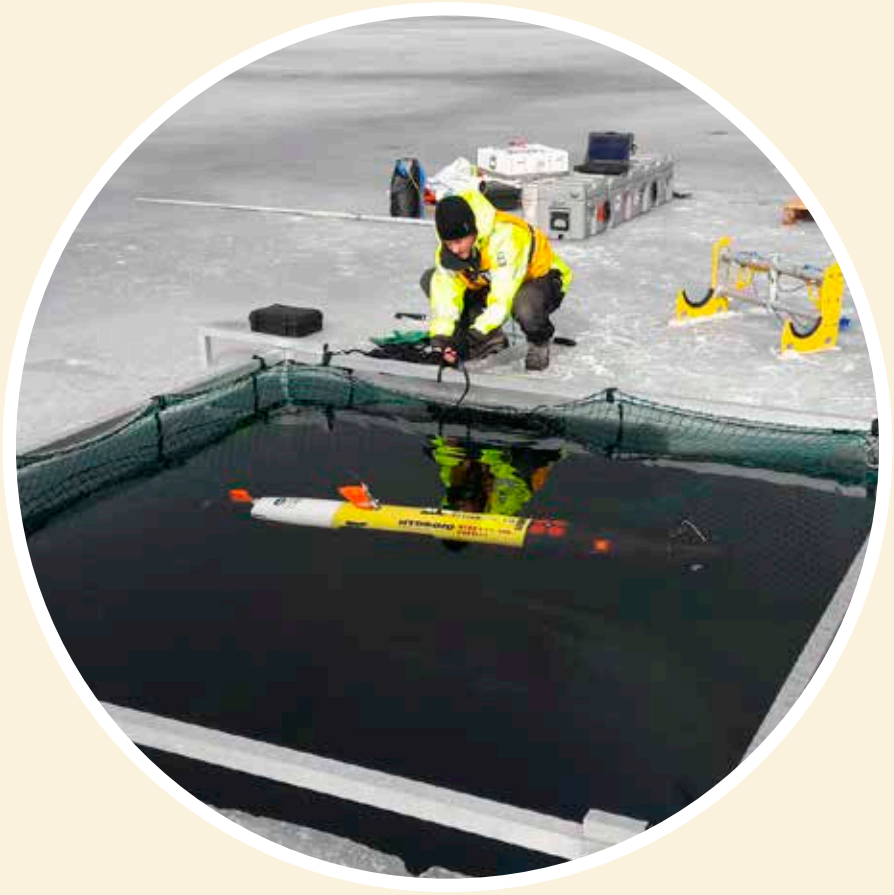
NTNU
Department of Marine Technology

DEPARTMENT OF

MARINE TECHNOLOGY

Annual Report 2016



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THE YEAR 2016 IN SUMMARY

In 2016, the recent downturn in the offshore oil & gas industry started to take hold also at the Department of Marine Technology. We saw a significant reduction in applications to our five-year master program for the first time in many years. We were able to recruit 100 well-qualified students for the five-year program, which is a good number, but still a reduction of 32% since the year before. The current difficulties in the job market for our newly graduated candidates also mean that we see signs of more students changing to other study programs. Together, this is a significant challenge, which we meet by increasing our recruitment efforts, various actions to show our students that the downturn will not last forever and that those who start their studies in a downturn typically end up graduating in boom times, and by making changes to our study program to make it more up-to-date and attractive. Increasing the number of international and two-year Norwegian master students is another action to take to counteract the fall in number of graduated students, and thereby income to the department.

One of our long-lasting and important recruiting activities is the Ocean Space Race, which is continuously growing in size and diversity, and which saw a record number of 571 attendants in 2016, representing 25 different high schools throughout Norway. We are looking for ways to grow and strengthen this initiative further, as the current concept with this has reached its capacity limit.

The Department of Marine Technology is hosting the NTNU strategic area Oceans, headed by prof. Ingrid Schjølberg. NTNU Oceans has developed into the cross-disciplinary platform for ocean-related research that it was intended to be, and the department is a very proud host. In 2016, Ocean Week was arranged outside of Tyholt for the first time. It is developing into a fruitful meeting place between researchers from different fields, politicians and decision makers.

NTNU merged with the university colleges in Trondheim, Gjøvik and Ålesund, effective from the beginning of 2016. This has of course had significant impact on the internal affairs at these institutions in the past year. Following the merger, an extensive reorganization has taken place in NTNU to fully integrate the merged institutions. The Department of Marine Technology has been relatively little impacted by the merger, as we have not been merged with any other department. In Ålesund, the Department of Ocean Operations and Civil Engineering has been formed as a result of the merger. This department is an important collaborator for the Department of Marine Technology, as we to a large extent work in the same field, and cooperating with the same companies. For instance is this department the leader of the SFI MOVE on offshore operations where our department has extensive activities. The reorganization, together with state demands for the reduction of the administration, has led to a reduction of the administrative staff at the department. Two people have had to move to other departments at NTNU.

Effective from September, the former head of department prof. Harald Ellingsen left to start as the director of the University Centre at Svalbard. He was replaced by prof. Sverre Steen as the acting head of department until the end of July 2017, when the head of department for the coming four years will start. Prof. Ellingsen has a 90% leave from the department, keeping a 10% position to follow-up his course in sustainable aquaculture.

The Ocean Space Centre was subject to a limited conceptual study ("begrenset KVU") in the autumn of 2016. DNV-GL and Menon investigated whether building separate wave basins and a seakeeping basin rather than the long basin with subdivisions ("D-Flex") would be better, and whether the Ocean Space Centre is expected to be a profitable enterprise for the Norwegian society at large. They concluded that all the suggested laboratories are expected to be profitable for the society, and that it will be more profitable to make the wave basins separate. The report and conclusions from DNV-GL and Menon will be subject to an independent quality-assurance study to be performed by independent consultants in 2017, on which basis the government will make a decision about which concept to go forward with.

Prof. Sverre Steen
Acting Head of the Department of Marine Technology

FACTS AND FIGURES

Staff
24 professors
10 professors emeriti
4 associate professors
2 assistant professors
14 adjunct professors
4 adjunct associate professors
9 researchers
23 postdoctoral fellows
90 PhD candidates, financed by IMT and/or CeSOS*
18 graduated PhD candidates
112 graduated MSc students
69 MSc exchanges to universities abroad **
14 administrative staff
19 technical staff
6 apprentice

Revenues
Income: 161.1 MNOK
Costs: 160.6 MNOK

Publications
2 books
4 book chapters
122 refereed journal articles
112 refereed conference papers
11 international keynote and plenary lectures
66 media contributions
43 other presentations

**Note: This number only includes PhD candidates who are financed by the Department of Marine Technology (IMT) and/or CeSOS. There are other PhD candidates who work at the department who are financed otherwise and are not listed here.*
***Note: Spring and autumn semester 2016 combined.*

ORGANIZATION

Head of Department
Prof. Harald Ellingsen
(until summer 2016)

Head of Department
Prof. Sverre Steen
(from summer 2016)

Assistant Head
of Department
Prof. Svein Sævik

Head of Office
Astrid E. Hansen

Head of Marine
Systems
Prof. Bjørn Egil
Asbjørnslett

Head of Marine
Structures
Prof. Roger Skjetne

The Department of Marine Technology consists of two research groups: the Marine Systems research group and the Marine Structures research group.

The Marine Systems research group teaches and conducts research on major aspects of marine systems, such as machinery, ships and maritime transport systems; offshore oil and gas infrastructure and systems; other offshore energy production systems; and fisheries and aquaculture. The research group focuses on system design and operation as well as interaction and adaptation to the surroundings in a total lifecycle perspective. The prioritized research areas are as follows:

- Risk and safety management of marine systems
- Multi-level design of complex marine systems
- Design and verification of complex energy systems
- Sustainable development of shipping in Arctic waters

The Marine Structures research group educates and conducts research in the fields of marine structures, marine hydrodynamics, underwater technology, and marine control engineering. Key research application areas are the following:

- Oceanography
- Wave-induced motions and strongly nonlinear loads
- Structural load effects
- Abnormal loads and accidental load effects
- Slender marine structures
- Ship and marine operations
- Propellers and propulsion
- Renewable energy propulsion
- Aquaculture facilities
- Very large floating structures
- Deep-sea mineral mining
- Wind, current, and wave energy production
- Structural design
- Underwater robotics
- Ocean science
- Autonomous marine systems

PRESENTATION OF NEW PROFESSORS

Erin E. Bachynski

Associate Professor, Department of Marine Technology, NTNU

Erin Bachynski holds bachelor and master's degrees in naval architecture and marine engineering from the University of Michigan, and a PhD from NTNU in 2014. She worked at MARINTEK (now SINTEF Ocean) for two years prior to becoming an Onsager Fellow in the area Marine Structures for the Future. Her main research area is the design and analysis of offshore renewable energy devices: this includes fixed and floating support structures for offshore wind turbines, hydro-elasticity, global analysis, and higher order wave loads. She works with the development and application of numerical tools and experimental techniques.

Josef Kiendl

Associate Professor, Department of Marine Technology, NTNU

I received my PhD degree in Civil Engineering at TU Munich in 2011 for my work on the isogeometric analysis and shape optimization for shell structures. From 2012 to 2015, I worked as a postdoc at the University of Pavia, Italy. Afterwards, from 2015 to 2016, I had an Assistant Professor position at TU Braunschweig, Germany, before I joined NTNU in late 2016. My research is mainly located in structural and computational mechanics with a focus on isogeometric methods, a novel form of finite element analysis, which merges CAD design and FEM analysis. Working at IMT, I want to further develop these methods to provide efficient tools for the design and analysis of marine structures.

Lars Erik Holmedal

Professor, Department of Marine Technology, NTNU

Prof. Lars Erik Holmedal obtained his PhD degree at NTNU in 2002 and then worked as a postdoc and a researcher at IMT from 2005 to 2016. Currently, he is a professor in marine hydrodynamics at the Department of Marine Technology. His main research works are related to wave- current-particle interaction, stochastic methods, and Computational Fluid Dynamics. He has published more than 40 peer-reviewed journal papers.

Sergey Ushakov

Professor, Department of Marine Technology, NTNU

I received my PhD degree in 2012 from the Department of Marine Technology at NTNU for my work on the measurement and characterization of particulate matter emissions from marine diesel engines. Before re-joining the department in 2016 as a professor in marine machinery, I worked for several years at MARINTEK (now SINTEF Ocean) within the fields of marine diesel engine emission characterization and emission reduction technologies, covering both volatile and non-volatile exhaust emissions. During this work, I was involved in a number of bigger and smaller research projects where I accumulated substantial experience with experimental work both in the laboratory and on board of different vessels. My current research focus is environmentally friendly shipping as well as the improvement of marine diesel engines' efficiency, especially emphasizing on the experimental part of this work.

EDUCATIONAL PROGRAMMES

The department is responsible for the organization and implementation of the Marine Technology educational programme at the faculty. It is offered to students in three main options (number of students graduated in 2016 in parentheses):

- as a 5-year integrated Master programme (79)
- as a 2-year Master programme for students with a Norwegian Bachelor degree (9)
- as a 2-year international Master programme (19)
- other Master programmes with a specialization in Marine Technology (12)

The first 3 years of the integrated Master programme feature introductory courses in mathematics, statistics, physics, chemistry, mechanics, and thermodynamics in addition to courses that introduce the marine disciplines and their aspects, design, and operational problems to be encountered throughout the programme.

Figure 1: Students on an aquaculture excursion at Hitra. Photo: Hans Jakob Farstad, Coastal Museum of South-Trøndelag.

From the 6th semester onwards, students can choose among eight specializations:

- Marine structures
- Marine cybernetics
- Marine hydrodynamics
- Marine engineering
- Safety and asset management
- Marine systems design
- Marine resources and aquaculture
- Marine subsea engineering

The study specializations combine the disciplines of hydrodynamics, structural engineering and marine systems. An emphasis is placed on the students' ability to combine practical understanding with the use of mathematical models and computer-based methods of analysis. Emphasis is also placed on the development of the students' ability to view the big picture in technical problems related to design, analysis and operation of marine systems.

The 2-year Master of Science programmes in Marine Technology is offered to students with a Bachelor degree in Naval Architecture, Ocean Engineering or an equivalent upon admission. The structure of the programmes is built on the courses offered in the last two years of the 5-year programme.

In addition to Marine Technology, the department is involved in the following programmes:

- Engineering and ICT — 5-year integrated Master programme
- Maritime Engineering — 2-year international Master programme (Nordic Five Tech programme, in cooperation with the Technical University of Denmark, the Royal Institute of Technology and Chalmers University of Technology in Sweden, and Aalto University in Finland)
- Marine Coastal Development — 2-year international Master programme
- Subsea Technology — 2-year Master programme in cooperation with Bergen University College
- European Wind Energy Master — 2-year international Master programme in cooperation with Delft University of Technology, Technical University of Denmark, and Carl von Ossietzky Universität Oldenburg

RECRUITMENT ACTIVITIES AND EVENTS

Ocean Space Race 2016

Website: www.oceanspacerace.no

The Ocean Space Race at NTNU is an annual national competition for senior high school students where the students compete against each other with their self-made model ships in the ocean basin at the Marine Technology Centre.

This year's Ocean Space Race took place on 3-4 March 2016 at the Marine Technology Centre in Trondheim. There were 570 participants – 519 pupils and 51 teachers – from 25 different high schools.

