



sfi



SFI
OFFSHORE
MECHATRONICS

ANNUAL REPORT 2017



UNIVERSITETET I AGDER

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ANNUAL REPORT 2017

Summary

HISTORY

SFI Offshore Mechatronics has its origins from the Agder cooperation within the field of Mechatronics, initiated by University of Agder with partners from the local industry of oil- and gas equipment production. This cooperation has been active for several years, and has its origin in the establishment of Master and PhD education to produce needed candidates for the regional and national labour market. Since then, the cooperation has developed to include R&D projects and mobility between industry companies and UiA.

ORGANISATION

SFI Offshore Mechatronics is hosted by UiA, Faculty of Engineering and Science. UiA is responsible for three work-packages, NTNU for two, University of Aalborg for one and Teknova for one work package. In addition, IRIS, NTNU Aalesund and RWTH Aachen participate in different WPs. GCE NODE heads a non-scientific work package for technology vision. The industrial partners are ABB, Bosch Rexroth, Cameron Sense, Klueber Lubrication, Egde consulting, Lundin, MacGregor, MHWirth, National Oilwell Varco, Skeie Technologies and Stepchange. SFI Offshore Mechatronics Steering board consists of 7 partners, where the industry partners hold majority. The Centre Director heads the daily operations, assisted by an administrative manager. The international Advisory Board gives strategic and scientific advice and consists of international experts in the fields of research.

THE RESEARCH

The main goal is to develop new concepts for autonomous systems where the construction, engineering and design, invite autonomy to minimize the number of manual processes, as well as to reduce risk and cost related to offshore drilling operations. The research shall result in enabling technologies, equipment, processes and solutions for autonomy and monitoring of heavy machinery, and for handling and analysing large data flows under demanding conditions. The research is carried out in six work packages: WP1 Drives, WP2 Motion Compensation, WP3 Robotics and Autonomy, WP4 Modelling and Simulation, WP5 Monitoring Techniques and WP6 Data Analytics, IT Integration and Big Data.

INTERNATIONAL COOPERATION

International cooperation and network is very important in SFI Offshore Mechatronics. There are both international research partners and industry partners in the Centre. The researchers in the Centre have extensive international networks in addition to the actual international universities in the partnership.

RECRUITMENT

By the end of 2017 22 PhDs and 2 Post.doc are employed in the Centre. Some of these have been recruited from industry partners. This has been a positive experience since the candidates bring valuable industry insight into the research.

COMMUNICATION AND DISSEMINATION ACTIVITIES

The main platform for presenting results is the SFI Offshore Mechatronics Annual Conference. In 2017 the annual conference took place in May, with over 80 participants. During the two days there were both presentations and discussion of results and group meetings. SFI Offshore Mechatronics has a web page, a Facebook profile, is on Twitter and LinkedIn. The Centre has an open and including attitude, and several high-school classes have visited, a lot of presentations in regional, national and international fora have been given, and participation on other relevant arenas.

Vision and Objectives

VISION

The SFI Offshore Mechatronics will become the international knowledge and research hub for the next generation of advanced offshore mechatronic systems for autonomous operation and condition monitoring of topside drilling systems under the control of land-based operation centres, to ensure safe and efficient operation in deeper water and in harsh environments.

The centre shall contribute significantly to growth and innovation in the industry, creating jobs and business with potential both within the target sector, and beyond, such as maritime industry, with a net positive impact on society.

MISSION STATEMENT

By 2023, SFI Offshore Mechatronics shall have succeeded in becoming an internationally renowned research-based innovation centre reaching national, international and long-term targets.

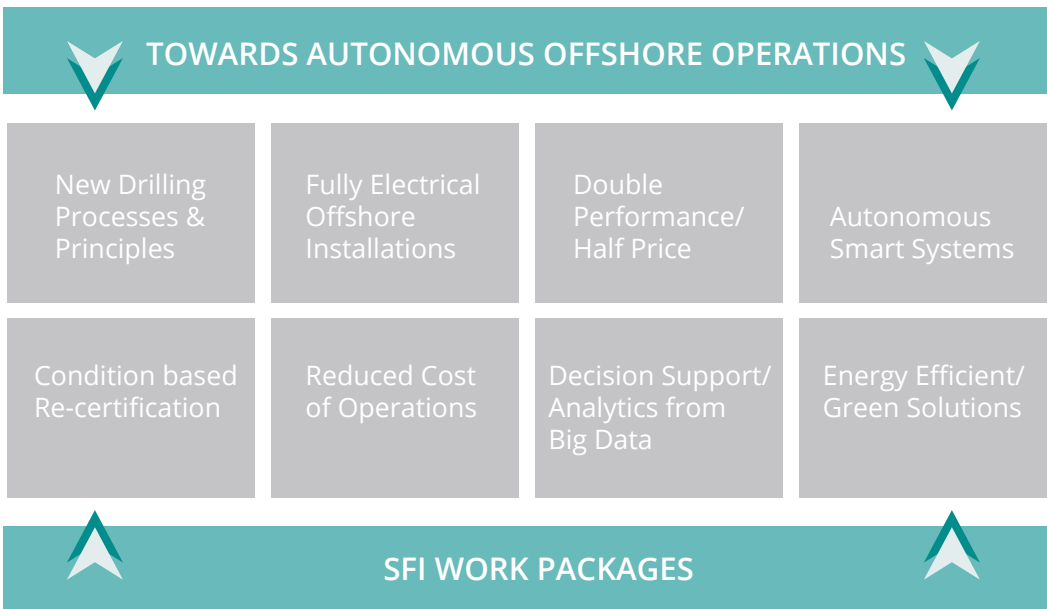
National target – develop new concepts for autonomous systems where the construction, engineering and design, invite autonomy to minimize the number of manual processes, as well as to reduce risk and cost related to offshore drilling operations.

