEX. Several practical subjects were looked at from the perspective of both Space Sciences and Ocean Sciences. The trainees were thus exposed to a dual perspective on systems engineering and power management; simulations, visualization and interfaces; autonomy; and sensors and instrumentation. The comprehension of the lecture subjects was consolidated with the formation of transdisciplinary teams to plan mission scenarios with different scientific objectives and technological challenges. The teams designed posters explaining the scientific and technological rationale of their proposed missions, and to explain their chosen solutions to these problems and goals.

Feedback and outcomes:

An anonymous online questionnaire was provided to the participants, to evaluate the TW. The feedback was overwhelmingly positive, with 73% of respondents classifying it overall as “good” or “very good”. 82% of the participants thought that the theoretical background was “important” or “very important”, with 64% considering the quality of the lectures as “good” and 18% considering them “very good”.

The approach of providing a double perspective of both Space Sciences and Ocean Sciences on several practical subjects was considered “important” or “very important” by 63% of participants, with 73% considering the practical subjects “somewhat important” or “very important” to their current work. The session of interdisciplinary sharing and brainstorming was considered “very important” by 55% of the participants, with 18% considering it “important”.

The formation of transdisciplinary teams to plan mission scenarios was considered “important” or “very important” by 73% of participants. The slides of the presentations and the posters will be accessible to the community in the partner area of the website.

Figure 1: The participants of the Training Workshop.

Tracked Robot exploration of extreme environments

A. Purser

One of the major themes identified as a key scientific challenge by the Helmholtz Alliance is that of "Hydrothermal vents and cold seeps as a potential resource for base, precious and rare high-tech metals and specific biological habitats". Within ROBEX, Jacobs University Bremen is investigating a Methane seep site at ~890 m depth in the Canadian Pacific with a university designed internet controlled deep sea crawler (Figure 1).

Figure1 – The latest generation of Jacobs University Bremen deep sea crawler, in operation at ~890 m depth in Barkley Canyon, Canadian Pacific. Image courtesy NEPTUNE-Canada

The current generation of crawler has been operating at the seep site for approaching 3 years, and has recorded an environmental dataset both from the seep site itself and the surrounding area, comprising of temperature, chlorophyll, turbidity, pressure, flow conditions and methane concentrations within the seabed waters. Additionally, video and still camera data has been collected to gauge how fauna behaviour may change in response to environmental variability over a range of spatial and temporal scales (Figure 2). The mobile nature of the crawler system, coupled with its direct internet accessibility and cabled power supply have allowed research scientists

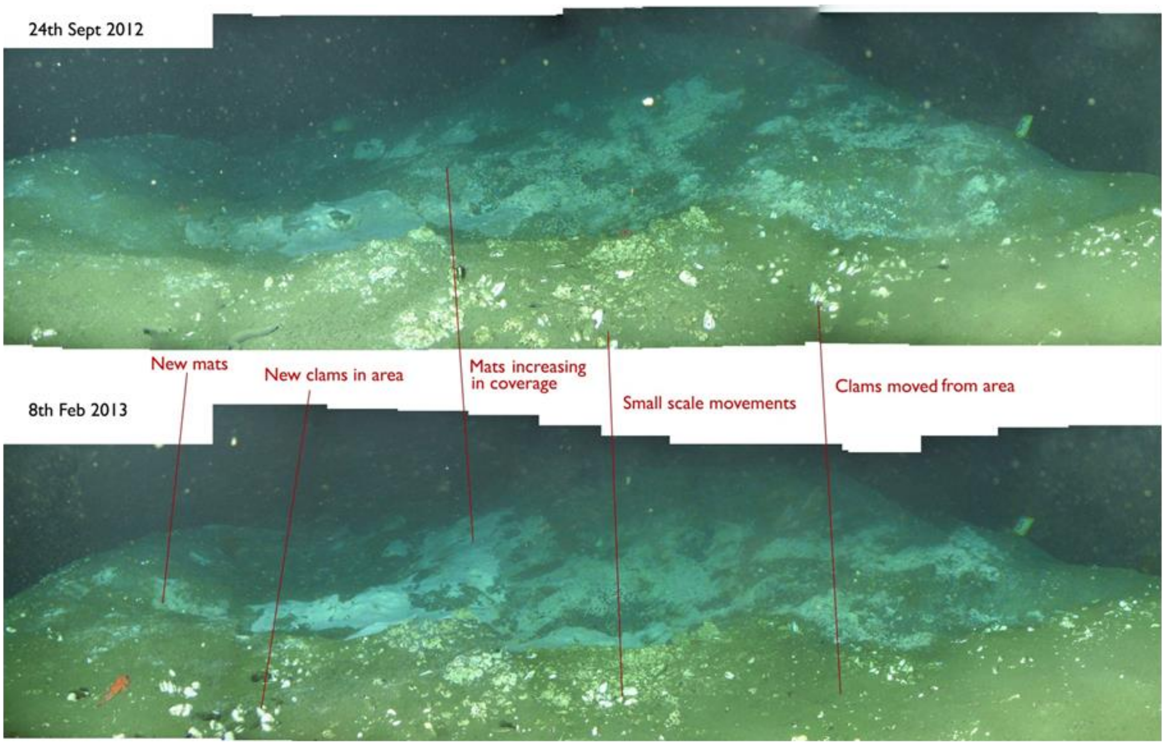

Figure 2 – Mosaic images showing the change in bacterial cover and faunal community change over time at a methane seep site in Barkley Canyon, Canadian Pacific (Purser et al., 2013).

to vary their experimental plans in real-time. A technical overview of the crawler design and early scientific results are presented in the recent paper by Purser et al. (2013).