Take a look at the programme

Media coverage:

- SINTEFweb: **Ocean Space Race 2016**, 6 March 2016
- Dusken.no: **Ser etter kloke hoder i vannet**, 4 March 2016

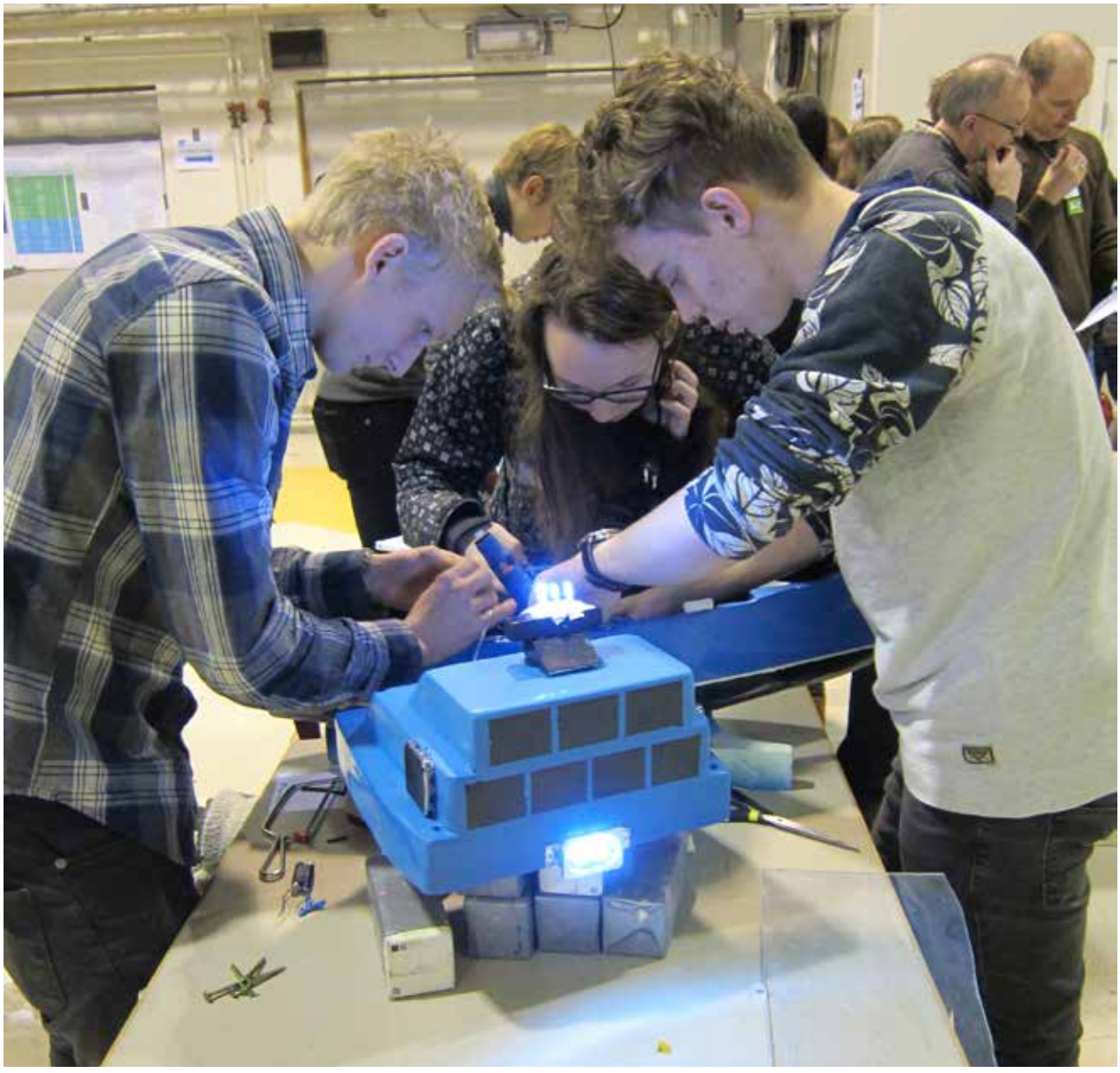


Figure 2: Pupils working on their ship model at the Ocean Space Race 2016. Photo: Kristin Lauritzsen, NTNU.

Other recruitment activities and events at IMT in 2016

Event/Programme	Date	Target audience	No. of partici-pants	Media coverage and websites
Educational exhibition at Frøya	27 Jan.	Pupils from Frøya and Hitra Junior High School and Frøya High School	200	**http://kystkompetanse.no/arrangement/yrkes-og-utdanningsmessa-2016/**
Girls' Day at NTNU	4-5 Feb.	female pupils with the highest grades in mathematics and physics at the secondary school level in Norway	250	
Educational exhibition in Trondheim	4-5 Feb.	High School pupils from Mid-Norway	1000+	
Ocean Space Race	4 March	High school pupils from all over Norway	550	**www.oceanspacerace.no**
Open Day at NTNU	27 Apr.	High school pupils from all over Norway	500+	**www.ntnu.no/moetntnu/apendag**
Ocean Week	9-13 May	Students, researchers, industry, politicians from marine and maritime sector	500	**www.oceanweek.no** **http://www.universitets-avisa.no/ytring/2016/05/06/Bl%C3%A5-vekst-%C2%ABEi-b%C3%A5tlengd-f%C3%B8re%C2%BB-57410.ece** **http://ilaks.no/lader-opp-til-ocean-week/** **https://fiskeribladet.no/nyheter/?artikkel=46851**
Boat Festival in Ålesund	13-16 July	All visitors at the festival	50 000	**http://batfestivalen.no**
Tjuvstarten ("Jumping the gun event")	15 Aug.	Female master students	25	
Researchers Night	23 Sep.	High School pupils from Trondheim	500+	**www.ntnu.no/forsknings-dagene/night**
Ocean Talent Camp Ålesund	28 Sep.	Pupils from Sunnmøre	200+	**www.oceantalentcamp.no**
Forskningstorget	30 Sep. – 1 Oct.	Pupils and other visitors	500+	
NTNU Bridgehead Aquaculture (conferences, excursions, seminars, speed-dating, mingling)	Through-out the year	Pupils, teachers, students, researchers, industry, authorities	250	**www.ntnu.no/brohode-havbruk**
Guided tours at the Marine Technology Centre and Gløshaugen, partially with competitions at the ocean basin	Through-out the year	Pupils from schools from all over Norway, students from Norway and Finland, visitors from Ålesund	238	
Courses in technology for teachers in secondary and middle schools	Through-out the year	Teachers in secondary and middle schools	Ca. 20	

MASTER STUDENTS' ACTIVITIES

- OUR STUDENTS REPORT

RUKA

Webpage: www.RUKA.no

From the 14th to the 24th of October, Tyholt was finally ready for the autumn highlight, namely RUKA-16! This is a cultural festival organized by and for marine students, and through the 34 years since the first RUKA, it has been one of the major highlights for the students every two years when UKA is not arranged. RUKA has become well known within the academic environment in Trondheim and is an important factor for the unique atmosphere at Tyholt. With 300 highly skilled marine engineering students as volunteers, hundreds of guests every evening and a well-planned schedule, the 10 days of RUKA-16 were a success. Both academic lectures, revue, swing course, beer tasting, casino, LAN party as well as many different sporting events were arranged.

Saturday 23rd October was the highlight, with 600 returning alumni who took part in the festivities. That evening, RUKA held concerts with the highly acclaimed rapper Unge Ferrari, our own incredibly skilled in-house band Ship Happens and the very promising DJ Henry Land. The voluntary officials did everything from rigging concert equipment, arranging courses and manning the bar to checking tickets, and they did a great job! It is beyond doubt that the marine students are capable of more than just crunching numbers.

Figure 3: Performing students during the revue. Photo: Steffen Johansen.

Career Day («Bedriftsdagen»)

Webpage: http://bedriftsdagen.no

On October 20th, the career day was organized with numerous companies from the maritime sector coming to talk about their career possibilities. Despite fewer companies than usual, the large group of enthusiastic students made the day a success. The day started with a stand area at Tyholt and speed presentations in the auditorium. The master candidates and the company representatives had dinner, followed by the revue. This is the only day each year where companies come exclusively to meet marine students, an opportunity that both students and companies greatly appreciate.

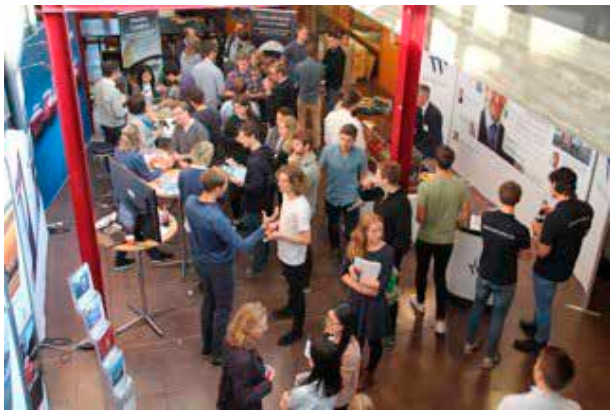


Figure 4: Students exploring their options with future employers. Photo: Cathrine Kabbe.

Figure 5: Speed-presentations during the career day. Photo: Cathrine Kabbe.

RESEARCH HIGHLIGHTS

A list of all of the department's research projects in 2016 is located in the appendices of this annual report. The following pages are selected research highlights from several of the department's projects in 2016.

Blue mining: Breakthrough solutions for the sustainable exploration and extraction of deep sea mineral resources

Project manager at NTNU: Prof. Martin Ludvigsen (Martin.ludvigsen@ntnu.no)
Period: 02/2014-01/2018
Project web page:
http://www.bluemining.eu/

The Blue Mining consortium consists of 19 partners from 6 European countries. The overall objective of Blue Mining is to provide breakthrough solutions for a sustainable deep sea mining value chain. NTNU and Department of Marine Technology is involved in two work packages. In Work Package one – Resource Discovery, we look into the feasibility of hyperspectral imaging for mineral prospecting. Postdoc Ines Dumke participated in a research cruise to the TAG hydrothermal field. The instrument rig HyBIS, see Figure 6, was lowered to the seabed at approximately 3500 meters depth searching for seabed minerals. Using spectral information of the seabed, minerals were categorized. In Work Package five NTNU is responsible for testing equipment for seabed mineral extraction. In June 2016 the offshore construction vessel Olympic Taurus was mobilized to test a subsea pump designed for vertical transport of crushed rock containing minerals. Using the subsea crane, the pump developed by the Dutch partner IHC was lowered to 450 meters depth for a 60 hour test program.

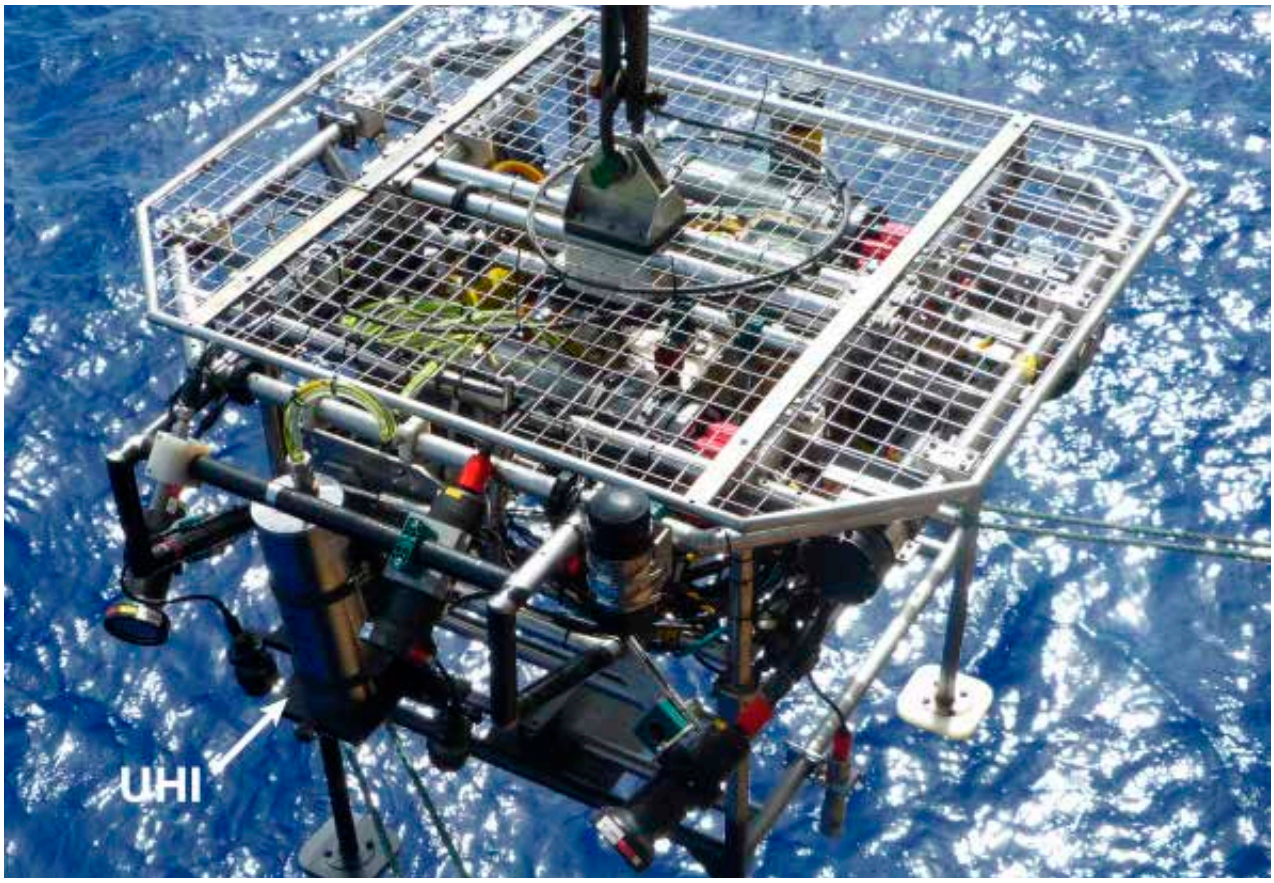


Figure 6: Underwater Hyperspectral Imager (UHI) mounted on the HyBIS vehicle during deployment from the RRS James Cook.