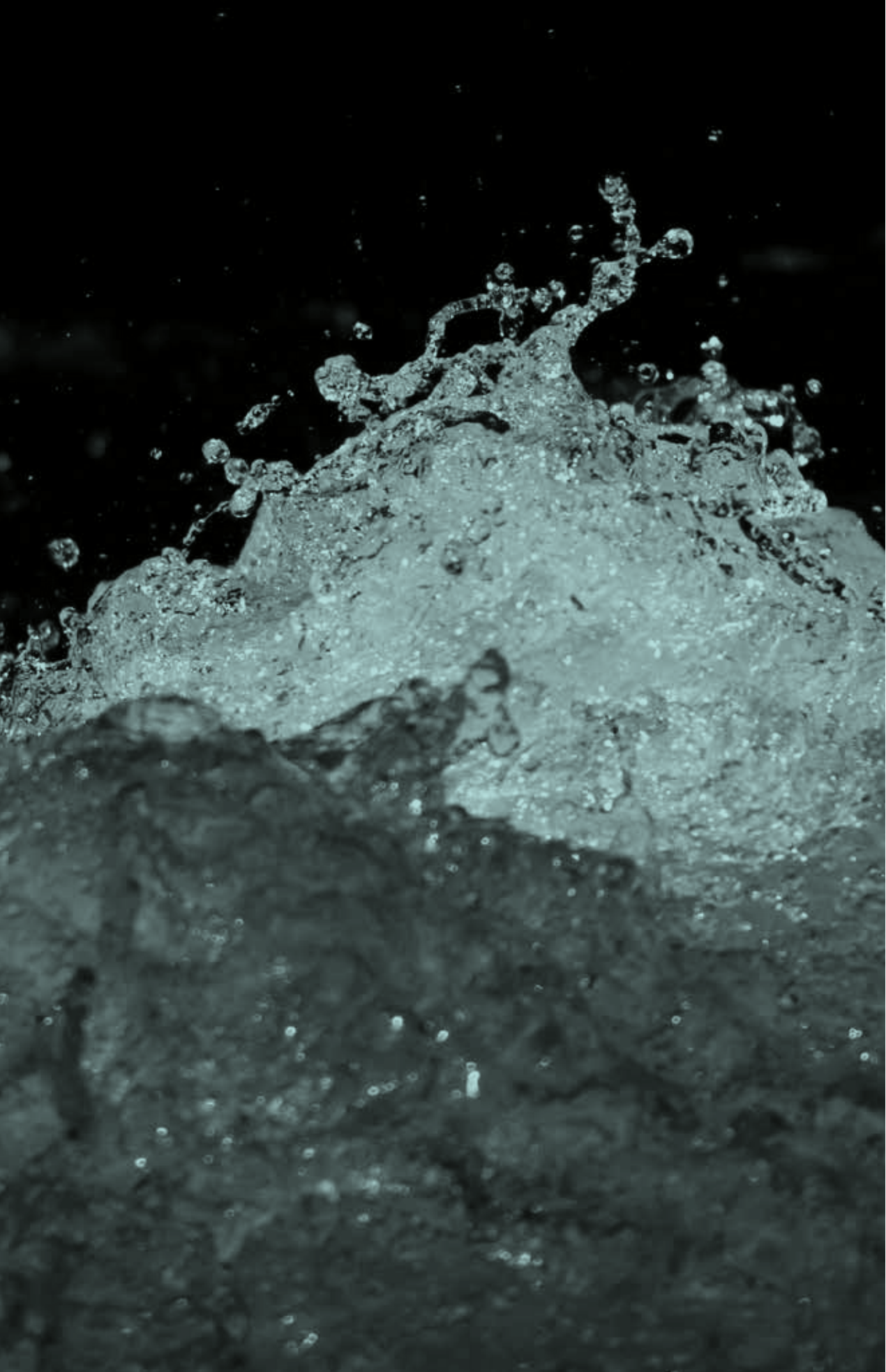
International target – support the industry partners to strengthen the global position by developing the most efficient and safe future drilling operations.

Long-term target – enable technologies, equipment, processes and solutions for autonomy and monitoring of heavy machinery, and for handling and analysing large data flows under demanding conditions.

GRAND CHALLENGES

The grand challenges are:





Research Plan/Strategy


RECRUITMENT

In 2017 22 PhD students and two Post.Docs worked in the centre. They were employed at University of Agder, Aalborg University, NTNU and RWTH Aachen.

THE RESEARCH PLAN

The research themes of all the positions have been defined in close cooperation with the partner companies. This is to ensure relevance for the industry partners. Several of the candidates are recruited from the industry partners.

The 8 year research plan for the SFI (2015-2023) is presented as follows:



The working titles of the positions

- WP1.2** Using digital hydraulic in secondary control of motor drive.
- WP1.3** Using digital hydraulic in secondary control of cylinder drive.
- WP1.4** Electrical and electrohydraulic linear actuators.
- WP1.5** Cylinder direct drive.
- WP2.1** Computer vision and 3D sensors for topside automation of offshore drilling.
- WP2.2** High-performance control for motion compensation.
- WP2.3** Nonlinear friction compensation in motion compensation systems with significant elasticity.
- WP2.4** Vision systems for offshore crane control in ship-to-ship operations.
- WP2.5** Real-time multiple DOF motion compensation using an industrial robot, sensor fusion and conformal geometric algebra.
- WP2.6** Real-time teleoperation and model-based control of cranes with loads.
- WP3.1** Development of offshore 3D sensor package.
- WP3.2** Autonomy systems foundation development.
- WP3.3** Handling of sensor fusion, point-clouds and 3D maps.
- WP3.4** Implementation of situational awareness/human factors concepts for operators using virtual arena.
- WP3.5** Reliable Communication in 5G.
- WP3.6** Instrumentation and real-time control of long-reach, light-weight arm intended for use offshore (associated PhD position).
- WP3.7** Coupled dynamics between vessel and crane (associated PhD position).



