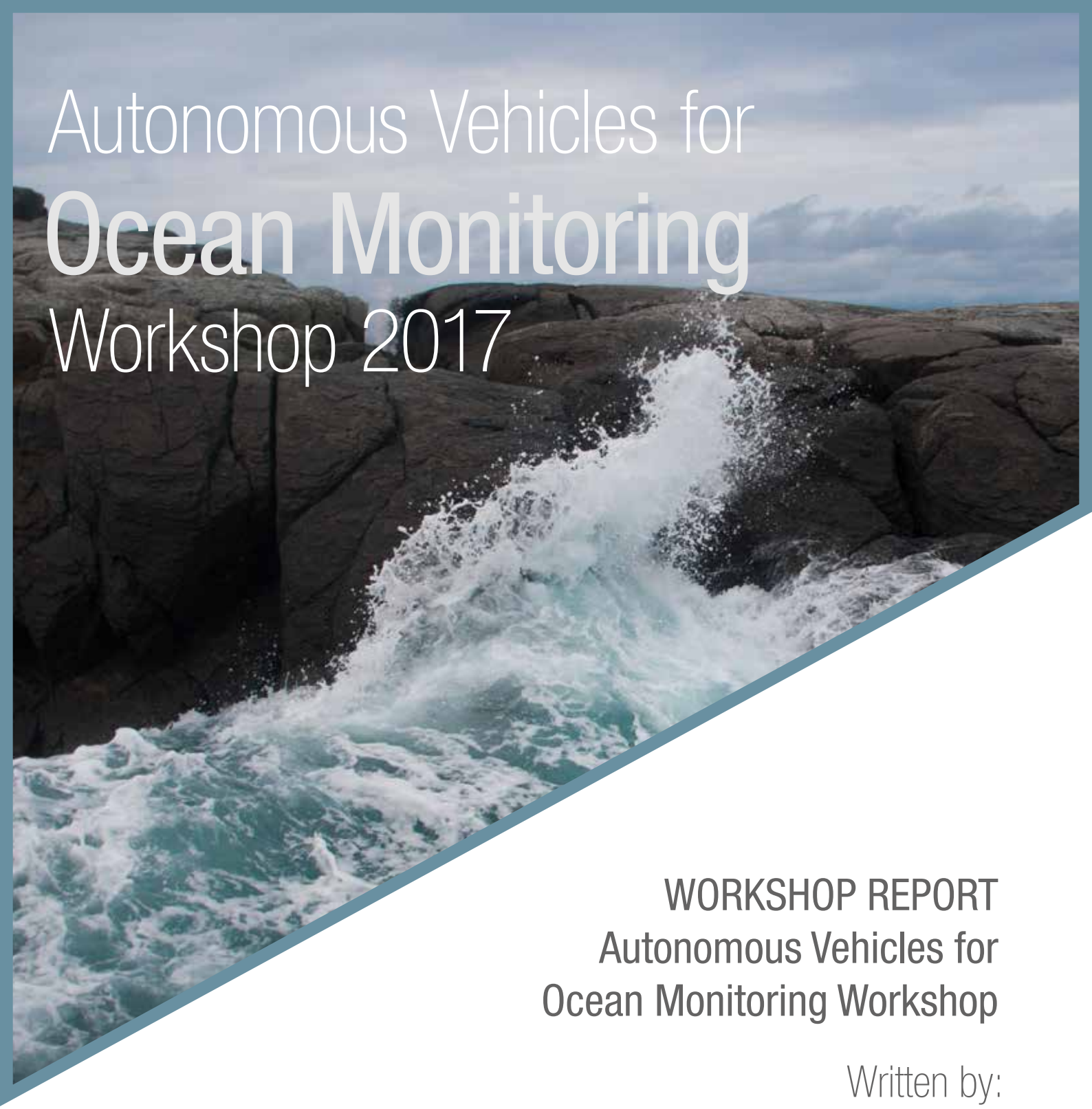

Autonomous Vehicles for Ocean Monitoring Workshop 2017

WORKSHOP REPORT
Autonomous Vehicles for Ocean Monitoring Workshop

Written by:
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RundeMiljøsenter

Background and objectives

The workshop was organized as part of the project «Fjernstyrte Undervass-farkoster» (Autonomous Underwater Vehicles; FjUF), funded by the regional research fund of mid-Norway.

The project is about exploring potential new uses for AUVs and gliders in and outside of research. The workshop was intended as a forum for everyone in Norway who works with autonomous vehicles for marine research and monitoring to share experiences, exchange knowledge, and discuss plans and expectations.