Design and verification of control system for safe and energy-efficient vessels with hybrid power plants (D2V)

Project manager: Prof. Asgeir J. Sørensen (asgeir.sorensen@ntnu.no)

Dynamically positioned (DP) vessels with electric power plants in the range of 10 -–80 MW are used in the offshore industry in several safety-critical operations, including drilling, supply, offloading, construction, anchor handling, and production. DP vessels are increasingly used, and they constitute a major part of the national and international maritime activities related to the exploration and exploitation of hydrocarbons and other advanced offshore operations. The development of knowledge and competence in the design and qualification of safe and environmentally robust power and energy management systems for safer and greener offshore vessels is critical for the Norwegian industry.

Design criteria and analysis of floating bridges for coastal highway route E39

Project managers at NTNU IMT: Prof. Jørgen Amdahl, Prof. Bernt J. Leira and Prof. Torgeir Moan (Torgeir.moan@ntnu.no)
Period: 2013-2017

According to the National Transport Plan 2014-2023 Norway intends to make the coastal highway, Route E39, along the Norwegian west coast from Kristiansand to Trondheim, ferry free and reduce the travelling time from 21 to 11 hours. The project includes replacing existing ferry connections in 7 fjords with bridges or tunnels. As most of the fjords are wide and deep, conventional bridges are not feasible and tunnels would be very expensive. Hence, floating bridges or submerged, buoyant tunnels are most relevant. The department is involved in

- developing the design standards (criteria, specification of methods)
- developing and verifying models for the inhomogeneous wave conditions in the fjord
- developing methods for dynamic analysis of bridges subjected to combined wind, wave and current loads
- developing and applying methods for ship impact analysis of floating bridges

Some examples are given in the highlights section.

Hydralab+

Project managers at NTNU IMT: Prof. Lars Erik Holmedal (Lars.erik.holmedal@ntnu.no) and Prof. Dag Myrhaug (Dag.myrhaug@ntnu.no)
Period: 2015 - 2019
Project web page: http://hydralab.eu

Climate change impacts, such as sea level rise, increased storminess, modification of meteorological tides are likely

Figure 7: A three span suspension bridge with two floating pylons. Illustration: Arne Jørgen Myhre, Norwegian Public Roads Administration.

to result in accelerated beach erosion (Glavovic et al, 2014). In coastal regions and estuaries among the leading processes that drive beach erosion, sediment transport and the modification of both bottom boundary layer properties and bed shear stresses are strongly related to wave-current interaction processes. As these factors may also influence many economic and ecological processes as well as security issues, a deeper understanding of wave-current interaction can certainly contribute to enhance the investigation and setup of climate change adaptation measures in coastal regions. In this framework, the evaluation of different scenarios with and without the presence of interacting forcing can help in understanding to what extent coastal regions are resilient to climate changes.

This is a Transnational access subproject of Hydralab+, where experiments of 3-d wave-current-sediment interaction are to be conducted in the DHI wave basin in Copenhagen during fall 2017. The budget for our part covers travelling and accommodation.

Investigation of injection and combustion properties of alternative fuels with the help of optical combustion rig

Project manager: Prof. Sergey Ushakov (Sergey.ushakov@ntnu.no)
Period: 09/2015-09/2018
Project web page: **http://www.smartmaritime.no/work-packages/wp-3-power-systems-and-fuel/**

The aim of the project is the development and validation of a research methodology/tool for detailed investigation of sprays of different fuels with the help of optical and thermodynamic techniques. To achieve these goals a big volume combustion rig is used to assess the performance of fuel injection systems intended for marine application. Application of high-speed camera filming together with such optical methods as shadowgraph and Schlieren as well as obtaining thermodynamic and dynamic pressure data allows very comprehensive analysis of injection and combustion processes.

In 2016 further work dedicated to the upgrade of the combustion rig was continued with the main emphasis on straightening of its design and modification of gas filling system and data acquisition module. Sensitivity tests with the reference fuel as well as preliminary alternative fuel tests have been performed and documented. Based on these results some final adjustments/modifications need to be done before proceeding to the main part of the experiments.

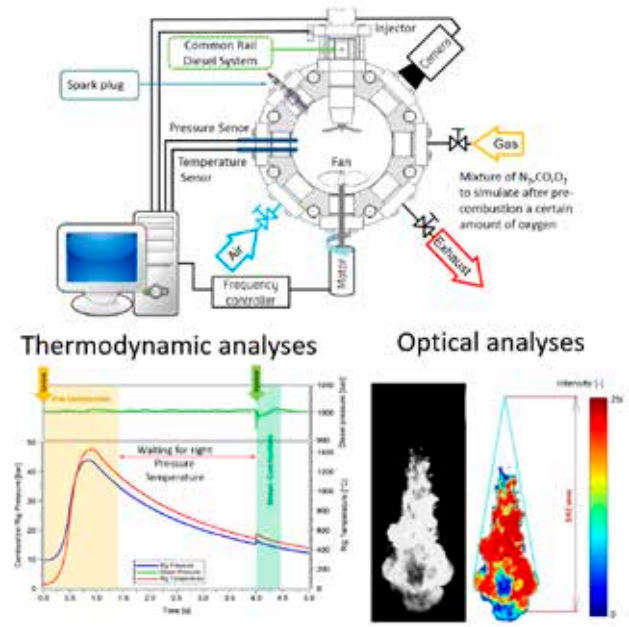


Figure 8: Investigation of ignition and combustion properties with the help of CVCR.

Low energy and emission design of ships (LEEDS)

Project manager: Prof. Bjørn Egil Asbjørnslett (Bjorn.e.asbjornslett@ntnu.no)
Period: 07/2012 – 09/2019
Project web page: **https://nb-no.facebook.com/HydroContestTeamNTNU**

The primary objective of the LEEDS project is to: Develop knowledge for concept design, system design and technology options to be used for radical ship design for low energy consumption and GHG emission. The intended effect is to support a long term development towards lowered energy usage in and GHG emissions from shipping, based upon knowledge building of PhDs and master students of marine technology. An essential part in this is participation in and contribution to development of the HydroContest (HC) ship

design competition for energy efficient shipping. The NTNU team participated for the first time in HydroContest in 2016, and won bronze medals in the mass-transport race and the long-distance race.

Figure 9: The NTNU HydroContest team 2016 with boat in mass-transport competition mode. Photo: Pierrick Contin.

Modern student-friendly diesel engine test cell

Project manager: Assoc. prof. Eilif Pedersen (Eilif.pedersen@ntnu.no)
Period: 09/2015-03/2017

Student education in Maritime Technology is currently focused on its theoretical part and use of laboratory (experimental) work is rather limited. Experimental educational activities first of all require appropriate infrastructure, effort from laboratory technicians and thorough planning and preparation of the actual laboratory exercises. All these steps have been undertaken by Marine Machinery group to provide wider educational possibilities for the students.

Figure 10: The new Scania engine.

In 2015-2016 a modern heavy-duty marine diesel engine, together with corresponding control and data acquisition system, was installed in the Marine Machinery Laboratory. The engine was connected to the engine brake and external water cooling system and was commissioned. All necessary adjustments were completed and students have successfully performed a number of laboratory exercises. The engine appeared to be load-stable, robust and easy to operate. Based on that it is expected the increase in number of laboratory/research work performed in this test cell.

Next generation subsea inspection, maintenance and repair operations (NextGenIMR)

Project manager: Prof. Ingrid Schjølberg (Ingrid.schjolberg@ntnu.no)

NTNU Norwegian University of Science and Technology · FMC Technologies · Statoil · SINTEF · The Research Council of Norway

NextGenIMR is coordinated by the Department of Marine Technology. Our industrial partners are FMC Technologies and Statoil, and SINTEF ICT is a research partner. The development of subsea facilities, including infrastructure and processing equipment, is important for achieving increased efficiency in future oil and gas production. Next-generation subsea factories will constitute complex installations including pump stations, compressors, storage tanks etc. Current and future inspection, maintenance and repair operations are vessel dependent and must be safe and reliable, as they are costly and dependent on open weather windows.

NextGenIMR has developed robust positioning and localization methods and collision-free motion planning algorithms for autonomous subsea inspection and light intervention operations. The project also focuses on subsea factory design for autonomous intervention. The project in particular addresses autonomous platforms; however, the results are also applicable to cable-connected ROVs where operation will shift from manual to automatic control with autonomous functions. Advances in sensor technology, communications, ICT architecture design, localization methods, robotics and task planning present new possibilities to bridge the gap between manual control and autonomy. NextGenIMR results will be tested, verified and demonstrated

in full-scale test beds available at NTNU and among industry partners. The technology will be highly relevant for operations in aquaculture and deep sea mining.

On-line risk modelling of DP systems

Project manager: Prof. Jan Erik Vinnem (Jan.erik.vinnem@ntnu.no)
Period: 01/2016 – 12/2019

The development of an on-line risk model for DP systems is carried out by two PhD candidates, one with emphasis on risk presentation and decision-making (human response) and one with emphasis on on-line risk modelling. The project is in 2016 in its initial phase, and has focused on lessons that may be learned from incidents and accidents, see illustration below of subsystems where technical failures were involved.

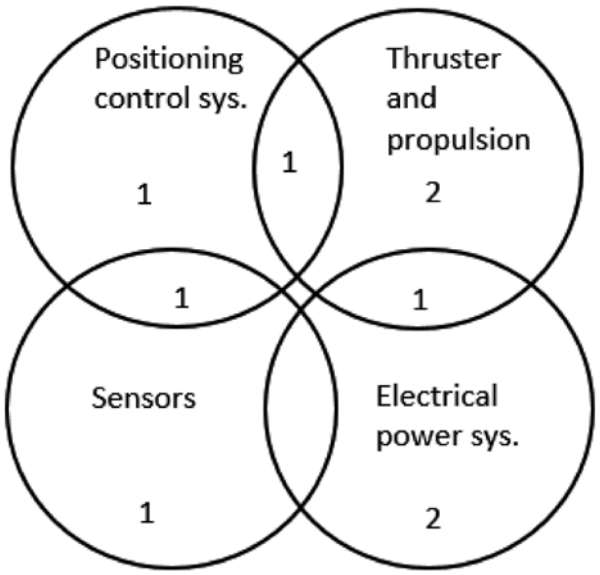


Figure 11: Number of accidents and incidents (2000-2015) analysed where technical failures were present in different subsystems.

Reducing risk in aquaculture (FISKRISK)

Project manager: Prof. Ingrid Bouwer Utne (Ingrid.b.utne@ntnu.no)
Period: 01/2016-12/2019
Project web page: **https://www.ntnu.edu/imt/reducing-risk-in-aquaculture**

SINTEF

Project participants: NTNU and SINTEF Ocean. The project is associated with SFI Exposed Aquaculture Operations.

Current technologies and operations in fish farms are highly dependent on manual labor for cleaning and maintenance, which leads to close human interactions with tools and fish cage structures. The sea-based aquaculture industry is one of the most dangerous occupations in Norway. Moving fish farms into more exposed areas will lead to increased challenges related to the working environment and management of operations. Hence, technological innovation and autonomy are important for future industry expansion. To ensure that the new concepts reduce risk to people and the environment, adequate risk management becomes even more important for sustainable fish farming operations in the future.

This project researches and develops novel concepts for autonomous operations and technology to improve safety and efficiency in aquaculture. In particular, the project addresses daily operations and inspection, maintenance, and repair (IMR) for exposed locations, but the project results will also be applicable to more sheltered fish production. Moreover, the project will assess, utilize and possibly adapt technology developed for subsea IMR in the oil and gas industry. Advances in sensor technology, robotics, ICT, and localization methods create new opportunities for reducing operators' manual workload and exposure time on the facilities at sea, for preventing fish escape, and for improving safety and operational efficiency.

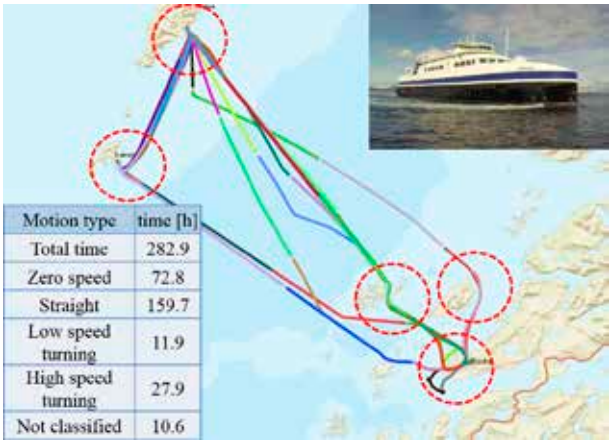
The project is funded by the Norwegian Research Council (HAVBRUK2) and finances: 1 PhD candidate, 1 postdoc, 1 senior scientist, and several master students.

Figure 12: Removal of ice on fish cage. Photo: SINTEF Ocean.

Sea trials and model tests for validation of shiphandling simulation models (SimVal)

Project manager: Prof. Sverre Steen (Sverre.steen@ntnu.no)
Period: 04/2013 – 12/2016
Project web page: **http://www.sintef.no/simval**

The focus for the NTNU activities in SimVal in 2016 was use of in-service data of R/V Gunnerus and M/F Landegode for validation of ship manoeuvring simulation models. The approach taken by postdoctoral researcher Afshin Abbasi-Hoseini was to use machine-learning methods to classify manoeuvers in the in-service dataset, and then to compare the in-service



Motion type	time [h]
Total time	282.9
Zero speed	72.8
Straight	159.7
Low speed turning	11.9
High speed turning	27.9
Not classified	10.6

Figure 13: The route pattern of M/F Landegode. The hatched red circles indicates areas where interesting manoeuvring is performed.

data for the particular manoeuvers with numerical simulation. PhD candidate Sergey Gavrilin took a different approach, by first selecting a repeated manoeuver performed by M/F Landegode in its regularly scheduled route and then fitting a meta-model to that manoeuver, before comparing the meta-model with the numerical simulation.