WP3.8 Formal Methods in Robotics (integrated MSc / PhD position).

WP4.1 Integrated simulation of multi-physical systems in offshore operations.

WP4.2 Component-based simulation systems for drilling automation and crane systems.

WP4.3 Protocols and standard for integration of simulation models and co-simulation.

WP4.4 Modelling and simulation of cable and pulley systems in offshore cranes.

WP5.1 Tapered big bearings.

WP5.2 Large diameter steel ropes.

WP5.3 Fibre ropes.

WP5.4 Condition-based lifetime prediction as result of calculated component loads.

WP5.5 Modelling the fatigue damage mechanism in welded joints (associated PhD position).

WP6.1 Distributed in-network intelligence across multiple components.

WP6.2 Design of architecture and self-organised cross-layer protocols for a heterogeneous wireless network platform.

WP6.3 Coordinated multi-variable data acquisition, intelligent data reduction, as well as automatic data quality verification and validation.

Organisation

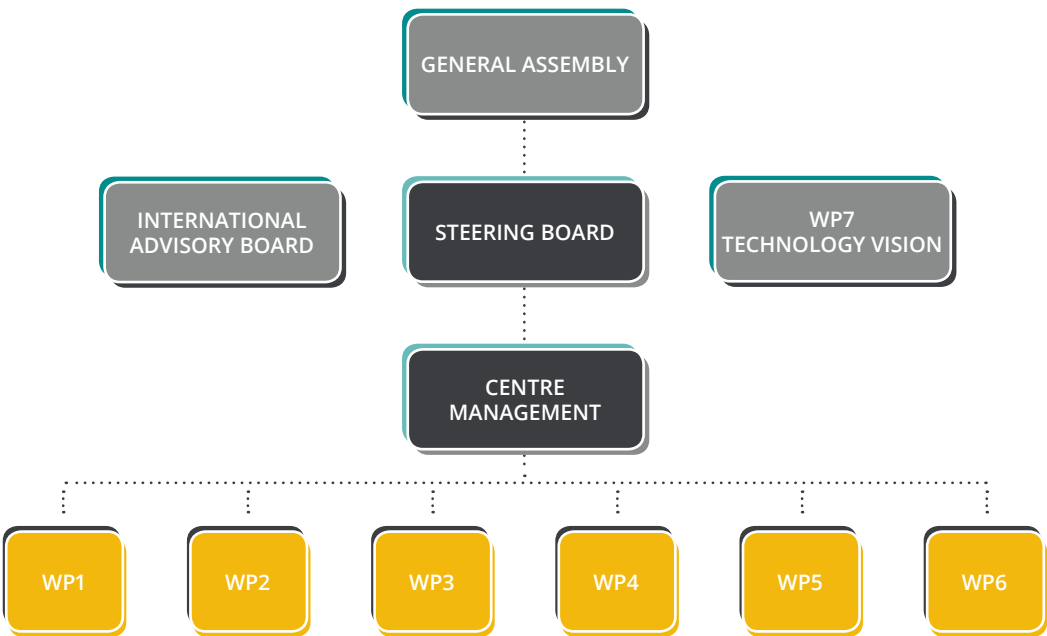
CENTRE MANAGEMENT

The SFI Offshore Mechatronics centre is hosted by UiA and the management is led by Centre Director, Professor Geir Hovland with assistance from Administrative Manager Rachel Funderud Syrtveit. In addition, UiA provides necessary resources from the Faculty and Central Management. From 2018 Anne-Line Agedal will be Administrative Manager of the Centre.



Geir Hovland and Rachel Funderud Syrtveit.

ORGANISATION MAP



Work Packages WP1 – WP6



WP-leaders: Olav Egeland, Torben Ole Andersen, Thomas Meyer, Anne Grete Ellingsen, Geir Hovland, Baltasar Beferull-Lozano and Morten Kjeld Ebbesen.

WP1



WP1 LEADER 1
Morten Kjeld Ebbesen, UiA
Co-sup. WP1.2, co-sup. WP1.3, and sup. WP1.4



WP1 LEADER 2
Torben Ole Andersen, AAU
Sup. WP1.2, sup. WP1.3, and co-sup WP1.4



WP1.2
Sondre Nordås
UiA



WP1.3
Viktor Hristov Donkov
AAU



WP1.4
Daniel Hagen
UiA



WP1.5
TBA
AAU



WP1.6
TBA
AAU



WP1.7
TBA
UiA



WP2



WP2 LEADER
Olav Egeland, NTNU
Supervisor WP2.1-2.4



Dirk Abel
RWTH Aachen
Sup. WP2.6



Geir Hovland
UiA
Sup. WP2.5



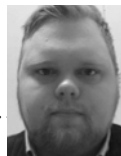
WP2.1
Geir O. Tysse
NTNU



WP2.2
Torstein Myhre
NTNU



WP2.3
Andrej Cibicik
NTNU



WP2.4
Alexander M. Sjøberg, NTNU



WP2.5
Sondre S. Tørdal
UiA



WP2.6
Philip Schubert
RWTH Aachen



WP2.7
TBA, NTNU



WP2.8
TBA, NTNU

WP3



WP3 LEADER
Geir Hovland, UiA
Supervisor WP3.1 and WP3.2, Co-supervisor WP3.6, WP3.7