The workshop was open for anyone who is interested in autonomous vehicles such as gliders and AUVs, from experts to novices. Developers, operators, researchers and other users (or potential future users) and students were all invited.

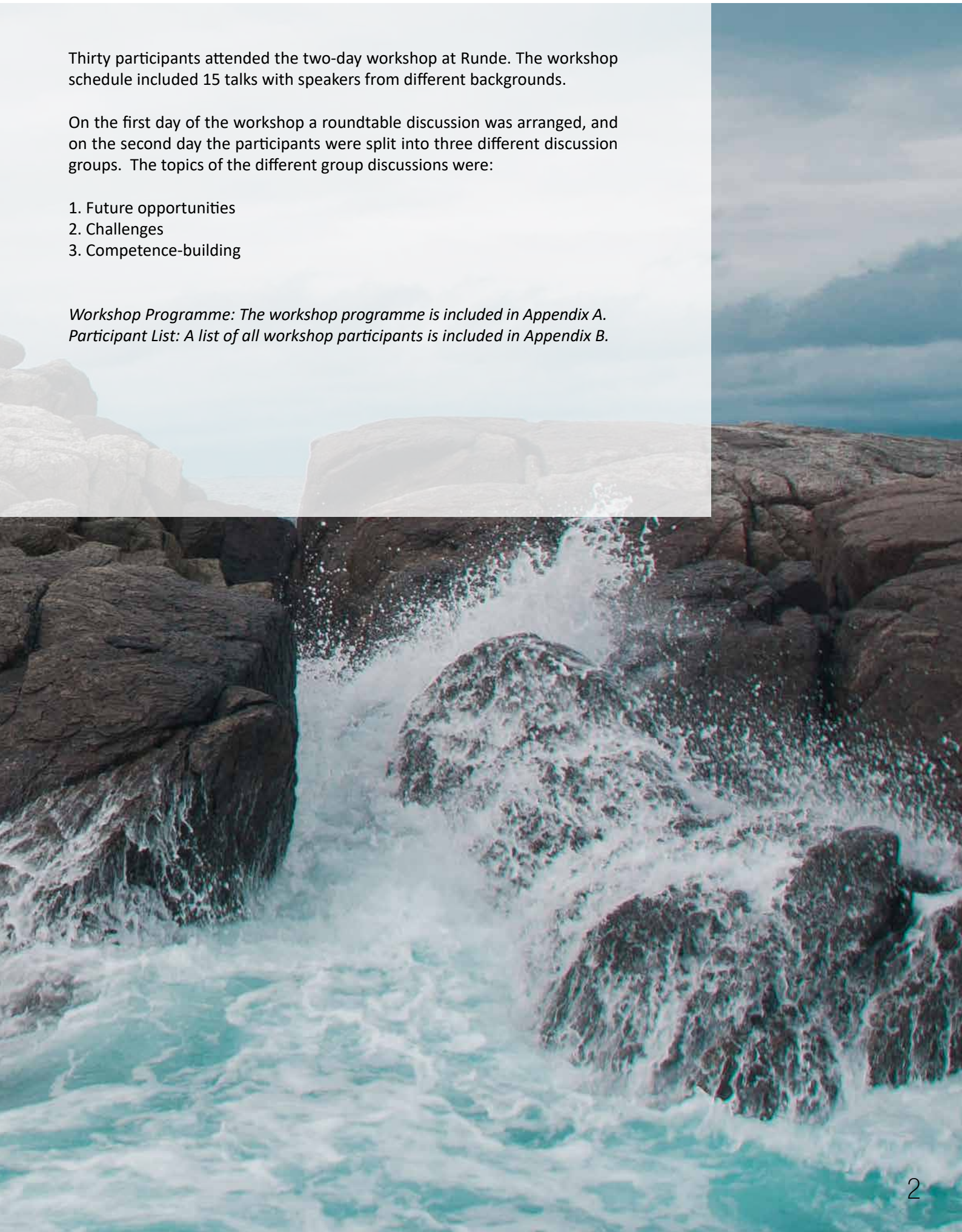
Workshop overview

Thirty participants attended the two-day workshop at Runde. The workshop schedule included 15 talks with speakers from different backgrounds.

On the first day of the workshop a roundtable discussion was arranged, and on the second day the participants were split into three different discussion groups. The topics of the different group discussions were:

1. Future opportunities
2. Challenges
3. Competence-building

Workshop Programme: The workshop programme is included in Appendix A.
Participant List: A list of all workshop participants is included in Appendix B.