Statoil's MIT-NTNU Offshore Wind Turbine project

Project manager: Prof. Torgeir Moan (Torgeir.moan@ntnu.no)
Period: 2010-2018

As part of the Statoil-MIT-NTNU energy cooperative efforts, this project on offshore wind turbines was initiated in 2010, with Erin E. Bachynski as the PhD candidate at NTNU. The initial focus was on the design and analysis of tension-leg floating wind turbines with a focus on the aero-hydro-elastic features. The research focus of the NTNU PhD candidate in 2016 has been on developing a methodology for fault tolerant control; also involving another affiliated PhD candidate; enabling them to deal with fault detection, isolation and tolerant control turbine , considering faults in the drivetrain and blades, respectively.

Deployment of larger scale wind turbine systems, in particular offshore, requires well-organized operation and maintenance strategies to make it as competitive as the classical electric power stations. Faults in the drivetrain, especially the gearbox and blade actuator faults rank among the most critical faults, due to their frequency of occurrence and associated downtime. Statistical change detection in time domain analysis is used to detect and estimate faults in a 5-MW reference gearbox installed on the OC3 Hywind with floating spar structure. A decoupled approach using SIMO-RIFLEX-AeroDyn and SIMPACK (gearbox model) was implemented in this study (Figure 14). The Generalized Likelihood Ratio (GLRT) was used to detect fault in the main shaft bearing and showed good performance according to the ISO 20816-1 standard.

Faults in the blade pitch sensors (PSB, PSF) and actuators (PAS) are detected by Kalman filter based on a residual generation and evaluation method, while fault isolation is conducted by inference methods. After successful fault isolation, the faults are accommodated by the fault-tolerant control system. The fault-tolerant control actions are carried out by a signal correction for sensor faults and by shutdown for the safety critical actuator faults. When the fault tolerant schemes are applied to systems where multiple faults are randomly imposed in the three rotor blades, they are found to effectively deal with the faults.

Related publications:

- **Cho, Seongpil; Gao, Zhen; Moan, Torgeir.** Model-based fault detection of blade pitch system in floating wind turbines. *Journal of Physics, Conference Series* 2016 ;Volume 753.
- **Ghane, Mahdi; Rasekhi Nejad, Amir; Blanke, Mogens; Gao, Zhen; Moan, Torgeir.** Statistical fault diagnosis of wind turbine drivetrain applied to a 5MW floating wind turbine. *Journal of Physics, Conference Series* 2016 ;Volume 753

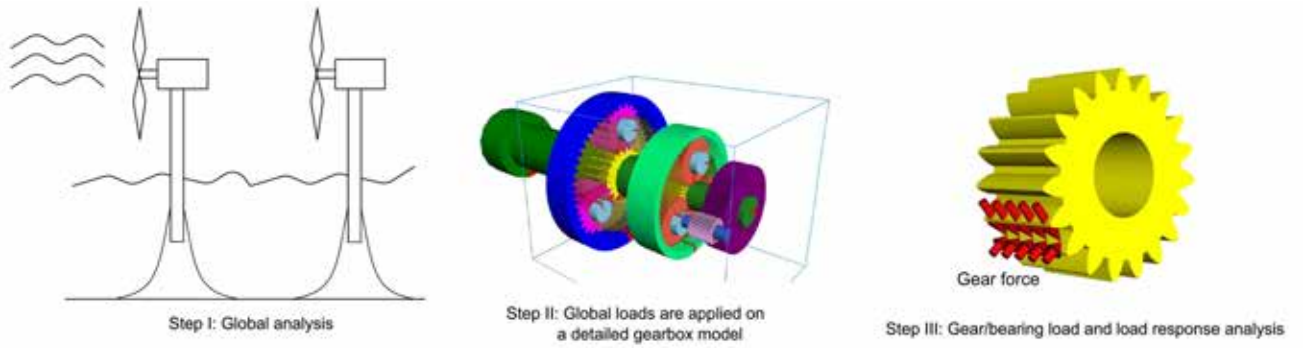


Figure 14:The three-step decoupled analysis approach employed in the project

RESEARCH CENTRES

Centre for Autonomous Marine Operations and Systems (NTNU AMOS)

Director: Prof. Asgeir J. Sørensen (Asgeir.sorensen@ntnu.no)
Web page: www.ntnu.edu/amos

NTNU AMOS

The NTNU Departments of Marine Technology and Engineering Cybernetics, together with MARINTEK, SINTEF Fisheries and Aquaculture, SINTEF ICT, DNV GL and Statoil and leading international and national collaborators, were awarded a Centre of Excellence (CoE) by the Research Council of Norway in 2013.

NTNU AMOS creates fundamental knowledge and innovates through multidisciplinary theoretical, numerical, and experimental research within the knowledge fields of hydrodynamics, structural mechanics, guidance, navigation, and control. Cutting-edge inter-disciplinary research will provide the necessary bridge to realize high levels of autonomy for ships and ocean structures, unmanned vehicles, and marine operations and to address the challenges associated with greener and safer maritime transport, monitoring and surveillance of the coast and oceans, offshore renewable energy, and oil and gas exploration and production in deep and Arctic waters.

Centre for Ships and Ocean Structures (CeSOS)

Director: Prof. Torgeir Moan (Torgeir.moan@ntnu.no)
Web page: www.cesos.ntnu.no

The Centre for Ships and Ocean Structures (CeSOS) was established as a Centre of Excellence by the Research Council of Norway (RCN) in 2002 with support from RCN as well as NTNU, MARINTEK, DNV and Statoil. Key researchers involve professors from the Departments of Marine Technology, Engineering Cybernetics and Mathematics at NTNU.

The centre has been operating in close cooperation with sponsors and scientists from the Technical University of Denmark (DTU), Massachusetts Institute of Technology (MIT), INSEAN and other universities and research institutes. CeSOS focuses on the development of fundamental knowledge concerning the design and operation of future ships and ocean structures by integrating theoretical and experimental research in marine hydrodynamics, structural mechanics and automatic control.

The support from RCN formally ended after 10 years, as scheduled; however, CeSOS personnel still conduct high-quality research activities as key personnel in NTNU AMOS. Furthermore, several PhD candidates are affiliated with NTNU AMOS. An overview of key personnel, scientific publications and PhD theses during the period of 2002-2012 are available on the CeSOS website (see link above). Since 2013, research activities have primarily been reported through the Department of Marine Technology and NTNU AMOS.

Rolls-Royce University Technology Centre (UTC) "Performance in a Seaway"

Director: Prof . Sverre Steen (Sverre.steen@ntnu.no)
Website: www.ntnu.edu/imt/rolls_royce

Rolls-Royce

The University Technology Centre is a research collaboration with Rolls-Royce Marine and MARINTEK (SINTEF Ocean from 2017 on).
In 2016, the main events and research activities were:

- PhD project of Øyvind Øksnes Dalheim, focusing on application of "big data" methods to full scale monitoring data of various vessels designs by Rolls-Royce, where focus is on performance in a seaway, including speed loss and added power.
- Model tests and analyses of thrust loss and ventilation mechanisms of propellers in limited submergence, performed by PhD candidate Anna Kozlowska. The focus of the work is on thrust loss when ventilation occurs at forward speed, and on efficient semi-empirical mathematical modelling of the thrust loss.
- Sigbjørn Eng Rudå did experiments and simulations investigating roll damping by means of tunnel- and and azimuthing thrusters, and found that by clever control of

Figure 15: Test set-up and snapshots from propeller ventilation model tests by Anna Kozlowska.

these thrusters, significant roll damping can be achieved, so that critical operations, which might otherwise not be possible, can be performed safely.
- The application for a new associated project, the KPN project Fleksprop, was successful. The project is focusing on design of propellers and thrusters where hydroelastic effects are utilized for improved performance. SINTEF Ocean is project manager. Rolls-Royce Marine is sponsor. The project starts in May 2017.

Norwegian Centre for Offshore Wind Energy (NOWITECH)

NTNU IMT responsible: Prof. Torgeir Moan (Torgeir.moan@ntnu.no)
Project web page: https://www.sintef.no/projectweb/nowitech

NOWITECH is one of eight national research centres on climate friendly energy generation established by the Norwegian Government in 2009. The centre combines knowledge about wind power with offshore experience to promote the development of wind farms in deep sea. The goal is to produce new knowledge, methods and technology to form a basis for industrial value creation and cost-effective offshore wind farms. Among the 25 PhD and postdoc positions in NOWITECH seven were allocated to the Department of Marine Technology and CeSOS. In 2016 two PhD candidates have been active, dealing with

- design and integrated analysis of semi-submersible wind turbines (C. Luan)
- development and execution of an innovative real-time hybrid testing of floating wind turbines (V.B. Chabaud)

A 5-MW braceless steel semi-submersible wind turbine has been developed and used as the basis for a 1:30 scale model tested in the towing tank and ocean basin of MARINTEK using hybrid testing techniques. An efficient time-domain approach with a focus on the determination of global forces and moments in structural components of the semi-submersible floater has been developed and validated against special cases for which other software exists and against model tests.

Due to lack of appropriate model testing facilities, scaling challenges as well as costs of full-scale testing, a real-time hybrid testing method was developed for floating wind turbines consisting in testing physically only the sea loads while the wind loads were computed and imposed by a mechanical actuators. The results of this method were compared with those of advanced numerical models.

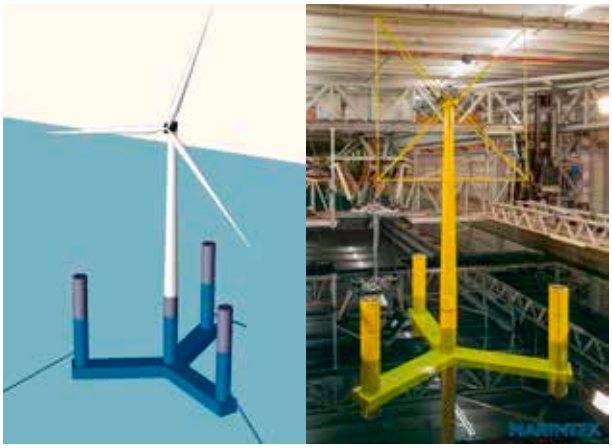


Figure 16: The 5-MW braceless semi-submersible wind turbine concept (left) and the 1:30 scale model tested at MARINTEK using hybrid testing techniques (right).

Related publications:

- **Luan, Chenyu; Gao, Zhen; Moan, Torgeir**. Design and Analysis of a Braceless Steel 5-MW Semi-Submersible Wind Turbine. In: *ASME 2016 35th International Conference on Ocean, Offshore and Arctic Engineering - Volume 6: Ocean Space Utilization; Ocean Renewable Energy*. ASME Press 2016 ISBN 978-0-7918-4997-2.
- **Sauder, Thomas Michel; Chabaud, Valentin Bruno; Thys, Maxime; Bachynski, Erin Elizabeth; Sæther, Lars Ove**. Real-time hybrid model testing of a braceless semi-submersible wind turbine. Part I: The hybrid approach. In: *ASME 2016 35th International Conference on Ocean, Offshore and Arctic Engineering - Volume 6: Ocean Space Utilization; Ocean Renewable Energy*. ASME Press 2016 ISBN 978-0-7918-4997-2.

SFI EXPOSED

Exposed Aquaculture Operations (SINTEF Ocean, former SINTEF Fisheries and Aquaculture AS)

NTNU responsible: Prof. Bjørn Egil Asbjørnslett (Bjorn.e.asbjornslett@ntnu.no)
Website: http://exposedaquaculture.no/en

The main objective of SFI EXPOSED is to develop knowledge and technologies for EXPOSED aquaculture operations, enabling the sustainable expansion of the fish farming industry. EXPOSED will develop knowledge and technology for robust, safe and efficient fish farming at exposed locations. The EXPOSED Centre brings together global leaders among salmon farmers, key service and technology providers, SINTEF Ocean representatives, and other robust research groups, including NTNU AMOS (the Norwegian Centre of Excellence for Autonomous Marine Operations and Systems) .

Eight initial projects have been selected for 2015-2016 and beyond. In 2015, an initial project (P1) documented the existing knowledge base and opportunities for innovation. Other projects have focused on developing methodology (P5), establishing research infrastructure (P8), carrying out preliminary studies (P4) and initiating research with PhD candidates (P6 and P7). Department of Marine Technology have several PhD candidates involved in research in the Centre, and more than 20 master students started their master thesis work in relation to the Centre's projects in 2016.

In 2016, the centre has arranged two days of "EXPOSED Days" in the spring, and a similar one-day event in the autumn. The "EXPOSED Days" serve as a meeting place for discussing innovation, presenting results, exchanging ideas, and creating new projects. There are a significant industrial, as well as political interest in EXPOSED and its objectives in 2016. This interest is driven by a combination of: An ambition to increase salmon production, given that key environmental challenges are addressed; Increasing salmon prices; Low oil prices and suppliers to the oil & gas sector looking for new markets; Industrial and political will to adapt competence and capacity from other industries in to seafood; A new opportunity for farmers to apply for development concessions regime that drives innovation towards technological concepts for more exposed farming.

Internationally, the topic of exposed sea farming raises significant interest. The research areas of the centre have been presented in various national and international forums to support future collaboration with other stakeholders.

SFI MOVE

Marine Operations (NTNU Ålesund)

NTNU IMT responsible: Prof. Svein Sævik (Svein.savik@ntnu.no)
Website: www.ntnu.edu/move

SFI MOVE aims to support the entire marine operations value chain by developing knowledge, methods and computer tools for safe and efficient analysis of both equipment and installation processes. The developed methods will be tested in simulated environments to both train individual users as well as improve team performance. The work is carried out in cooperation with NTNU Ålesund and SINTEF Ocean and in close cooperation with the industry partners.