Olav Egeland
NTNU
Sup. WP3.3



Houxiang Zhang
NTNU Aalesund
Sup. WP3.4



Morten Ottestad
UiA
Co-Sup. WP3.1



Ilya Tyapin
UiA Sup. WP3.6



Jing Zhou
UiA Sup. WP3.7



Frank Y. Li
UiA
Sup. WP 3.5



Knut Berg Kaldestad
UiA Technician
Sup. WPs



Charlotte Skourup
ABB
Co.Sup WP3.4



David Anisi
ABB
Co.Sup WP3.2



WP3.1
Joacim Dybedal
UiA



WP3.2
Atle Aalerud
UiA



WP3.3
Aksel Sveier
NTNU



WP3.4
Thiago G. Monteiro
NTNU
Aalesund



WP3.5
Thilina N. Weerasinghe
UiA



WP3.6
TBA
UiA



WP3.7
TBA
UiA



WP3.8
TBA
UiA



WP3.9
TBA
UiA



WP4



WP2 LEADER
Olav Egeland, NTNU
Supervisor WP2.1-2.4



Christian Holden, NTNU
Sup. WP4.1 & WP4.2



Houxiang Zhang
NTNU Aalesund
Sup. WP4.3



Terje Rølvåg
NTNU
Sup. WP4.4



Geir Hovland
UiA
Co-Sup. WP4.3



Bjørn Haugen
NTNU
Co-sup. WP4.4



Arne Styve
NTNU
Aalesund
Co-sup. WP4.3



WP4.1
Savin Viswanathan
NTNU



WP4.2
Njål Tengedal
NTNU



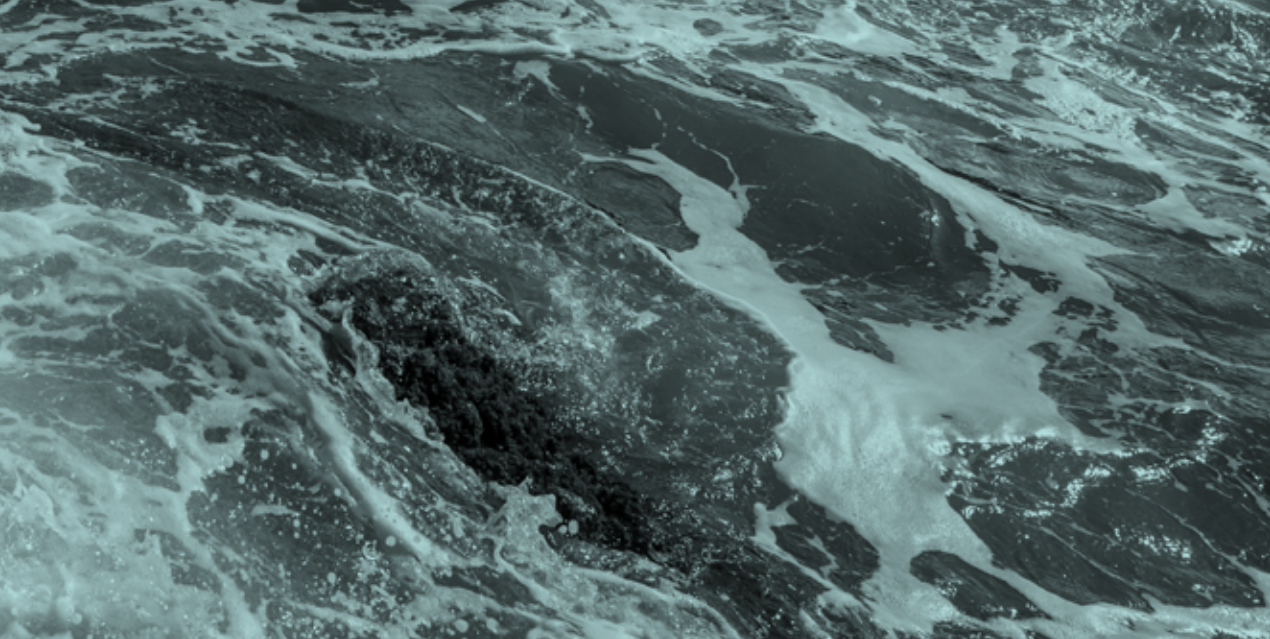
WP4.3
Lars Ivar Hatledal
NTNU Aalesund



WP4.4
Gaute Fotland
NTNU



WP4.5
TBA
NTNU



WP5



WP5 LEADER
Thomas J.J. Meyer
Teknova



WP5 Scientific advisor
Eric Bechhoefer
Teknova



Ian K. Jennions
Cranfield U.

Subtask 5.1
«Big tapered roller
bearings»



Tor Inge Waag
Task leader, Teknova

Subtask 5.2
«Big steel ropes»



Rune Schlanbusch
Task leader, Teknova

Subtask 5.3
«Big fiber ropes»



**Ellen Nordgård-
Hansen**
Task leader, Teknova

Subtask 5.4
«Winch Lifetime
predictions»



Achim Feldermann
Task leader, Aachen IME

Subtask 5.5
«Welded joints
fatigue predictions»



Tom Lassen
Task leader, UiA



**Kjell Gunnar
Robbersmyr**
UiA



WP51
**Martin
Hemmer**
UiA



WP5.3
**Shaun
Falconer**
UiA



Geir Grasmø
UiA



WP5.4
Lothar Wöll
Aachen IME



WP5.5
**Zbigniew
Mikulski**
UiA

WP6



WP2 LEADER
Baltasar Beferull-Lozano, UiA
Supervisor WP6.1 and WP6.2



Daniel Romero
UiA
Co. Sup.



Øyvind Mydland
UiA
Part-time
UiA (collaborating in WP6.
topics/link to industry)



WP6.1
Luis M. Lopez-Ramos
UiA



WP6.2
TBA



WP6.3
TBA



WP6.4
TBA

WP7 TECHNOLOGY VISION

The purpose of WP7 is to ensure input to the work packages during the 8-year period of the SFI Offshore Mechatronics project. The objective of WP7 is to provide bi-yearly updates and strategic input on market, technology development and business framework.