Presentations

Anthony Bosse, University of Bergen (UiB).

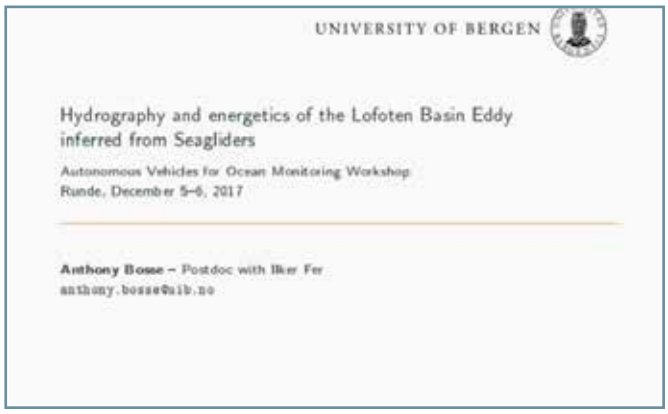
The Mohn Ridge front: Mean structure and aspects of seasonal and mesoscale to submesoscale variability.

Anthony Bosse, oceanographer from UiB, presented a project investigating the Mohn Ridge front using gliders. This front separates the warm and saline waters of the Lofoten Basin from the cold, fresh waters in the Greenlad Sea. Gliders were chosen, as high spatial and temporal resolution was necessary to investigate the variability of the front current, and water exchange mechanisms across this front.

Petter Østenstad, Norwegian Defence Research Establishment (FFI).

Gliders in a military operational setting.

Sonar is a very important tool in naval warfare, particularly for detecting submarines. The oceanographic conditions (sound velocity, bathymetry) severely affects the performance of sonar, and must be known to use this tool effectively. FFI investigated the use of gliders as a monitoring tool to map the changes in hydrography in time and space during naval operations.



Anthony Bosse, University of Bergen (UiB).

Hydrography and energetics of the Lofoten Basin Eddy inferred from Seagliders.

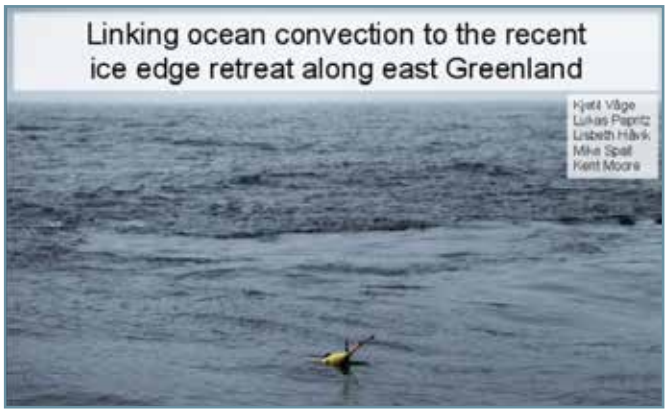
The Lofoten Basin is an energetic area with lots of eddy activity. A strong, permanent eddy, the Lofoten Basin Eddy, is investigated with gliders and other platforms over 5 years. The goal is to understand the eddy preservation mechanism(s), as well as to study the importance of the eddy on water mixing and deep water formation.

Ilker Fer, University of Bergen (UiB).

Microstructure measurements using an underwater glider.

Ilker Fer reported from two projects using gliders with microstructure turbulence sensors to investigate turbulence and energy dissipation in the ocean. Turbulence is important for water mixing, and the small scale turbulence dissipates motion into heat. Measuring microstructure turbulence requires a very careful approach, and gliders are demonstrated to be excellent platforms for this type of measurements.

Presentations



Kjetil Våge, University of Bergen (UiB).

Linking ocean convection to the recent ice edge retreat along east Greenland.

Kjetil Våge investigates the circulation patterns and water mass transformations in the Iceland Sea. Historical data, mostly from floats, are limited to the eastern part, and thus gliders are used to also investigate the western part. The new data helps understand the retreat of the ice edge, and sheds light on a number of deep mixing phenomena.

Carsten Frank, Kongsberg Maritime Contros.

Mixing platforms. Moving from platforms to systems.

Carsten Frank introduced the concept of "Mixing platforms" to increase the scalability, the sensor range and communication ability. Advanced (mobile) platforms & sensor suites/measuring networks are solutions for continuous and comprehensive monitoring in the water column and at the seabed (for physical, chemical, biological parameters and processes). The Kongsberg challenge is the development of solutions for platforms deployment and recharge at sea.