The business focus areas are as follows:

- Demanding marine offshore operations, such as operations in ultra-deep water or arctic regions, or those requiring year-round availability
- Installation and maintenance of offshore wind
- Subsea mining

Active involvement from the industry is key to supporting the marine operation innovation process. An Industrial Advisor Group has been established to achieve needed industrial involvement and commitment and is composed of participants from companies in the consortium. This group develop an annual innovation plan, the first of which was established in the fall of 2015, then revised in 2016 for implementation in 2017.

The Industrial Advisory Group outlined major challenges and sub-projects to be executed by SFI MOVE. The following 5 innovation projects have been defined:

- Sub-pr. 1: OW, Low cost Offshore Wind Installation and Maintenance
- Sub-pr. 2: Subsea; Safe, All-Year, Cost Effective Subsea Operations
- Sub-pr. 3: Virtual Prototyping; Simulation Technology and Virtual Prototyping as a Common Approach from Design to Operation
- Sub-pr. 4: Seabed Mining; Exploration of Technologies to develop Seabed Mining as a new Business Area
- Sub-pr. 5: OW; Innovative Installation of Floating Wind Power Systems

The Industrial Advisory Group initiates projects through business cases and follows up on the results on an annual basis.

SFI MOVE runs for 8 years and include altogether 13 PhD and 8 postdoc positions.

SFI Smart Maritime

Norwegian Centre for Improved Energy Efficiency and Reduced Emissions from the Maritime Sector (SINTEF Ocean)

NTNU responsible: Prof. Bjørn Egil Asbjørnslett (Bjorn.e.asbjornslett@ntnu.no)
Website: www.smartmaritime.no

The SFI Smart Maritime is dedicated to improving energy efficiency and reducing harmful emissions from ships. With particular focus on the Norwegian Maritime Industry, our mission is to provide our partners with technologies, tools and capabilities for effective identification, assessment and verification of performance optimization solutions. The research focus is on technological solutions within hydrodynamics (hull and propellers) and machinery system (energy optimization, exhaust emissions and fuels). To test the effect of these technologies and measures on the ship performance, a ship-as-a-system approach is adopted, enabling the virtual design and optimization of a ship by means of numerical simulation models. To complete the ship performance analysis, life-cycle analysis is applied to assess the full economic viability and environmental impact of the new design.

In the first full year of operation, the Centre has focused its activity on exploring potential, state-of-the-art of technologies, and building first versions of simulation tools. Academic and industry collaboration has been covered in five technical sub-projects (SPs), complementary in terms of discipline as well as partner involvement, leading to the main scientific achievements presented in the SFI Smart Maritime annual report. The five sub-projects are: Main dimensions and hull form, Marine hybrid power systems; Fuel and abatement technologies; Energy saving devices and technology; Analysis of full-scale data; Simulation of long-term ship performance; and Ship transport environmental assessment model.

The Department of Marine Technology has several PhD candidates involved in research in the Centre, and several master students started their master thesis work in relation to the Centre's projects in 2016.

The web page www.smartmaritime.no has been populated with general information, publications and status reports. An e-mail newsletter was launched and is now released regularly.

Sustainable Arctic Marine and Coastal Technology (SAMCoT)

Researchers from IMT: Professors Roger Skjetne (Roger.skjetne@ntnu.no), Ingrid B. Utne (Ingrid.b.utne@ntnu.no) and Jørgen Amdahl (Jorgen.amdahl@ntnu.no)
Website: www.ntnu.edu/samcot

The research centre CRI SAMCoT is a Centre for Research-based Innovation for the development of robust technology necessary for sustainable exploration and exploitation of the valuable and vulnerable Arctic region. Its lead partner is the NTNU Department of Civil and Transport Engineering.

It was awarded to NTNU and started in 2011, with a duration of 4+4 years, and it successfully passed the midterm evaluation in 2015. The vision is to become a "Leading international centre for the development of robust technology needed by the industry operating in the Arctic region."

OCEAN SPACE CENTRE

NTNU contact: Prof. Sverre Steen (Sverre.steen@ntnu.no)
Website: www.oceanspacecentre.no/english

The revised concept for Ocean Space Centre, with separate test basin for seakeeping and offshore, and with a flexible small lab area for the NTNU IMT was compared against the previous alternative with one long basin that could be divided in three by movable gates by DNV GL and Menon in a limited conceptual study ("Konseptvalgutredning", KVU). DNV GL and Menon concluded that the revised concept had similar cost but improved functionality compared to the previous alternative. They also concluded that the planned laboratories will be profitable for the society. Their conclusions will be verified in 2017 in the formal quality assurance (KS1), which must be passed before the planning of the new centre can continue.

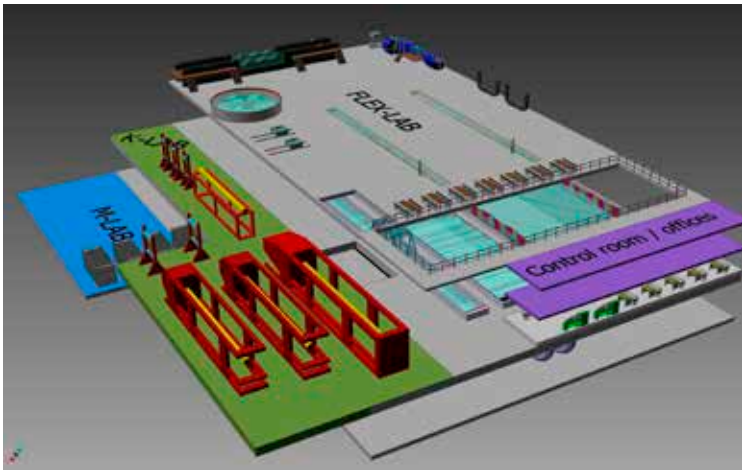


Figure 17: Flexible lab area for research and education proposed for the Ocean Space Centre.

STRATEGIC RESEARCH AREA NTNU OCEANS

Director: Prof. Ingrid Schjølberg (Ingrid.schjolberg@ntnu.no)
Coordinator: Alexandra Neyts (Alexandra.neyts@ntnu.no)
EU Manager: Anastasios Lekkas (Anastasios.lekkas@ntnu.no)
Website: www.ntnu.edu/oceans

NTNU Oceans is one of four strategic research areas at NTNU. The Faculty of Engineering Science and Technology and the Department of Marine Technology host NTNU Oceans for NTNU.

The overall vision of NTNU Oceans is knowledge for a sustainable use of the oceans. The focus is on science and technology for polar regions, deep ocean operations and exploration, marine minerals, bio marine resources and maritime transport. NTNU Oceans builds multidisciplinary research across knowledge fields. The fields of ICT, biotechnology, advanced materials, safety and risk management provide essential knowledge and tools. The ocean environment, policy, governance, society and humanities are key factors to ensure sustainable knowledge development.

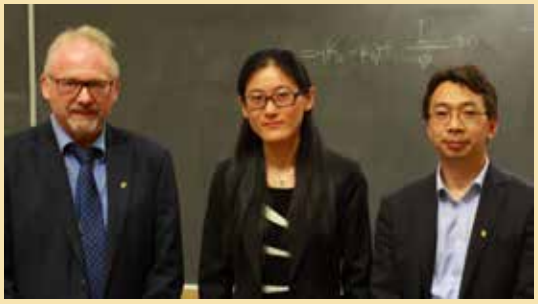
In 2016, three major pilot projects are running.

- Deep Sea Mining, including more than 17 PhD and postdoc positions addressing ethics, geophysics, environmental issues, geological processes, history of sea laws and concept development for retrieving marine minerals.
- Eco-intensive Aquaculture, more than 12 PhD and postdoc positions addressing biological aspects such as lice and algae development, waste management, water column and seafloor effects, life cycle aspects and technology development for sustainable aquaculture.
- Norway as a sea nation will establish a deeper knowledge base on the dynamic interplay between education, identity, society and industry across generations and coastal communities.
- Risk and reliability in artic environment. The main research question is how to achieve a sufficient safety level in arctic operations and technology with little available ice data.

RESEARCH FACILITIES

	Facility	Description	Operational institution	Website
1	Ocean basin	LxWxD = 70m x 50m x 10m; waves from two directions, variable water depth, winds and currents	MARINTEK	**https://www.ntnu.edu/imt/lab/ocean**
2	Large towing tank (tank I+III)	LxWxD = 260m x 10m x 5m - 10m; waves in the direction of the tank, two carriages, max 10m/s	NTNU and MARINTEK	**https://www.ntnu.edu/imt/lab/towing**
3	Cavitation laboratory	Circulating water tunnel with controlled pressure; measurement section of 1.2m in diameter, velocity up to 12m/s	NTNU and MARINTEK	**https://www.ntnu.edu/imt/lab/cavitation**
4	Circulating water tunnel	Used for flow visualization, PIV and LDV measurements in connection with student exercises and PhD research projects	NTNU	**https://www.ntnu.edu/imt/lab/cwt**
5	Small towing tank	LxWxD = 25m x 2m x 1m; towing tank for educational purposes	NTNU and MARINTEK	**https://www.ntnu.edu/imt/lab/towing**
6	Marine cybernetics laboratory (MC-lab)	LxWxD = 35m x 3.5m x 1.6m; waves from one direction, advanced towing carriage and instrumentation for control system experiments	NTNU	**https://www.ntnu.edu/imt/lab/cybernetics**
7	Marine HIL simulation laboratory	Hardware-In-The-Loop (HIL) simulation lab for students and researchers to verify their HW/SW setups, signal communication, user interfaces, and test scenarios in real time for bugs and weaknesses prior to conducting actual time-limited experiments	NTNU	**https://www.ntnu.edu/imt/lab/hil**
8	Wave tank	LxWxD = 13m x 0.6m x 1m; for 2-D studies of wave kinematics	NTNU	-
9	Marine structures laboratory	Static and dynamic testing of structures and structural components	NTNU and MARINTEK	**https://www.ntnu.edu/imt/lab/structures**
10	Machinery laboratory	Equipment for testing of marine engines, fuel, and new concepts	NTNU and MARINTEK	**https://www.ntnu.edu/imt/lab/machinery**
11	Hybrid power laboratory	Combined power and simulation lab for testing novel marine power plants	NTNU and MARINTEK	**https://www.ntnu.edu/imt/lab/hybrid**
12	Applied underwater robotics laboratory (AUR-lab)	Two remotely operated underwater vehicles (ROV), one autonomous underwater vehicle (AUV), research vessel Gunnerus and associated instrumentation systems	NTNU	**https://www.ntnu.edu/aur-lab**
13	Unmanned aerial vehicles laboratory (UAV-lab)	Unmanned aerial vehicles and open-source guidance, navigation, control, and communication systems, payload sensors, simulators, test fields, crew, and support systems	NTNU	**http://www.itk.ntnu.no/english/lab/unmanned**
14	Aquaculture engineering laboratory (ACE)	Large-scale laboratory facility designed to develop and test new aquaculture technologies	SINTEF Fisheries & Aquaculture, NTNU and more	**http://www.sintef.no/en/all-laboratories/ace/**
15	Flume tank	LxWxD = 2.5m x 0.61m x 0.61m; flume with a test section, velocity of 0.03-1.0m/s, laminar flow	SINTEF Fisheries & Aquaculture	**www.sintef.no/en/fisheries-and-aquaculture/about-us2/laboratories/sintef-fisheries-and-aquaculture-flume-tank/**

AWARDS AND HONOURS



Prof. Moan graduates his 75th PhD candidate

Prof. Torgeir Moan graduated his 75th PhD candidate, Lin Li, on 31 May 2016 at the Marine Technology Centre in Trondheim. Dr Li's thesis is entitled "Dynamic Analysis of the Installation of Monopiles for Offshore Wind Turbines".

Figure 18: From the left: Prof. Torgeir Moan, Dr Lin Li and Dr Li's co-supervisor Prof. Zhen Gao. Photo: Jon Are Nilsen, NTNU.

PhD graduate Arnt G. Fredriksen named Europe's most talented engineer

Dr Arnt G. Fredriksen was named the most talented engineer in the yearly engineering competition organized by the European federation of Engineering Consultancy Associations (EFCA).

Find more information about the honour in Teknisk Ukeblad: **Norsk ingeniør hedret i internasjonal konkurranse**, 3 June 2016

Figure 19: Dr Arnt G. Fredriksen at the EFCA Conference 2016. Photo: Liv Kari Hanseteen.

Prof. Martin Ludvigsen receives the Kom-Award

Prof. Martin Ludvigsen received the Kom-award and the title "Best Communicator of the Year" from the Faculty of Engineering Science and Technology at the annual party of the Faculty of Engineering Science and Technology 26 October 2016 at Banksalen in Trondheim for doing an excellent job communicating his research to a wider audience.

Figure 20: Prof. Martin Ludvigsen with the Kom-Award. Photo: NTNU.

Prof. Torgeir Moan is awarded the Davidson Medal

Figure 21: From the left: SNAME Vice-president Prof. Apostolos Papanikolaou, Prof. Torgeir Moan and SNAME president Mr. Joseph Comer. Photo: Sergio Pantoja/SNAME.

The Society of Naval Architects and Marine Engineers (USA) awarded the Davidson Medal to NTNU AMOS adviser Prof. Torgeir Moan for "Outstanding Scientific Accomplishment in Ship Research." He was handed the medal during an award ceremony at the SNAME Annual Meeting in Seattle on 3 November 2016.

Prof. Odd M. Faltinsen held the **24th Wallace Lecture in Ocean Sciences and Engineering** about sloshing at the Massachusetts Institute of Technology (MIT), Department of Mechanical Engineering, on 1 April 2016.

Prof. Asgeir J. Sørensen receives the SOBENA International Award

Figure 22: Prof. Sørensen's SOBENA International Award 2016.