WP7 creates an open arena for future trends, barriers and opportunities. To meet the objective, it was necessary to establish a baseline for the work. The baseline was established through interviews with key persons in the participating companies and academic partner institutions, in addition to conducting literature studies.

Results from the first trend workshop and group discussions formed the basis for a workshop with the Steering Board, WP-leaders and partners in November. Topics for discussion included sensors, real-time data transfer, data sharing & interoperability, data analytics, condition-based maintenance, robotization, automation, autonomy of processes, standards & requirements, and new contract structures & business models.

Steering Board

The Steering board (2017-2019) consists of 7 members, and 2 deputy members: Leif Haukom (GCE NODE), Charlotte Skourup (ABB), Arild Strand (Bosch Rexroth), Morten Halvorsen (NOV), Thor Arne Håverstad (Teknova), Torben Ole Andersen (Aalborg University) and Michael Rygaard Hansen (UiA), Eivind Gimming Stensland (Deputy, MacGregor) and Torgeir Welo (Deputy, NTNU).

The majority of the SFI Offshore Mechatronics Steering Board members are from the Industry Partners. The Steering board is appointed for 2 years. It is the General Assembly which appoints the Steering board.



Leif Haukom
GCE NODE
Chairman



Charlotte Skourup
ABB
Deputy Chairman



Morten Halvorsen
NOV



Arild Strand
Bosch Rexroth AS



Torben Ole Andersen
AAU



Thor Arne Håverstad
Teknova



Michael Rygaard Hansen
UiA



Eivind Gimming Stensland
MacGregor



Torgeir Welo
NTNU

The Centre has one General Assembly every year, where all partners meet and work-plans for the following year are presented and discussed.

The General Assembly 2017 was held on November 16. Here the budget for next three years and the WP annual work plans were presented and approved.

KEY NUMBERS 2016

Steering Board Meetings	4
WP leader meetings	11
Workshops	2
Reference Group Meetings	21
Conferences	1
General Assembly	1

Partners



Partners gathering on the SFI OM annual conference.



UNIVERSITY OF AGDER

Rexroth
Bosch Group

ABB



teknova



IRIS



S
Skeie Technology



NTNU

KLÜBER
LUBRICATION

RWTH AACHEN
UNIVERSITY



EGDE

mhwirth

Lundin
Norway



stepchange

GCE | **NODE** | GLOBAL CENTRE
OF EXPERTISE

MAGGREGOR

Cooperation Between the Centre's Partners



The SFI OM project started April 1, 2015. In this Project it was important to align the research with the industry partners which were faced with a difficult situation caused by low oil prices and a significant reduction in orders. Several of the partners had to reduce the number of employees in 2015 and 2016. Therefore, in order to get the best possible start and make the project relevant for all partners, the Centre arranged 3 work-shops where industry and academia together defined the scientific focus areas for the project.

There are 6 scientific work-packages in SFI Offshore Mechatronics. For each WP there is a reference group. Effort has been put in to getting relevant people from the partners to participate in the WPs. This is an important action, to get the SFI activities and results communicated to, and discussed with, industrial partners.

In addition to participating in reference group meetings, there are other initiatives to share knowledge between researchers and industry partners.

In August over 20 Mechanical and Structural Engineers from MacGregor Norway AS visited UiA and got presentations by centre management and associated researchers. The engineers also got demonstrations of autonomous robotics and the motion-lab.

In the autumn 2017 participants in the SFI from UiA visited engineers at MHWirth to plan an outdoor test of 3D sensors developed in the project. The test will take place during Q3 2018, in the MHWirth testing tower (Kristiansand).

The industry and researchers are together working on leveraging the research produced in the SFI. On October 18 the SFI Centre management arranged a Patenting vs. Publication workshop together with UiA Nyskaping. Innoventus Sør and Bergen Teknologioverføring presented cases and business models, and went through the patenting process.

In 2017 some of the project's industry partners took initiative to apply for funding for spin-off and related projects. Some of these were granted funding from RCN and RFF Agder, and involve researchers from UiA also connected to SFI Offshore Mechatronics.

Scientific Activities and Results

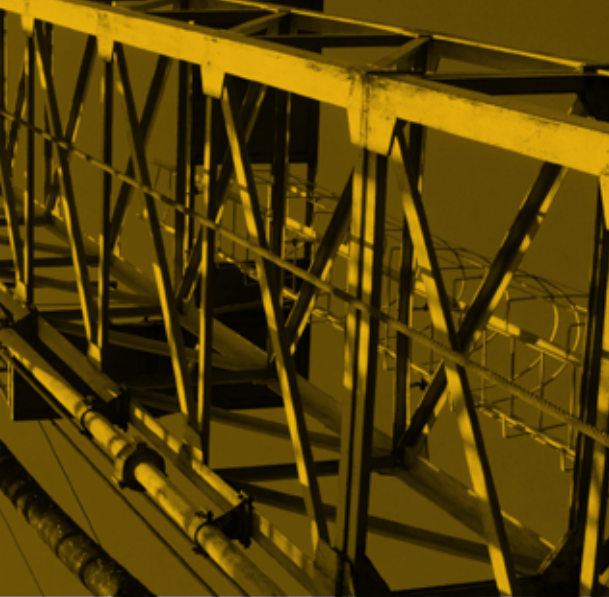


With the **Mechatronic Innovation Lab (MIL)** opening in 2017 on UiA Campus Grimstad, the SFI OM has gotten access to valuable equipment. One example is the rope testing machine. WP5 has an aim to improve offshore maintenance operations by developing technologies and methods that enable condition-based maintenance strategies. Two of the five subtasks studies large diameter steel and fiber ropes, typical for the offshore industry. Through the rope testing machine, the researchers can get a better understanding of how ropes perform over time.

On November 27th WP5 co-arranged the second Steel and Fiber Ropes seminar gathering representatives from both the industry and academia.