Joel Pederick, Maritime Robotics

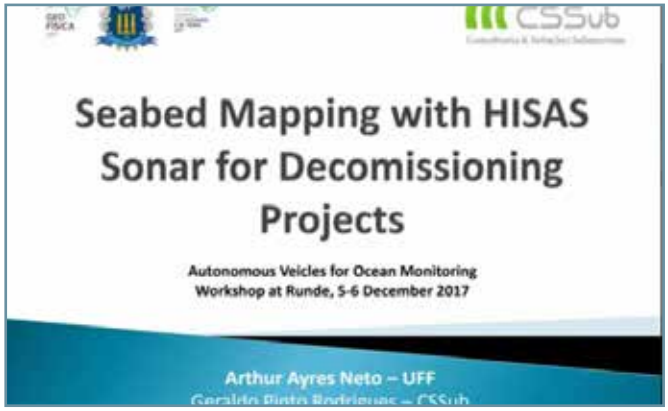
Unmanned Surface Vehicles

Joel Pederick demonstrated the innovative, flexible and cost-efficient offshore monitoring and data management approach by Maritime Robotics. Many projects are in development in collaboration with other scientific and technological institutions (USV Applications, Runde Hydrographic Survey, The Wave Glider and Robots helping Robots), using platforms that can move in space, provide long-term and real-time monitoring, and in addition reduce cost compared to other traditional measurement concepts.

Atle Gran, Kongsberg Maritime

Results from HUGIN Environmental Survey.

Atle Gran presented the results from a HUGIN AUV Environmental Survey in Oslo fjord. The area is important due to the two national parks (Ferder and Hvaler) and the high density of ships. Using the Sonar HISAS 1032 they found boat wreck, ropes, fresh water pipes, chain of lobster pots, trawl marks, whale bones, corals and a plane. For specific targets they used the Cathx color camera to take photos. Atle Gran also presented the Skagerrak survey 2015, a joint project with the Norwegian Coastal Administration that found 54 wrecks with chemical weapons from WW-II. Finally, he presented the K-Mate for autonomous ship operation.



Arthur Ayres, University Federal Fluminense (UFF).

Seabed mapping with HISAS sonar for decommissioning projects.

Arthur Ayres showed the use of new sonar technologies (HISAS 1030 and EM 2040 multibeam) to develop consistent surveys procedures to map subsea installations around production platforms for decommissioning projects. The methodology decreases the survey costs and improves the visualization of the seafloor, resulting in more efficient decommissioning planning.

César Martinez UTEK.

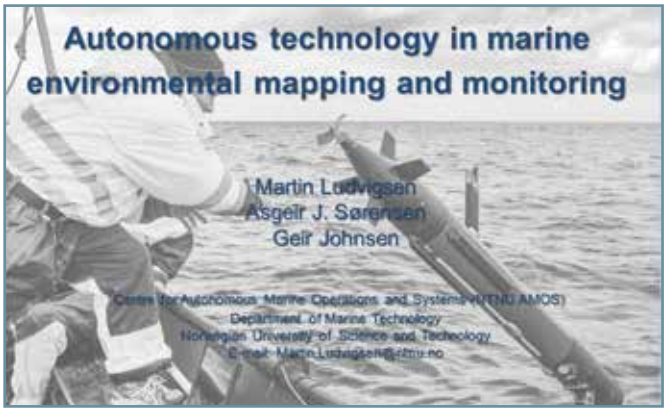
Unmanned technologies.

UTEK is the first Spanish company specialized in USV development. With a multidisciplinary team, the company has a scientific park in Madrid and a test field at San Juan Reserve. The concept of UTEK is the use of USVs to deploy other systems, such as AUV or ROV for surveillance and security, maritime research and rescue, environmental control, oceanic research and "3D"missions (Dull, Dirty and Dangerous).

André Santi, Prooceano.

Seagliders applied to underwater acoustics.

Prooceano presented the project with Petrobras in Santos Basin to identify and classify anthropogenic noise according to the regulations in Brazil, for oil & gas activities. The project goal was to characterize the ocean soundscape of the area
before the industry activity reaches maturity level in the region, by using profilers and gliders with 2 years of continuous data collection.



Martin Ludvigsen, NTNU AMOS.

Autonomous technology in marine environmental mapping and monitoring.