Like Prof. Torgeir Moan and Prof. Odd M. Faltinsen before him, Prof. Asgeir J. Sørensen received the SOBENA International Award in recognition for his outstanding contribution to the progress of naval architecture and ocean engineering. Prof. Sørensen was handed the award at the biannual conference of SOBENA, the Brazilian Society of Naval Architecture, Marine and Offshore Engineering, on 9 November 2016 in Rio de Janeiro. **Find more information about the honour on NTNU AMOS's webpage**

PhD candidate Peng Li receives the Chinese Government Award for Students Abroad

PhD candidate Peng Li received the "Chinese Government Award for Outstanding Self-financed (non-government sponsored) Students Abroad". His supervisors are Profs. Faltinsen, Greco and Lugni.

The award is handed out by the Chinese Scholarship Council (CSC) to honour overseas Chinese PhD candidates with outstanding academic accomplishment across all academic disciplines. It is based on academic merit and encourages Chinese PhD candidates abroad to achieve first-class results during their studies. The winners are selected for their academic and research work through a rigorous evaluation process.

IMT researchers receive the NOWITECH Innovation Award 2016

Figure 23: From the left: PhD candidate Thomas Sauder, Adj. Assoc. Prof. Erin E. Bachynski, MARINTEK researcher Maxime Thys, PhD candidate Valentin Chabaud, committee chair Oddbjørn Malmo from Kongsberg Maritime and John Olav Tande from SINTEF Energy Research. Photo: Hans Christian Bolstad, SINTEF.

Find more information about the honour in the blog from SINTEF Energy: **NOWITECH Innovation Award 2016**, 16 June 2016

Best paper award

Prof. Trygve Kristiansen received the award for the best paper of the offshore technology symposium at the OMAE-conference 2015. The award was presented to him at OMAE 2016 in Busan, South-Korea, 19-24 June 2016.

Kristiansen, Trygve; Ommani, Babak; Berget, Kjetil; Baarholm, Rolf Jarle. An experimental and numerical investigation of a box-shaped object in moonpool; a three-dimensional study. 34th International Conference on Ocean, Offshore and Arctic Engineering (OMAE 2015); 2015-05-31 - 2015-06-05

For more information about the achievements listed in this chapter as well as to retrieve more IMT news, visit:

www.ntnu.edu/imt/newsandevents

Team NTNU wins twice 3rd place at the Hydrocontest 2016

At HydroContest 2016 in July, team NTNU won 3rd place in the heavyweight category against team HEIA-Fr. In addition, they finished 3rd in the long distance race.

Read more on **the team's facebook page**

Figure 24: Master students from team NTNU won 3rd place twice at the HydroContest 2016: in the heavyweight category as well as in the long distance race. Photo: Team NTNU, Hydrocontest.

Spin-off company BluEye wins innovation award

Figure 25: Spin-off company BluEye wins the innovation award "Trøndelagsmøtets gründerpris" among 9 nominated companies. From the left: Erik Dyrkooren (BlueEye), the Norwegian Minister of Foreign Affairs Børge Brende, Christine Spliten (BluEye) and Eli Arnstad (director in SpareBank1 SMN). Photo: Trønder-Avisa.

Find more information in Trønder-Avisa: **Dyp idé vant gjev innovasjonspris**, 14 January 2016

Moan-Faltinsen Best Paper Awards

This year's Moan-Faltinsen Best Paper Awards were presented at MARINTEK's and NTNU's Christmas lunch on 21 December 2016 at the Marine Technology Centre.

Peng Li was the recipient of the award within marine hydrodynamics for his paper "Nonlinear vertical accelerations of a floating torus in regular waves", published in the *Journal of Fluids and Structures* (2016, 66: 589-608) and co-authored by Prof. Odd M. Faltinsen and Adj. Prof. Claudio Lugni.

Ming Song received the award within marine structures for her paper "A comparative analysis of the fluid-structure interaction method and the constant added mass method for ice-structure collisions", published in *Marine Structures* (2016, 49: 58-75) and co-authored by Dr Ekaterina Kim, Prof. Jørgen Amdahl, Jun Ma and Yi Huang.

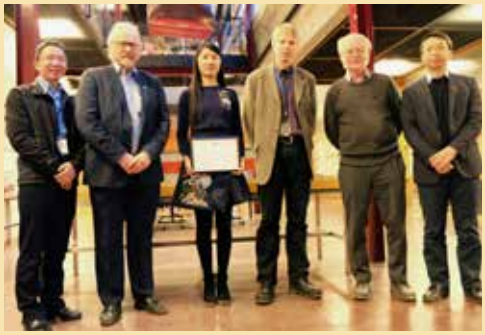


Figure 26: Left photo from the left: Naiquan Ye, Prof. Torgeir Moan, Ming Song, Prof. Sverre Steen, Prof. Odd M. Faltinsen and Prof. Zhen Gao. Right photo from the left: Peng Li and Prof. Odd M. Faltinsen. Photos: Kun Xu, NTNU.

APPENDICES

Staff

Academic staff, permanent

Name	Position
Aanondsen, Svein Aanond	Assistant Professor
Amdahl, Jørgen	Professor
Asbjørnslett, Bjørn Egil	Professor
Bachynski, Erin E.	Associate Professor
Digernes, Torbjørn	Professor
Erikstad, Stein Ove	Professor
Gao, Zhen	Professor
Greco, Marilena	Professor
Haugen, Stein	Professor
Holm, Håvard	Associate Professor
Holmedal, Lars Erik	Professor
Kiendl, Josef	Associate Professor
Kristiansen, Trygve	Professor
Lauritzsen, Kristin	Assistant Professor
Leira, Bernt Johan	Professor
Ludvigsen, Martin	Professor
Myrhaug, Dag	Professor
Pedersen, Eilif	Associate Professor
Pettersen, Bjørnar	Professor
Schjølberg, Ingrid	Professor
Skjetne, Roger	Professor
Sævik, Svein	Professor
Sørensen, Asgeir Johan	Professor
Utne, Ingrid Bouwer	Professor
Ushakov, Sergey	Professor
Vinnem, Jan Erik	Professor
White, Maurice Furneaux	Professor
Ås, Sigmund Kyrre	Professor

Administrative staff

Name	Position
Bremvåg, Annika	Higher Executive Officer
Ellingsen, Harald	Professor & Head of Dept. until summer 2016
Gripp, Jannike	Executive Officer
Hansen, Astrid Elisabeth	Head of Office
Karoliussen, Renate	Senior Executive Officer
Kristiansen, Lasse	Project Manager
Mahic, Sanda	Higher Executive Officer
Mørkve, Kristin Johansen	Senior Executive Officer
Neyts, Alexandra	Project Manager
Nordtiller, Marit	Higher Executive Officer
Petersen, Trond I.	Higher Executive Officer
Steen, Sverre	Professor & Head of Dept. from summer 2016
Wesoly, Dorota	Higher Executive Officer
Wold, Sigrid Bakken	Senior Executive Officer
Østhus, Oddny Kristine	Senior Executive Officer

Technical staff

Name	Position
Aamot, Kristian	Head Engineer
Bach, Bjørn Tore	Head Engineer
Bakken, Cato	Apprentice
Bratlie, Emil	Head Engineer
Bremset, Gunnar	Engineer
Dahl, Magnus	Apprentice
De la Torre O., Pedro R.	Head Engineer
Egseth, Martin	Apprentice
Fleischer, Eirik	Head Engineer
Gran, Frode	Head Engineer
Innset, Trond	Staff Engineer
Jalali, Mostafa	Staff Engineer
Johnsen, Marcus	Apprentice
Lines, Johan Terje	Engineer
Loe, Tor Magnus	Apprentice
Minde, Kristian	Staff Engineer
Paulsen, Oddvar	Staff Engineer
Rosten, Terje	Head Engineer
Rønning, Veronika	Apprentice
Selven, Mats Johan S.	Engineer
Skarpnes, Kay Arne	Staff Engineer
Vinje, Ole Erik	Engineer
Volden, Frode	Head Engineer
Wahl, Torgeir	Head Engineer
Aasen, Einar Magnus	Head Engineer

Academic staff, temporary

Name	Position
Abbasi-Hoseini, Afshin	Postdoctoral Fellow
Abrahamsen-Prsic, Mia	Postdoctoral Fellow
Balland, Océane	Adjunct Associate Professor
Bar, Eirin M. S.	Postdoctoral Fellow
Bindingsbø, Arne Ulrik	Adjunct Professor
Brett, Per Olav	Adjunct Professor
Bø, Torstein I.	Postdoctoral Fellow
Bøckmann, Eirik	Postdoctoral Fellow
Chabaud, Valentin Bruno	Postdoctoral Fellow
Chai, Wei	Postdoctoral Fellow
Cheng, Zhengshun	Postdoctoral Fellow
Dumke, Ines	Postdoctoral Fellow
Ehlers, Sören	Adjunct Professor
Eliassen, Lene	Postdoctoral Fellow
Fagerholt, Kjetil	Adjunct Professor
Faltinsen, Odd Magnus	Professor
Fredheim, Arne	Adjunct Professor
Hagen, Arnulf	Adjunct Professor
Hassani, Vahid	Adjunct Associate Professor
Haver, Sverre	Adjunct Professor
Jafarzadeh, Sepideh	Postdoctoral Fellow
Jiang, Fengjian	Postdoctoral Fellow
Jiang, Zhiyu	Postdoctoral Fellow
Kim, Ekaterina	Postdoctoral Fellow
Koushan, Kourosh	Adjunct Professor
Kozlowska, Anna M.	Researcher
Krokstad, Jørgen	Adjunct Professor
Larsen, Kjell	Adjunct Professor
Lefebvre, Nicolas	Researcher
Lekkas, Anastasios	Researcher
Longva, Vegard	Researcher
Lugni, Claudio	Adjunct Professor
Malmquist, Christian	Researcher
Moan, Torgeir	Professor
Mosleh, Ali	Adjunct Professor
Nielsen, Ulrik Dam	Adjunct Associate Professor
Pettersen, Sigurd S.	Researcher
Piehl, Henry Peter	Postdoctoral Fellow
Rasekhi Nejad, Amir	Postdoctoral Fellow
Riska, Kaj A.	Adjunct Professor
Rustad, Anne Marthine	Adjunct Associate Professor
Sadjina, Severin Simon	Postdoctoral Fellow
Sha, Yanyan	Postdoctoral Fellow
Shi, Wei	Postdoctoral Fellow
Skejic, Renatp	Postdoctoral Fellow
Søreide, Fredrik	Adjunct Professor
Thorsen, Mats Jørgen	Postdoctoral Fellow
Todalshaug, Jørgen Hals	Researcher
Tymokha, Oleksandr	Researcher
Wang, Hong	Postdoctoral Fellow
Wei, Zhijun	Researcher

PhD candidates, financed by IMT and/or CeSOS*

Name	Country
Afzal, Mohammad Saud	India
Alwan, Sabah Nouri Jasem	Australia
Arnesen, Bent Oddvar	Norway
Bardestani, Mohsen	Iran
Bergström, Martin	Finland
Bjørnø, Jon	Norway
Bore, Pål Takle	Norway
Brandtsegg, Andreas Saur	Norway
Brodtkorb, Astrid H.	Norway
Candeloro, Mauro	Italy
Cho, Seongpil	South Korea
Choi, Minjoo	South Korea
Dahl, Andreas Reason	Norway
Dalheim, Øyvind Ø.	Norway
Das, Jitapriya	India
Eidsvik, Ole A.	Norway
Erceg, Boris	Croatia
Erceg, Sandro	Croatia
Fekete, Balázs	Hungary
Fossum, Trygve Olav	Norway
Fu, Ping	China
Gavrilin, Sergey	Russia
Ghane, Mahdi	Iran
Giske, Finn-Idar G.	Norway
Godø, John Martin K.	Norway
Guachamin Acero, Wilson I.	Ecuador
Gunnu, Giriraja Sekhar	India
Gutsch, Martin	Norway

Name	Country
Hanssen, Finn-Christian W.	Norway
Hassel, Martin	Norway
He, Zhao	China
Horn, Jan-Tore Haugan	Norway
Hegde, Jeevith	India
Heyn, Hans-Martin	Germany
Hogenboom, Sandra	Netherlands
Holen, Siri Marianne	Norway
Holmen, Ingunn Marie	Norway
Hoseini Dadmarzi, Fatemeh	Iran
Jørgensen, Erlend K.	Norway
Knudsen, Tore H.	Norway
Kramer, Jarle Andre	Norway
Krivopolianskii, Vladimir	Russia
Li, Lin	China
Li, Peng	China
Li, Quinyuan	China
Luan, Chenyu	China
Ma, Shaojun	China
McGuinness, Edgar John	Ireland
Mentzoni, Fredrik	Norway
Milakovic, Aleksandar-Sasa	Croatia
Miyazaki, Michel Rejani	Brazil
Nam, Woongshik	South Korea
Natskår, Asle	Norway
Nielsen, Jørgen B.	Norway
Norgren, Petter	Norway
Nornes, Stein M.	Norway
Pedersen, Morten Dinhoff	Norway
Ravinthrakumar, Senthuran	Norway
Proserpio, Davide	Italy
Rehn, Carl Fredrik	Norway
Ren, Zhengru	China
Rivera Medina, Ausberto	Peru
Rokseth, Børge	Norway
Sandvik, Endre	Norway
Sandøy, Stian S.	Norway
Shen, Yugao	China
Siddiqui, Mohd A.	India
Singh, Dig Vijay	India
Skjong, Stian	Norway
Smilden, Emil	Norway
Sture, Øystein	Norway

Name	Country
Souza, Carlos E. S. de	Brazil
Stovner, Bård Nagy	Norway
Strand, Ida M.	Norway
Strandenes, Håkon	Norway
Sørum, Stian S.	Norway
Taskar, Bhushan	India
Thieme, Christoph A.	Germany
Thorat, Laxminarayan	India
Tõns, Tõnis	Estonia
Ueland, Einar S.	Norway
Ulveseter, Jan Vidar	Norway
Verma, Amrit S.	India
Viuff, Thomas	Denmark
Værnø, Svenn Are Tutturen	Norway
Wan, Ling	China
Wu, Xiaopeng	China
Yu, Zhaolong	China
Yum, Kevin Koosup	South Korea
Zhao, Yuna	China
Ødegård, Øyvind	Norway