Geir Hovland and **Jan Kučera** presented groundbreaking scientific research results combining, for the first time, blockchain technology and control engineering in the paper "Nonlinear Feedback Control and Stability Analysis of a Proof-of-Work Blockchain", MIC, Vol. 38, No.4, 2017. This paper has the potential to create a whole new research area within these two disciplines. The controller presented in the paper has been implemented in a public blockchain project and has already demonstrated remarkable results.



During the year the WPs have presented papers and participated in several IEEE conferences; American Control Conference in Seattle, USA. Oceans'17 MTS in Aberdeen, UK, Advanced Intelligent Mechatronics (AIM) in Munich, Germany, Mediterranean Conference on Control and Automation in Malta and MFI 2017- International Conference on Multisensor Fusion, Conference on Computational Advances in Multi-Sensor Adaptive Processing (CAMSAP) on Curacao, Signal and Information Processing (IEEE GlobalSIP) in Montreal, Canada, 25th European Signal Processing Conference (EUSIPCO) on Kos Greece, August and Integration for Intelligent Systems in South Korea.



A new large-scale robotic facility came into operation in Q4-2017. The lab is located at the University of Agder and consists of equipment from the industry partner ABB as part of their in-kind contribution. The lab consists of 3 industrial robots, two linear track motions and one 3-axis overhead Gantry, in addition to a scaled-down processing facility. The equipment is currently used in WP3 for real-time collision detection and avoidance based on point cloud data.



Other conferences researchers from the Centre have participated in during the year are: Computer Graphics International in Yokohama, Japan, Annual conference of the prognostics and health management society in St Petersburg, FL, USA, COMADEM conference in Bucharest, Romania and Antriebstechnisches Kolloquium (ATK) in Aachen, Germany.



International Cooperation

INTERNATIONAL ADVISORY BOARD

The SFI International Advisory Board (IAB) was established in the beginning of 2016:

- Professor Rolf Johannsson, Lund University, Sweden
- Professor Ian Jennions, Cranfield University, UK
- Professor Iraj Ershagi, University of Southern California, USA

NORTEX DATA SCIENCE CLUSTER

SFI Offshore Mechatronics participates in “NorTex Data Science Cluster” funded by INTPART. This is a collaboration project initiated by IRIS, UiA, GCE NODE, Rice University and UT Austin. The project finances several activities to stimulate and promote research collaboration between Norwegian and US partners, not limited to the mentioned partners, but will include other academic institutions or industrial companies relevant for the proposed Data Science Cluster.



Professor **Frank Yong Li** spent parts of 2017-2018 at Rice University on sabbatical leave from the University of Agder working on wireless communication research. Prof. Li is the main supervisor of the project WP3.5 in SFI Offshore Mechatronics.

OTHER ACTIVITIES

September 7-9 all members of WP1 participated in the workshop DFP17 (Digital Fluid Power 2017) in Aalborg, Denmark, together with 60 other participants from both academia and industry. On the agenda for the workshop was different aspects of digital hydraulic. Researchers from the WP presented several papers and received valuable feedback.





Recruitment

The following researchers and technicians were hired in SFI Offshore Mechatronics in 2015-2017.

NAME	POSTITION / INSTITUTION	PERIOD
Torstein Myhre	Post.Doc, NTNU	2015-2017
Geir Olav Tysse	PhD, NTNU	2015-2018
Sondre Sanden Tørdal	PhD, UiA	2015-2018
Achim Felderman	PhD, RWTH Aachen	2015-2017
Atle Aalerud	PhD, UiA	2016-2019
Andrej Cibicik	PhD, NTNU	2016-2019
Joacim Dybedal	PhD, UiA	2016-2019
Shaun Falconer	PhD, UiA	2016-2019
Daniel Hagen	PhD, UiA	2016-2019
Martin Hemmer	PhD, UiA	2016-2019
Sondre Nordås	PhD, UiA	2016-2019
Aleksander Meyer Sjøberg	PhD, NTNU	2016-2019
Aksel Sveier	PhD, NTNU	2016-2019
Thilina Weerashinge	PhD, UiA	2016-2019
Philipp Schubert	PhD, RWTH Aachen	2016-2019



All PhDs and Post.Docs together, May 2017.

Lothar Wöll	PhD, RWTH Aachen	2016-2019
Zbigniew Mikulski	PhD, UiA (associated)	2016-2019
Viktor H. Donkov	PhD, Aalborg	2017-2019
Thiago G. Monteiro	PhD, NTNU Aalesund	2017-2021
Savin Viswanathan	PhD, NTNU	2017-2020
Njål Tengesdal	PhD, NTNU	2017-2020
Lars Ivar Hatledal	PhD, NTNU Aalesund	2017-2020
Gaute Fotland	PhD, NTNU	2017-2020
Luis M. Lopez-Ramos	Post.Doc, UiA	2016-2018

The centre management and the WP-leaders are actively working on recruitment of female PhD candidates from the master programs at UiA, AAU, NTNU and RWTH Aachen. In general, there are few female master students in the relevant disciplines. The few potential candidates have been actively contacted and motivated to apply for the upcoming positions. The centre management is also actively looking for female supervisors to join the individual work-packages.

Communication and Dissemination Activities

SFI Offshore Mechatronics has a web page for news and general information about the project: sfi.mechatronics.no/

The web site is for both partners and the public. All information about the organisation, activities and results that are not sensitive is published here. From the web site there is generated a monthly newsletter with over 350 subscribers.

The project is also on Twitter (@sfimechatronics), on Facebook (facebook.com/SFIOffshoreMechatronics) and LinkedIn (linkedin.com/groups/2556388) with almost 500 followers.



The SFI Offshore Mechatronics centre wants to contribute in recruiting students to engineering and science. During the year we had visits from regional high schools to give insight in what we do through tutorial sessions and demonstrations in the Mechatronics lab.