In addition to providing real-time access to sensor data and 24 / 7 mobility, the cabled nature of the current generation of crawler renders it an ideal workbench on which to mount complex and experimental equipment for deep sea testing. During the initial year of ROBEX Jacobs University Bremen has redesigned (with collaboration with ROBEX partners and DFKI in particular) the front navigational camera of the crawler, to allow for the development of automated photogrammetrical and mapping systems for forthcoming crawler deployments. With collaborators from DLR, TU Berlin, MARUM, AWI and particularly GEOMAR and DFKI techniques to develop 3D maps of the location surrounding the crawler are in development. With deep sea data collected by standard webcam early tests show promise in automatically creating relief maps for areas of the seabed surrounding the crawler. These techniques are as applicable in the deep sea as in the lunar environment.

Jacobs University is part of the team developing the autonomous underwater crawler – alongside DFKI, AWI, GEOMAR and DLR-RMC. The current Jacobs University Bremen crawler will within the lifetime of the ROBEX project be modified by this cross-disciplinary group for autonomous deployments in the deep sea, and the techniques developed will be also relevant for autonomous deployments of tracked robot vehicles within lunar environments.

REFERENCE:

Purser, A., Thomsen, L., Barnes, C., Best, M., Chapman, R., Hofbauer, M., Menzel, M., Wagner, H. (2013) Temporal and spatial benthic data collection via an internet operated Deep Sea Crawler. Methods in Oceanography, 5, 1-18.

Concurrent Engineering Study

C. Lange, R.M. Paris Lopez, M. Wilde, T. Zoest

The first phase 0/A-Studie for a space demonstration mission within ROBEX took place in the "Concurrent Engineering Facility CEF" of the Institute of Space Systems of the German Aerospace Center (DLR) from the 22nd to the 26th of July 2013.

In the so-called "concurrent engineering process" several experts work simultaneously on a common technical development, in order to shorten the product development time (time saving), avoid subsequent product changes (cost reduction) and improve the coordination of development and production (quality improvement).

The study for the ROBEX "space" scenario, which was derived from the research questions, envisions the construction of an active seismic network on the Moon (ROBEX ASN), and the relevant infrastructure was designed in the typical way for a concurrent engineering study iterative process. The aim of the study was to agree on a detailed mission scenario and develop a preliminary design for the planned central station, the rover and the "payload Support Unit". In addition, the mass, the energy demand and the amount of data needed should be defined, so that the necessary scientific instruments can be accommodated and an analysis of the concept of modularity can be performed.

To tackle each of these questions there is a CE expert brings his experience and access to the relevant databases to the common scenario to be developed in the CE study. Working within a guided process that simultaneous access of all the experts to a common data set, and direct verbal, and media communication

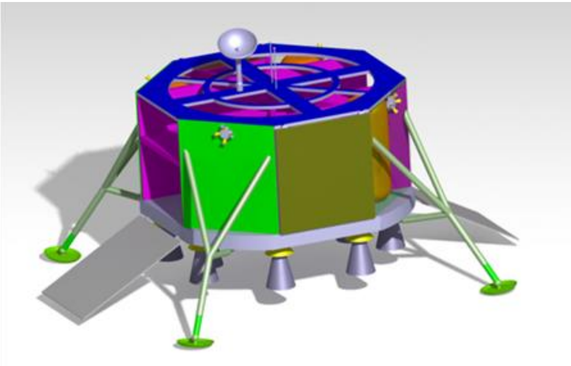

Figure 1: The Robex ASN landing system in its configuration, which was developed jointly during the CE study. You can see for example the ramp over which the rover disembarks from inside the lander on to the lunar surface.

among all subsystems are characteristic of a concurrent engineering study. In several common, moderated "Design Sessions" overarching issues were discussed and agreed upon, data compared, and basic decisions made. Free intervening periods of analysis, calculations, documentation and discussion in reduced groups provided the basis for the further iterative process.