**Note: This list only includes PhD candidates who are financed by the Department of Marine Technology (IMT) and/or CeSOS. There are other PhD candidates who work at the department who are financed otherwise and are not listed here.*

Nationality and gender distribution of PhD candidates

In 2016, the Department of Marine Technology had 90 PhD candidates*, of whom 9 were female. The geographical distribution of the origin of PhD candidates was as follows:

- Norway: 46 %
- Other European countries: 14 %
- China: 14 %
- Other Asian countries: 20 %
- South America & Australia: 6 %

Professor emeritus

Berge, Stig	Minsaas, Knut Johan
Endal, Anders	Rasmussen, Magnus
Karlsen, Ludwig	Sillerud, Bjørn Oskar
Kristiansen, Svein	Valland, Harald
Larsen, Carl Martin	Westby, Ola

The Department's Economy

Distribution of financial contribution

The income of the department of marine technology is generated from two primary sources:

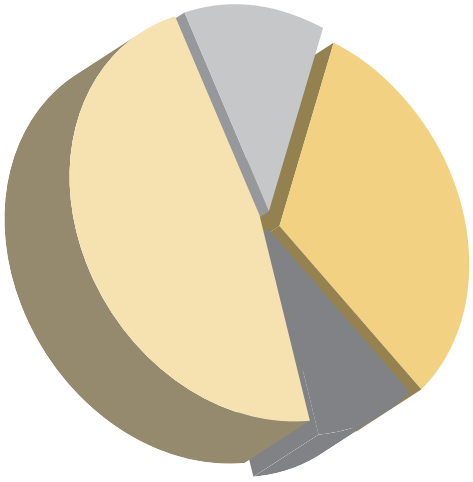
- funding from the government for normal operations and strategic restructuring
- external funding from private and public contributors for both commissioned and sponsored projects

The governmental funding is relatively stable. However, as it depends on both the quality and the quantity of research results, there are some variations in time. Income from commissioned and sponsored projects varies with the economic situation in the industry.

Distribution of cost categories

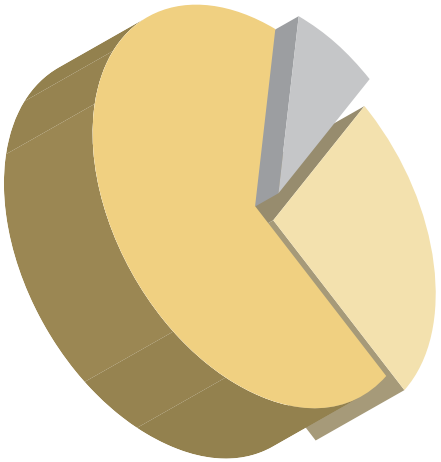
Zero-based budgeting is used, having the costs adjusted to the income level. Salary and social costs make up over 65% of the total costs.

Income 2016



- Funds normal operation MNOK 51.6
- Funds for strategic restructuring MNOK 19.5
- External funding MNOK 75.5
- Other income MNOK 14.5

Cost allocation 2016



- Investments MNOK 12.4
- Salary and social costs MNOK 107.4
- Other operating costs MNOK 40.8

Research Projects

European projects

Project	Programme
AQUAEXCEL 2020: AQUAculture Infrastructures for EXCELlence in European Fish Research towards 2020	Horisont 2020
Blue Mining: Breakthrough Solutions for the Sustainable Expliration and Extraction of Deep Sea Mineral Resources	7th Framework Programme (European Union)
COLUMBUS: Monitoring, Managing and Transferring Marine and Maritime Knowledge for Sustainable Blue Growth	Horisont 2020
Hydralab IV: A Network Dealing with the Complex Interaction of Water with Environmental Elements, Sediment, Structures and Ice	7th Framework Programme (European Union)
HyDynPro: Hydroelastic Effects and Dynamic Response of Propellers and Thrusters	Era-Net MARTEC Project HyDynPro
MARE-WINT: New Materials and REliability in Offshore WINd Turbines Technology	7th Framework Programme (European Union: Marie Curie)
MARINA: A Platform Project to Establish a Set of Equitable and Transparent Criteria for the Evaluation of Multi-purpose Platforms for Marine Renewable Energy	7th Framework Programme (European Union: ENERGY)
SWARMs: Smart and Networking Underwater Robots in Cooperation Meshes	ECSEL (European Union)

National projects

Project	Programme
Air-sea Interaction and Transport Mechanisms in the Ocean	RCN (FRINATEK)
Arctic Field Logistic and Transarctic Shipping	Ministry of Foreign Affairs (MFA B2020)
Arctic DP: Safe and Green Dynamic Positioning Operations of Offshore Vessels in an Arctic Environment	RCN (KMB)
Brohode Frøya	Innovation Norway & Sør-Trøndelag County Authority
Corrosion Fatigue of Armor Wire	Statoil ASA
Design and Verification of Control Systems for Safe and Energy-efficient Vessels with Hybrid Power Plants (D2V)	RCN (KMB)
Development of a Significantly More Efficient and Eco-friendly Fishing Vessel (ECOFIVE)	RCN
Dimensioning Sea Loads on Offshore Wind Turbines in Shallow to Intermediate Waters (DIMSELO)	RCN
Enabling Technology Providing Knowledge of Structure, Function and Production in a Complex Coastal Ecosystem (ENTiCE)	RCN (MARINFORSK)
Et Fullskalalaboratorium eller Testing av Fremtidens Marine Teknologi i Tett Samarbeid Mellom Næring og Akademia (F/F Gunnerus)	RCN (BIP)
Exploitation Technologies for Marine Minerals on the Extended Norwegian Continental Shelf (MarMine)	RCN (BIA)
Fergefri E39 - Forskning Knyttet til Flytebruer og Flytende Nedsenkede Tunneler fra 2014	Norwegian Public Roads Administration
FIV & VIV in Ultra-deep Waters	UIT Solutions
Follow-up JIP on Nonlinear FE-methods for Determination of Structural Capacity	DNV GL

Project	Programme
Forprosjekt Risiko Norske Skip	Norwegian Maritime Authority
Full Scale Performance Prediction for Energy Efficient Ship Design (PropScale)	RCN (KPN)
Handling Uncertainty in the Design of Ocean Engineering Systems (SIMOSYS)	RCN (KPN)
Holistic Risk-based Design for Sustainable Artic Sea Transport (RISKAT)	RCN (KPN)
Joint Centre of Excellence for Arctic Shipping and Operations	Lloyd Register Foundation
JPIO-cruise Participation on Cruise Leg SO242-1 on the "Ecological Aspects of Deep Sea Mining" Cruise for NTNU	RCN
Kjedet Flytebru	RCN (BIA)
Low Energy and Emission Design of Ships (LEEDS)	RCN (KMB)
Maritime Logistics Fleet Size and Mix (MARFLIX)	RCN (KMB)
National Ship Risk Model	RCN (SMARTRANS)
Next Generation Subsea Inspection, Maintenance and Repair (NextGenIMR)	RCN (KPN)
Prediction of ICE-ship-interaction (PRICE)	RCN (MARTEC)
Qualitative Assessment North Rankin Alpha	Alliance Engineering Consultant Pty. Ltd
Real-time Hybrid Model Testing for Extreme Marine Environments	RCN (MAROFF-2)
Reducing Risk in Aquaculture - Improving Operational Efficiency, Safety and Sustainability	RCN
Safe, Environmental Friendly, and Cost Effective Operation of Vessels and Installations in the Arctic	RCN (BIA)
Centre of Sustainable Arctic Marine and Coastal Technology (SAMCoT)	RCN
Sea Trials and Model Test for Validation of Shiphandling Simulation Models (SimVal)	RCN (KPN)
SES Service Fartøy for Vindmølleparker til Havs	RCN (MAROFF-2)
SFI Exposed Aquaculture Operations	RCN (SFI)
SFI Marine Operations (MOVE)	RCN (SFI)
SFI Smart Maritime - Norwegian Centre for Improved Energy-efficiency and Reduced Emissions from the Maritime Sector	RCN (SFI)
Ship Concepts for Harvesting Recovery and Storage of Energy (HRS-Ship)	RCN (BIP)
Sustainable Design of Ships for the Future (SHIP-4C)	RCN (KMB)
SUSTAINFARMEX - Towards Sustainable Fish Farming at Exposed Marine Sites	RCN (KMB)
University Technology Centre (UTC): Providing an Integrated and Validated Approach to "Performance in a Seaway"	Rolls-Royce Marine AS
Virtual Prototyping of Marine Systems and Operations (ViProMa)	RCN (KPN)
WaveSpring - Discovery Verification	Aalborg University

BIA: User-driven innovation platform (Brukerstyrt innovasjonsarena)
BIP: User-driven innovation project (Brukerstyrt innovasjonsprosjekt)
FRINATEK: Independent projects in mathematics, natural sciences and technology under the FRIPRO funding scheme
KPN/KMB: Knowledge building project for the industry (Kompetanseprosjekter for næringslivet)
RCN: Research Council of Norway
SFI: Centre for Research-based Innovation
SMARTRANS: Næringslivets transporter og ITS

PhD Degrees

Date	Name	Gender	Title of the thesis	Country	Main supervisor
14/01/2016	Vincentius Rumawas	M	Human Factors in Ship Design and Operation: An Experimental Learning	Indonesia	Bjørn Egil Asbjørnslett
19/01/206	Martin Storheim	M	Structural Response in Ship-platform and Ship-ice Collisions	Norway	Jørgen Amdahl
29/02/2016	Mia Abrahamsen-Prsic	F	Numerical Simulations of the Flow around Single and Tandem Circular Cylinders Close to a Plane Wall	Croatia	Bjørnar Pettersen
22/04/2016	Tufan Arslan	M	Large-eddy Simulations of Cross-flow around Ship Sections	Turkey	Bjørnar Pettersen
13/05/2016	Pierre-Yves Henry	M	Parametrisation of Aquatic Vegetation in Hydraulic and Coastal Research	France	Dag Myrhaug
31/05/2016	Li Lin	F	Dynamic Analysis of the Installation of Monopiles for Offshore Wind Turbines	China	Torgeir Moan
31/05/2016	Øivind Kåre Kjerstad	M	Dynamic Positioning of Marine Vessels in Ice	Norway	Roger Skjetne
10/06/2016	Xiaopeng Wu	M	Numerical Analysis of Anchor Handling and Fish Trawling Operations in a Safety Perspective	China	Torgeir Moan
16/06/2016	Zhengshun Cheng	M	Integrated Dynamic Analysis of Floating Vertical Axis Wind Turbines	China	Torgeir Moan
22/08/2016	Ling Wan	M	Experimental and Numerical Study of a Wave Energy Converter Concept	China	Torgeir Moan
26/08/2016	Wei Chai	M	Stochastic Dynamic Analysis and Reliability Evaluation of the Roll Motion for Ships in Random Seas	China	Bernt Leira
31/08/2016	Øyvind S. Patricksson	M	Decision Support for Conceptual Ship Design with Focus on a Changing Life Cycle and Future Uncertainty	Norway	Stein Ove Erikstad
15/09/2016	Mats Jørgen Thorsen	M	Time Domain Analysis of Vortex-induced Vibrations	Norway	Svein Sævik
04/10/2016	Edgar McGuinness	M	Safety in the Norwegian Fishing Fleet – Analysis and Measures for Improvement	Irland	Ingrid Utne
18/11/2016	Sepideh Jafarzadeh	F	Energy Effiency and Emission Abatement in the Fishing Fleet	Iran	Harald Ellingsen
02/12/2016	Wilson Ivan Guachamin Acero	M	Assessment of Marine Operations for Offshore Wind Turbine Installation with Emphasis on Response-based Operational Limits	Ecuador	Torgeir Moan
08/12/2016	Mauro Candeloro	M	Tools and Methods for Autonomous Operations on Seabed and Water Column Using Underwater Vehicles	Italy	Asgeir Sørensen
13/12/2016	Valentin Chabaud	M	Real-time Hybrid Model Testing of Floating Wind Turbines	France	Sverre Steen

Master Degrees

Name	Topic	Supervisor
Ai, Peng	Design and Hydrodynamic Analysis of a Semi-submersible with Two 5WM Wind Turbines	Gao, Zhen
Alm, Thomas Gløersen	A Method for Determining the Mode Shapes from a Finite Element Model for Use in a Finite-mode Vibration Simulation Model	Pedersen, Eilif
Andreassen, Elisabeth	Development of a New Total Risk Indicator for the Trends in Risk Level Project (RNNP)	Vinnem, Jan Erik
Armstrong, Michael Andrew	Seismic Inversion for Identification of Soil Stiffness and Damping for Offshore Wind Turbines	Moan, Torgeir
Arnesen, Bent Oddvar	Motion Control Systems for ROVs	Schjølberg, Ingrid
Bay, Martine Gripp	Assessment of Marine Riser Joints During Offshore Drilling Operation	Sævik, Svein
Birkeland, Fride Midtbø	Numerical Simulation of Installation of XL Monopile for Offshore Wind Turbines	Leira, Bernt Johan
Biørn-Hansen, Einar	Coupling of a 2D Boundary Element Method with a Local Analytical Solution to Deal with Geometrical Singularities	Greco, Marilena
Bjerkelund, Kristoffer	Fabrication of the Hywind Substructure	Leira, Bernt Johan
Bjørnø, Jon	Thruster-assisted Position Mooring of C/S Inocean Cat I Drillship	Skjetne, Roger
Borlet, Rémi Marcel	Design and Optimization of Mooring Systems for Floating Wind Turbines	Larsen, Kjell
Brusletto, Lars Sletbakk	Computer Vision Based Obstacle Avoidance for a Remotely Operated Vehicle	Ludvigsen, Martin
Bua, Nils Haktor	Sway Control on a Surface Effect Ship	Hassani, Vahid
Bøhn, Alexandra	Fatigue Loads on Large Diameter Offshore Wind Monopile Foundations in Non-operational Situations	Krokstad, Jørgen Ranum
Dai, Yukun	Numerical Simulation of Flow around Single and Two side-by-side Square Cylinders with Horizontal Offsets Mounted on the Seafloor	Myrhaug, Dag
Deng, Shi	Numerical Simulations for Lift-off Operation of an Offshore Wind Turbine Monopile	Gao, Zhen
Dickens, Magnus	Design of Value Robust Container Ship Using the Responsive System Comparison Method	Asbjørnslett, Bjørn Egil
Dokmo, Hanne Bjørkås	Developing a Risk Model for Fire in Passenger Ships	Haugen, Stein
Eliassen, Agnes Karin	Assessment of Pipeline Integrity after Trawling Impact by Investigating Dent with Gouge	Ås, Sigmund Kyrre
Emblemsvåg, Øyvind Andre Hagen	Numerical Simulations of Flow around a Simplified Hull Form	Holm, Håvard
Espedal, Mikal Hansson	Numerical Analysis of a Floating Wind Turbine	Kristiansen, Trygve
Finstad, Christian B	Peak-shaving Control of Loads on Diesel-generators in Hybrid Electric Ships	Skjetne, Roger
Frederich, Preben	Constrained Optimal Thrust Allocation for C/S Inocean Cat I Drillship	Skjetne, Roger
Frimanslund, Erik Kristian Thon	Feasibility of Deep-sea Mining Operation Within Norwegian Jurisdiction	Ludvigsen, Martin
Grindstad, Anne Cecilie	Jordmodeller og Utmatning av Fritthengende Stigerør	Sævik, Svein