SFI Offshore Mechatronics WP3 researchers were co-organizers and had a presentation at the conference NFA Autonomy in March. The presentation is available at:

sfi.mechatronics.no/wp-content/uploads/2016/03/SFI-20160316-Autonomy.pdf



Dissemination Activities

PUBLICATIONS

JOURNAL PAPERS

Aksel Sveier, Adam Leon Kleppe, Lars Tingelstad and Olav Egeland, **Object Detection in Point Clouds Using Conformal Geometric Algebra**, *Advances in Applied Clifford Algebras*, Feb. 2017.

Lothar Wöll, Georg Jacobs and Achim Feldermann, **Sensitivity Analysis on the Reliability of an Offshore Winch Regarding Selected Gearbox Parameters**, *MIC*, Vol 38, No. 2, 2017.

Daniel Hagen, Witold Pawlus, Morten K. Ebbesen and Torben O. Andersen, **Feasibility Study of Electromechanical Cylinder Drivetrain for Offshore Mechatronic Systems**, *MIC*, Vol 38, No. 2, 2017.

Sondre Sanden Tørdal and Geir Hovland, **Relative Vessel Motion Tracking using Sensor Fusion, Aruco Markers, and MRU Sensors**, *MIC*, Vol 38, No. 2, 2017.

Grigoris Tsagkatakis, Baltasar Beferull-Lozano, Panagiotis Tsakalides, **"Singular spectrum-based matrix completion for time series recovery and prediction"**, *EURASIP Journal on Advances in Signal Processing*.

R. Schlanbusch, E. Oland and E. Bechhoefer, **"Condition Monitoring Technologies for Steel Wire Ropes – A Review"**. *International Journal of Prognostics and Health Management*, vol. 8(1), p 14.

Espen Oland, Rune Schlanbusch and Shaun Falconer, **"Condition Monitoring Technologies for Synthetic Fiber Ropes – a Review"**. *International Journal of Prognostics and Health Management*, 2017: Vol 8 (2). ISBN 2153-2648-, 2017 014.

Lars Tingelstad, Olav Egeland, **"Motor Estimation using Heterogeneous Sets of Objects in Conformal Geometric Algebra"**, *Advances in Applied Clifford Algebras*, 2017.

Geir Hovland and Jan Kučera, Nonlinear **Feedback Control and Stability Analysis of a Proof-of-Work Blockchain**, *MIC*, Vol 38, No. 4, 2017

PUBLISHED CONFERENCE PAPERS

Torstein Myhre and Olav Egeland, **"Estimation of Crane Load Parameters During Tracking Using Expectation-Maximization"**, *American Control Conference*, Seattle, May 24-26, 2017.

Sondre Sanden Tørdal, Witold Pawel Pawlus and Geir Hovland, **“Real-time 6-DOF Vessel-to-Vessel Motion Compensation Using Laser Tracker”**, MTS/IEEE OCEANS Conference, 2017, Aberdeen.

Sondre Sanden Tørdal and Geir Hovland, **“Inverse Kinematic Control of an Industrial Robot used in Vessel-to-Vessel Motion Compensation”**, Proc. 25th Mediterranean Conference on Control and Automation (MED), July 2017.

Joacim Dybedal and Geir Hovland, **“Optimal Placement of 3D Sensors Considering Range and Field of View”**, Proc. IEEE/ASME Advanced Intelligent Mechatronics (AIM), Munich, Germany, July 2017.

David A. Anisi, Svein Gjermund Tveide and Valentinos Kongezos, **“State classification for autonomous gas sample taking using deep convolutional neural networks”**, Proc. 25th Mediterranean Conference on Control and Automation (MED), July 2017.

Olav Heng and Sondre Sanden Tørdal, **“Calibration of the Norwegian Motion Laboratory using Conformal Geometric Algebra”**, in Computer Graphics International, ENGAGE Workshop, 2017.

Erind Ujkani, Petter Sait Eppeland, Atle Aalerud and Geir Hovland, **“Real-Time Human Collision Detection for Industrial Robot Cells”**, MFI 2017, November 16-18, South Korea

Martin Hemmer, Tor Inge Waag and Kjell G. Robbersmyr, **“A Review of Methods for Condition Monitoring of Large, Slow-Rotating Bearings”**, University of Central Lancashire, COMADEM 2017.

Rune Schlanbusch, Eric Bechhoefer and Thomas J.J. Meyer, **“Low Computation Acoustic Emissions Structural Health Monitoring Trough Analog Signal Pre-Processing”**, Annual Conference of the Prognostics and Health Management Society 2017.

Sondre Nordås, Morten K. Ebbesen and Torben O. Andersen, **“Feasibility Study of a digital hydraulic winch drive system”**, The 9th Work-shop on Digital Fluid Power, Aalborg, Denmark, Sept. 2017.

Sondre Nordås, Morten K. Ebbesen and Torben O. Andersen, **“The potential of a digital hydraulic winch drive system”**, The 9th Work-shop on Digital Fluid Power, Aalborg, Denmark, Sept. 2017.

Viktor Donkov, Henrik Clemmensen Pedersen, Morten Kjeld Ebbesen and Torben O. Andersen, **“Applying Digital Hydraulic Technology on a Knuckle Boom Crane”**, The 9th Work-shop on Digital Fluid Power, Aalborg, Denmark, Sept. 2017.

Zbigniew Mikulski, Vidar Hellum and Tom Lassen, **“Modeling of the fatigue damage evolutions in welded joints”**, International Conference on Ocean, Offshore and Arctic Engineering (OMAE)

L. Ben Saad, C. Asensio-Marco and B. Beferull-Lozano, **“Topology design to reduce energy consumption of distributed graph filtering in WSN, in 5th IEEE Global Conference on Signal and Information Processing (IEEE GlobalSIP),**Montreal, Canada, November 2017.