Martin Ludvigsen presented the ambition of the Centre for Autonomous Marine Operations and Systems (AMOS) at NTNU: to improve offshore operations and marine monitoring while lowering the cost. To achieve this we need smaller, unmanned, and data-driven systems. Autonomous systems are more intelligent and adaptive than automatic ones, and have complex functionality even with no, or limited, communication.

Presentations

Lionel Camus, Akvaplan-NIVA.

Unmanned ocean vehicles, a flexible and cost-efficient offshore monitoring and data management approach.

Lionel Camus leads the project 'GLIDER' that promotes a cost-effective and flexible concept for ocean monitoring using different types of autonomous vehicles: Seaglider, Wave Glider, and Sailbuoy. Data use and interpretation will be developed into a product that can be sold to for example oil companies. The project also aims to enhance ecosystem knowledge and environmental management practices.

Gisle Nonstad, GCE Subsea.

GCE Subsea.

Gisle Nonstad gave a very brief introduction to the Global Centre of Expertise (GCE) subsea industry cluster. Autonomous vehicles are applicable to all of the GCE's focus areas: deep-sea mining, marine food production, integrated monitoring, subsea factories and offshore renewable energy.

Anne Ansnes Hageberg, Christian Michelsen Research (CMR).

Real-time acoustic monitoring with autonomous vehicles.

Anne Ansnes Hageberg presented work done at CMR using an unmanned surface vehicle, the Sailbuoy, equipped with an echo-sounder for fish detection and biomass monitoring. The sonar processing system LSSS has been customized for the Sailbuoy. On-board processing is needed to reduce and compress data for sending to shore. CMR have a PhD-project on mobile acoustic observation methods. They are also part of the "GLIDER" project.

Karsten Kvalsund, Runde Environmental Centre (REC).

Glider activity at Runde.

Karsten Kvalsund made a short, introductory presentation about how gliders work and the glider activity at Runde. Most of the activity have been in relationship with the NACO-project, but use of gliders with newly developed passive acoustic sensors and hydrocarbon sensors were also presented.

Roundtable discussion

A roundtable discussion was organized on the first day of the workshop. At the table were representatives from each partner in the 'FjUF' project: Svein Rune Smådal (Havila), Martin Ludvigsen (NTNU AMOS), Steinar Aabelvik (Kongsberg Evotec), Håvard Stave (Fosnavåg Ocean Academy), and Nils-Roar Hareide (Runde Environmental Centre), who took the role as moderator of the discussion. Members of the audience also participated actively in the discussion. Here follows a short summary of the discussion.

Havila gave the EU project NEXOS the opportunity to launch a glider from their ship Havila Troll, and crew from the ship participated in fieldwork with light AUVs in summer 2017 as part of the FjUF project. These research experiments have been successful, but are there also business opportunities in the use of this technology? Could we for example offer the industry a tool for measuring pollution, spotting leaks in infrastructure?

Value is generated in the oil & gas sector, fisheries, aquaculture, marine management, research, tourism and military applications; in all these branches there are tasks that can be automated.

New Norwegian rules for certification of officers on aquaculture service vessels are under way. 2500 vessels will need certified personnel. Can transport to the fish farms be solved with autonomy?

It is important to remember cyber security, and to make sure you can trust the data and that nobody is manipulating them. Autonomous ships are getting a lot of attention, but in reality it will probably be a while until we see completely unmanned ships in operation. In the FerryBox measurement programme, a data quality control system is already implemented.

Kongsberg Evotec has a Launch And Recovery System (LARS) for the MUNIN AUV. An opportunity to utilize standby vessels in place of expensive research ship time can be very beneficial. Do the end customers, such as oil companies, need measurements with an AUV or glider? As oil fields age, such as the Troll field, more monitoring is needed – potentially using autonomous technology.

There is a strong focus on green operations and environment. Authorities such as the Environment Agency set the requirements, so it is important that they are up-to-date with the technological possibilities, e.g. fluorocarbon sensors on gliders. If the new equipment is implemented in industry, it builds demand for more scientific and technological development.

Group discussion

All workshop participants were divided into three groups to discuss a topic relevant to autonomous vehicles. Since the workshop participants came from a varied range of backgrounds, and with different interests in the workshop, we thought it could be fruitful to let them exchange views, experiences and questions.