Name	Topic	Supervisor
Hafstad, Jens Mjøen	Numerical Investigation of Collapse and Ductile Fracture in X65 Offshore Pipelines Subject to External Pressure, Bending and Axial Loads	Sævik, Svein
Hagen, Haakon Gunnerius Johnsrud	Viscous Flow around a Simplified Model of a Christmas Tree	Holm, Håvard
Hatlem, Odd Helge	Design for Operational Efficiency and HSE in Marine Operations between Floating Cage Collars and Service Vessels in the Aquaculture Industry	Asbjørnslett, Bjørn Egil
Henriksen, Andreas Viggen	Camera-assisted Dynamic Positioning of ROVs	Skjetne, Roger
Hjelvik, Vegard Nesset	Bestemme GM ved Hjelp av Rulleperiodetest	Holm, Håvard
Holm, Jørgen Thode Gryteland	Analyse og Dimensjonering av Halsafjordens Strekkstag Understøttede Hengebro Utsatt for Støt fra Store Skip	Amdahl, Jørgen
Holmemo, Marius	Tidal Boundary Layer Flow over a Flat Bottom with Vegetation	Myrhaug, Dag
Hovind, Ada	The Environmental Impact of Capacity Utilisation on RoRo Shipping	Asbjørnslett, Bjørn Egil
Hugo, Åsmund Pedersen	Kinematic Control of Underwater Robotic System	Schjølberg, Ingrid
Huynh, Johnny Quang Tuan	Detailed Design of a Thruster Solution for a Small Mass-market Remotely Operated Underwater Vehicle	Ludvigsen, Martin
Islam, Md Touhidul	Design, Numerical Modelling and Analysis of a Semi-submersible Floater Supporting the DTU 10MW Wind Turbine	Gao, Zhen
Jacobsen, Nikolai Havikbotn	Application of RCM Principles to Identify Barriers in Design of Unmanned Engine Rooms for Oceangoing Merchant Vessels	Utne, Ingrid Bouwer
Jaer, Peter Sommerseth	Improvement of Thermodynamic Properties in Combustion Research Facility with Symmetrical Ignition Sources	Pedersen, Eilif
Jansen, Kristin Victoria	A Global Assessment of a Floating Bridges Ability to Withstand a Ship Collision	Leira, Bernt Johan
Jónsdóttir, Kristbjörg Edda	Simulation of Anchor Loads on Pipelines	Sævik, Svein
Josefsen, David	Simulation of Vessel Response Time for Emergency Preparedness Against Acute Pollution	Asbjørnslett, Bjørn Egil
Kjelsaas, Camilla	Analysis of Transportation and Installation of a Component of an Artificial Sea Bed	Leira, Bernt Johan
Klingan, Kristine Ekeli	Automated Optimization and Design of Mooring Systems for Deep Water	Larsen, Kjell
Koloshkin, Evgenii	Torsion Buckling of Dynamic Flexible Risers	Sævik, Svein
Koppenol, Boy Solo	Dynamic Analysis of a Floating Vertical Axis Wind Turbine Using the Actuator Cylinder Flow Theory	Gao, Zhen
Kristiansen, Aleksander V	Estimation of the Economic Effect of Implementing Reliabilty-centred Maintenance onboard a Maritime Vessel	Utne, Ingrid Bouwer
Krugerud, Christine	Design and Automated Optimization of Mooring Systems for Shallow Water and Harsh Environments	Larsen, Kjell
Kullmann, Annelise B	A Comparative Life Cycle Assessment of Conventional and All-electric Car Ferries	Asbjørnslett, Bjørn Egil
Kvamme, Bettina Wickman	Design for Operational Efficiency and HSE in Marine Operations between Floating Cage Collars and Service Vessels in the Aquaculture Industry	Asbjørnslett, Bjørn Egil

Name	Topic	Supervisor
Land, Ketil	Engine Controller Design and Implementation for a 255 kW Diesel Engine	Pedersen, Eilif
Leimeister, Mareike	Rational Upscaling and Modelling of a Semi-submersible Floating Offshore Wind Turbine	Bachynski, Erin
Liu, Haobin	Stress Analysis of the Structural Interface between the Spar and the Torus in the Combined Wind and Wave Energy Concept STC	Gao, Zhen
Lubis, Michael Binsar	Time Domain Simulation of Jack-up in Second Order Irregular Seas	Amdahl, Jørgen
Lunde, Einar	Numerical Investigation of Flow around Straight Cylinders with Inclination	Pettersen, Bjørnar
Maastad, Marius	Numerical and Experimental Study of the Fred Olsen Wind Turbine Concept	Gao, Zhen
Madduma Hewage, Tharindu Dilshan	Assessment and Numerical Simulation of the Pendulous Installation Method in Deepwater	Larsen, Kjell
Malik, Mohibb Ghani	Hydrodynamic Modelling Effects on Fatigue Calculations for Monopile Offshore Wind Turbines	Gao, Zhen
Moe, Ole Harald	Analysis and Design of Bjørnafjorden TLP Supported Suspension Bridge Subjected to Large Ship Collisions and Extreme Environmental Loads	Amdahl, Jørgen
Mork, Håkon	Ultimate Strength and Capacity Assessment of Ice Class Vessel Operating in Ice	Leira, Bernt Johan
Muren, Marit Maukon	Response Calculations of Semi-submersible Column Exposed to Slamming Loads	Amdahl, Jørgen
Murray, Brian	Assessment and Numerical Simulation of the Pendulous Installation Method in Deepwater	Larsen, Kjell
Myklebost, Oda	Comparative Evaluation of the Performance of a Trimaran Seismic Vessel	Steen, Sverre
Nahian, Nishat Al	Structural Analysis of the Gripper Connection during Monopile Installation	Gao, Zhen
Nicolaysen, Sven Ole M	Validation of Seakeeping Calculations of a Wind Farm Installation Vessel	Steen, Sverre
Overn, Ida Haftun	Investigation of Wave-induced ULS and ALS Characteristic Loads and Responses on a Pile Structure in the Ekofisk Area	Haver, Sverre Kristian
Palm, Astrid Maria	Buckling and Load Shedding in Redundant Plated Ship Structures	Amdahl, Jørgen
Park, Seoyeon	Global Buckling of Pipelines	Sævik, Svein
Rabliås, Øyvind	Development of a New Navier-Stokes Solver Using a Generalized HPC Method for the Pressure Poisson Equation	Greco, Marilena
Rahman, Md. Rafiur	Numerical Modeling and Analysis of the Combined Wind and Wave Energy Concept SFC	Gao, Zhen
Rakke, Stian Glomvik	Ship Emissions Calculation from AIS	Asbjørnslett, Bjørn Egil
Ravinthrakumar, Senthuran	Evaluation of Extreme Design Wave Loads for Hull Girder Strength Assessment	Leira, Bernt Johan
Reiersen, Lars M. Utnes	Investigation of Moonpool Resonance as Vessel Damping Device	Kristiansen, Trygve
Rist-Christensen, Ida	Autonomous Robotic Intervention Using ROV	Ludvigsen, Martin
Riste, Kristine Bøyum	Development of a Frequency-domain Model for Dynamic Analysis of the Floating Wind Turbine Concept - WindFloat	Gao, Zhen

Name	Topic	Supervisor
Rolfseng, Jon Henning	Analysis of Accelerometric Datasets for Wind Turbine Monitoring	Utne, Ingrid Bouwer
Rudå, Sigbjørn Eng	Use of Tunnel Thrusters and Azimuthing Thrusters for Roll Damping of Ships	Steen, Sverre
Ruud, Fredrik Jonsson	Autonomous Homing and Docking of AUV REMUS 100	Ludvigsen, Martin
Rørvik, Jørgen	Application of Inviscid Flow CFD for Prediction of Motions and Added Resistance of Ships	Steen, Sverre
Salen, Stian Røyset	Probabilistic Damage Stability	Aanondsen, Svein Aanond
Sandbakken, Sindre Schafroth	Long Term Analysis of Semi Submersible Offset	Haver, Sverre Kristian
Sandvik, Endre	Design Optimization of Offshore Construction Vessels	Steen, Sverre
Sandøy, Stian Skaalvik	System Identification and State Estimation for ROV uDrone	Skjetne, Roger
Scheide, Audun Werner	Design and Analyze of a Pressure Vessel for an Underwater Remotely Operated Vehicle Produced by Injection Molding	Ludvigsen, Martin
Schwebe, Tjark Tilman	Dynamic Collapse of the Hull Girder in a Container Ship in Waves	Amdahl, Jørgen
Schöpfer, Philipp	Non-linear Irregular Wave Impact on Monopile Structures	Ås, Sigmund Kyrre
Sharoni, Rotem	Marine Inverted Pendulum	Skjetne, Roger
Shetelig, Marte	An Assessment of the Current Schedule Risk Analysis Practice at Aker Solutions AS	Bindingsbø, Arne Ulrik
Skåland, Edvard Knutsen	The Influence of the Choice of Propeller Design Tool on Propeller Performance	Steen, Sverre
Solstad, Torkil Eide	Improved User-experience for Control of ROVs	Skjetne, Roger
Spange, Joachim	Autonomous Docking for Marine Vessels Using a Lidar and Proximity Sensors	Skjetne, Roger
Spilde, Eirik Hereid	Experimental Investigation of Vertical Forces in Pure Sway Motion for a Free Surface Roll Damping Tank	Holm, Håvard
Strand, Anders Salberg	Wellhead Platform Subjected to Accidental Loads	Amdahl, Jørgen
Sundstrøm, Tonje Seglem	Installation of Subsea Equipment with Focus on Slender Objects	Larsen, Kjell
Svendsen, Kristian Freng	Structural Design and Dynamic Analysis of a Tension Leg Platform Wind Turbine, Considering Elasticity in the Hull	Bachynski, Erin
Tian, Cai	Numerical Investigation of Flow around Intersecting Cylinders	Pettersen, Bjørnar
Tian, Xiaoshuang	Design, Numerical Modelling and Analysis of TLP Floater Supporting the DTU 10MW Wind Turbine	Gao, Zhen
Tsigkris, Efstathios	Dynamic Response Analysis of a Spar Floating Wind Turbine in Level Ice with Varying Thickness	Gao, Zhen
Tvedt, Petter Andre	Submerged Towing and Upending of TLP Thethers	Larsen, Kjell
Ueland, Einar Skiftestad	Marine Autonomous Exploration Using a Lidar	Skjetne, Roger
Utby, Haakon	Hydrodynamic Optimization of Bulk and Tank Ship Hulls	Steen, Sverre
Vamråk, Vegard Moesødegård	Sway Control on a Surface Effect Ship	Hassani, Vahid
Velarde, Joey	Design of Monopile Foundations to Support the DTU 10 MW Offshore Wind Turbine	Bachynski, Erin
Waage, Ida Fredsvik	Investigation of Wave-induced ULS and ALS Characteristic Loads and Responses on a Pile Structure in the Ekofisk Area	Haver, Sverre Kristian
Wang, Chunsheng	Hybrid Power Plant Concepts for Marine Vessels	Pedersen, Eilif

Name	Topic	Supervisor
Wang, Ruoqi	Design of Mooring Systems in Extreme Seastates with Focus on Viscous Drift Force Modelling	Larsen, Kjell
Wille, Kristian Løken	Autonomous Sailboats	Hassani, Vahid
Wist, Andrea Sørdal	A Simulation Model for Analysing Weather Impact on Upstream Supply Chain Service Performance	Erikstad, Stein Ove
Xu, Dapeng	Numerical Modelling and Simulations for Lowering of an Offshore Wind Turbine Tripod	Gao, Zhen
Xue, Wenfei	Design, Numerical Modelling and Analysis of a Spar Floater Supporting the DTU 10MW Wind Turbine	Gao, Zhen
Zhao, Shunan	Risk Modeling of DP Operation for Offshore Tandem Offloading	Vinnem, Jan Erik
Østgård, Malene Denita	Numerical Investigation of Flow around Straight Cylinders with Inclination	Pettersen, Bjørnar
Århus, Gisle Hoel	Analysis and Design of Ship Collision Barriers on a Submerged Floating Tunnel Subjected to Large Ship Collisions	Amdahl, Jørgen

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