L. Ben Saad, T. Weerasinghe and B. Beferull-Lozano, **“Topology Design to Increase Network Lifetime in WSN for Graph Filtering in Consensus Processes”** in 25th European Signal Processing Conference (EUSIPCO), Kos Greece, August 2017.

B. Zaman, L.M. López-Ramos, D. Romero, B. Beferull-Lozano, **“Online Topology Estimation for Vector Autoregressive Processes in Data Networks”**, IEEE International Conference on Computational Advances in Multi-Sensor Adaptive Processing (CAMSAP), 2017.

M. Ramezani, B. Beferull-Lozano, **“Graph Recursive Least Squares Filter for Topology Inference in Causal Data Processes”**, IEEE International Conference on Computational Advances in Multi-Sensor Adaptive Processing (CAMSAP), 2017.

M. Hemmer, T.I. Waag., **“A Comparison of Acoustic Emission and Vibration Measurements for Condition Monitoring of an Offshore Drilling Machine”**. In Proceedings of the Annual Conference of the Prognostics and Health Management Society 2017. ISBN 978-1-936263-26-4.

Shaun Falconer, Andreas Gromsrud, Espen Oland and Geir Grasmø, **“Preliminary Results on Condition Monitoring of Fiber Ropes using Automatic Width and Discrete Length Measurements”**. Proceedings of the Annual Conference of the Prognostics and Health Management Society 2017. ISBN 978-1-936263-26-4.

Oland, E., E. Bossolini, O. W. Nielsen, M. P. Sørensen, **“Modelling the thermal properties of large diameter fibre ropes”**. In Proceedings of the OIPEEC conference. La Rochelle, France.

L. Wöll, G. Jacobs, A. Feldermann, S. Neumann, F. Straßburger, **“Influence of wave height on the reliability of an offshore winch”**. Antriebstechnisches Kolloquium 2017, ATK 2017, Aachen, Germany, 7 Mar 2017 – 8 Mar 2017.

T. Lassen and Z. Mikulski, **“Fatigue methodology for life predictions for the wheel-rail contact area in large offshore turret bearings”**, 11th ICMFF.

OTHER

BACHELOR AND MASTER THESIS PROJECTS, SPRING 2016

1. Espen Eilertsen, Glenn Nevland and Sondre Ripegutu, **Development of gripping tool for industrial robot** (BSc thesis, UiA)
2. Stephen Hangluah, Mikal Sørensen and Magnus Isdal Kolbeinsen, **Mathematical modeling and control of a three-phase separator process module** (BSc thesis, UiA)
3. Geir Arne Aspheim, Kamil Bjørlykstøl and Øyvind Vatne, **Development of a tool for handling of plates with a robot** (BSc thesis, UiA)
4. Renate Christianne Evensen, Malene Ådland Hope and Siri Marte Schlanbusch **Autonomous stair robot** (BSc thesis, UiA)
5. Oddgeir Auklend, **Autonomous Inspection Robot** (MSc thesis, UiA)
6. Teodor Nilsen Aune and Morten Hallquist Rudolfson **Two-wheeled self-balancing service robot** (MSc thesis, UiA)
7. Therese Stalleemo Bjerland and Stian Berge Jacobsen, **Generation of 3D point cloud using actuated 2D laser scanner** (MSc thesis, UiA),
8. Olav Heng, **Modelling of the Motion-Lab using Geometric Algebra** (MSc thesis, UiA)
9. Petter Sait Eppeland and Erind Ujkani, **Real-time human collision detection for industrial robot cells** (MSc thesis, UiA)
10. Aksel Larsen Rasmussen **Testing of IMU** (MSc thesis, UiA)
11. Kai-Trygve Aas, **Design optimization of electric powertrains** (MSc thesis, UiA),
12. Jan Thomas Birkeland, **Thermal modeling and validation of AC motor drives** (MSc thesis, UiA)
13. Kim Roger Anderssen and Andreas Mella, **Wireless Analogue Gauge Reader** (MSc thesis, UiA)
14. Torgeir Lillemoen **Active Wave Motion Compensation while Trawling** (MSc thesis, UiA)
15. Kenneth Ring Thorbjørnsen **Model-based Design of a Digital Hydraulic Motor and Comparison Analysis Against a Conventional Hydraulic Motor**

16. Ronny Landsverk, **Modelling, simulation and verification of coupled dynamics between vessel and crane** (MSc thesis, UiA)
17. Petter Gøytil, **Closed-Loop Electrohydraulic Pressure Control** (MSc thesis, UiA)
18. Bjarte Aarsand and Stian Gausel Haugen, **Timing Algorithms for Valve Actuation** (MSc thesis, UiA),
19. Andreas Gromsrud **Continuous Width and Length Measurements of Fiber Ropes using Computer Vision** (MSc thesis, UiA)
20. John Hatletved, **Modular modelling of rig, drilling structure and fluid** (MSc thesis, UiA)
21. Remi Bendiksen Askeland, **Development of control system for underwater actuated vehicle** (MSc thesis, UiA)
22. Øyvind Mikkelsen, **Determination of Crack Depth by ACPD Methods** (MSc thesis, UiA)
23. Haris Milak, **Robotic welding of steel casing for electrodes used in silicon production** (MSc thesis, NTNU)
24. Marius Christopher **Grifftun: Robotic Assembly of Power Electronics** (MSc thesis, NTNU)
25. Jon Andreas Moseid, **Crane Modeling and Production for Cable and Pulley Development** (MSc thesis, NTNU)
26. Tarald and Axel Brautaset Hagen, **Shark Attacks on Streamer Cables** (MSc thesis, NTNU)
27. Katharina Schick, **Model-based sensitivity analysis of selected system parameters on the lifetime of an offshore winch** (MSc thesis, RWTH Aachen)
28. Erlend Erdal Christiansen, **Digital Twin Crane**, NTNU

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