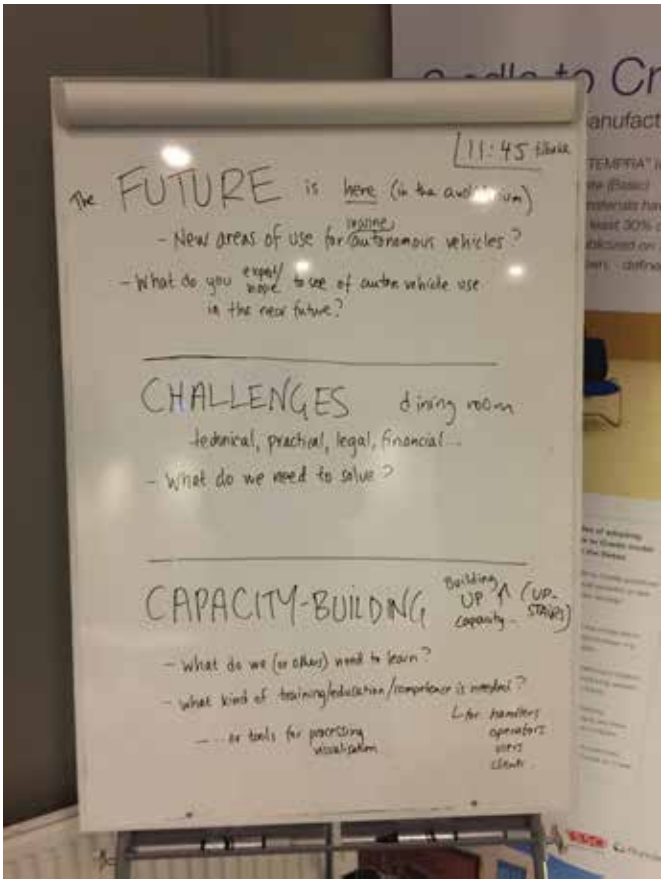
The topics were:

1. Future opportunities
2. Challenges
3. Competence building.

The 'Future opportunities' would include topics such as new areas of use and sensor requirements.

The 'Challenges' topic was meant to stimulate discussion of technical, financial, regulatory or other issues that need solving.

The 'Competence-building' group was to discuss the needs for capacity-building and increased knowledge in the field of marine autonomous vehicles. After the discussions, a condensed summary was presented to everyone.



Future opportunities

AUV can be used for: underwater pollution detection, energy activities monitoring (oil & gas and windparks), aquaculture management, military missions, surveillance, ship traffic, environmental monitoring, oceanographic and climate research. It is still important to develop demand and to formulate the needs to motivate more and new uses for underwater autonomous vehicles. Increasing demand can help lower vehicle costs and thus enable more scientific users. Integrated monitoring systems are the future for ocean monitoring and mapping.

Challenges

There was cordial consensus that the main obstacle for increased use of AUVs was not lack of ability or usefulness, but lack of financing. Marine archaeology was discussed as an example of an area with great need, and where AUVs could do great work, but where funding was hard to find.

Also, markets exist, both in oil & gas, aquaculture and offshore wind, but need to be unlocked. Technology is currently being transferred from oil & gas to other maritime sectors. Some legislation might be in the way for some applications, and also when crossing borders.
Real time access to data is considered important, which in turn challenges communication links and on-the-fly processing of data. Also, the sheer volume of data collected can be a challenge too.

A final challenge for added uptake of AUV technology is the upfront cost of equipment and training. A rental model was proposed as a solution.
The discussion also dwelled on the challenge of micro-plastics in the ocean, and how an in-situ sensor on AUVs or gliders might be used to monitor the problem, and spread awareness.

Competence building

There is a need for competent AUV and glider operators. Several types of knowledge is needed: integration and calibration of sensors, navigation, programming, interpreting the data, etc. To keep the capacity, it needs to be used – not only a few weeks per year. It was suggested that several organizations could get together and educate a pool of people.

Outlook

Picking the right vehicles for the right application is essential to more efficient environmental monitoring. Managing the mission according to the power range of sensors and platforms, and planning what and how to measure is essential to optimize the environmental monitoring time and costs.

The systems with inter-communication and inter-operational capability are creating new ways of data acquisition and monitoring. The challenges are processing the big and heavy data and cyber security.

Conclusion

Throughout the workshop, participants gained a better understanding of the capabilities and limitations of autonomous underwater and surface vehicles and how they are used in marine research and monitoring today.

Autonomous vehicles are often considered from the point of view of saving costs, but they also enable completely new approaches. Workshop participants also identified challenges that need to be solved.

Appendix A: Workshop programme
Appendix B: List of participants