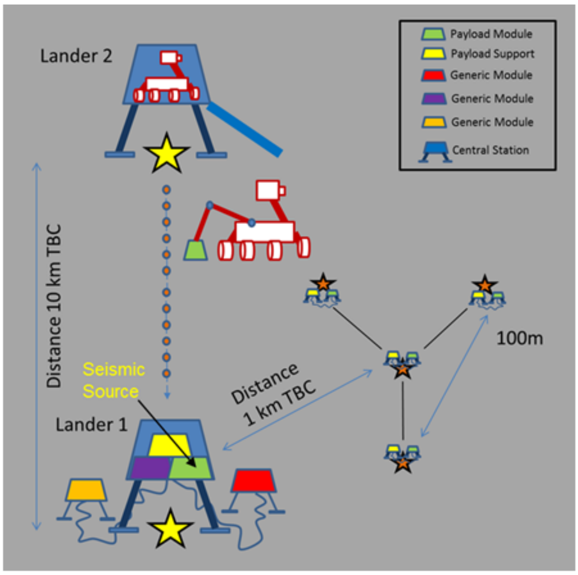

Figure 2: The Robex ASN mission scenario as it was studied in the CE study. Important elements here are the two landing systems , the rover and the Y-shaped network of seismometers and " Payload Support Units ". In Lander 1, you can see the active seismic source.

At the end of the Robex ASN study significant progress has been achieved: the planning for the scenario as well as the infrastructure can be substantiated now and a rocket delivery system (eg, the European Ariane 5 launcher)

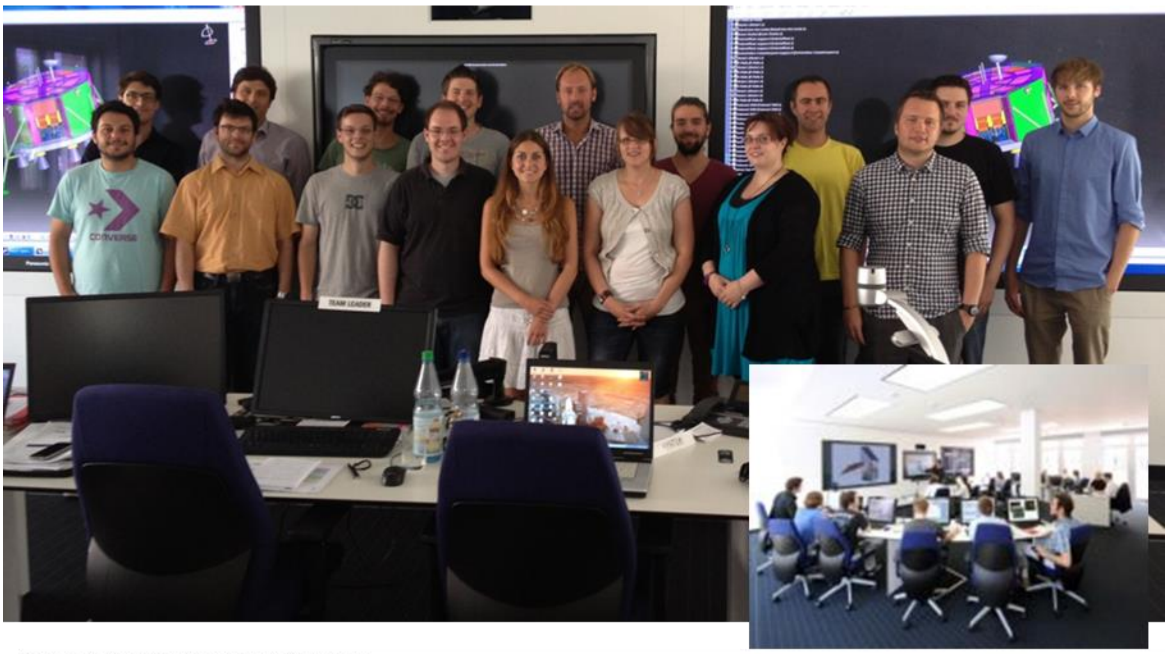

Figure 3: The CE Study participants.

was in accordance with the overall launching mass selected, the overall scenario thus demonstrated to be feasible. However, there are still open questions that could not be solved within the CE study, such as the design of the seismic source necessary for the "actives seismic Network", the optimization of the lifetime, and the analysis of the interfaces between all the elements. After the end of the study, which will be documented in a final report, the next practical steps both on planning the demo mission and the further development tools in ROBEX were agreed upon, so that the first elements of the Active Seismic network can be built.

News

3rd Community Workshop

The third Community Workshop will take place at the German Maritime Museum (DSM) in Bremerhaven. Representatives from the various partner institutes and work packages come together and present their outcomes of research collaborations within the preparatory phase (first project year) and are further developing the plans for the ROBEX project demo missions.

Expert directory

During the ROBEX 1st Training Workshop, an expert's directory was created to facilitate internal exchange of competences. Each participant inserted their name, contact and list of relevant skills. This directory was enlarged during the community meeting, and will also be available to the community in the partner area of the website. If you still don't appear in the directory, contact us at p.mendesjacobs-university.de .

Find us on Facebook

The ROBEZ Alliance is now on Facebook. Drop by and share your latest achievements, something you've just learned, or just to write on our wall. We welcome your content, and hope to be a hotspot for all the ROBEX partners. Find us at:

https://www.facebook.com/robexallianz

On the cover: Rima Ariadaeus on the Moon by Apollo 10, May 1969 (Source: NASA)

The ROBEX Alliance Newsletter is non-periodical - if you have items to contribute to the next issue, please send them to p.mendes@jacobs-university.de