



SFI
OFFSHORE
MECHATRONICS

ANNUAL REPORT 2016

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ANNUAL REPORT 2016

Summary

HISTORY

SFI Offshore Mechatronics is based on 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 and Teknova for one work package. In addition IRIS, NTNU department Aalesund, University of Aalborg and RWTH Aachen participate in different WPs. GCE NODE heads a non-scientific work package for technology vision.

The industrial partners are ABB, Applicia, Bosch Rexroth, Cameron Sense, Egde consulting, GCE NODE, Klueber Lubrication, Lundin, MacGregor, MH Wirth, NOV, Skeie Technology and Stepchange.

SFI Offshore Mechatronics Steering board consists of seven partners, where the industry partners hold majority. The Centre Director heads the daily operations, assisted by an administrative manager. The international Advisory Board consists of international experts covering the fields of research, and will give strategic and scientific advice.

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

RECRUITMENT

By the end of 2016 15 PhDs and 1 Post.doc are employed in the Centre. The recruiting has also been made 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 arena for presenting results is the SFI Offshore Mechatronics Annual Conference. It took place in Grimstad May 2016, and was a cooperation with FME NORCOWE. Over 130 participants had presentations of results and group meetings for two days. SFI Offshore Mechatronics has a web page, a Facebook profile, is on Twitter and on LinkedIn. The Centre has an open and including attitude, several classes from high-school have visited, there has been a lot of presentations in regional, national and international fora and participation on the relevant arenas, such as OTC and ONS.

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 SFI 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.

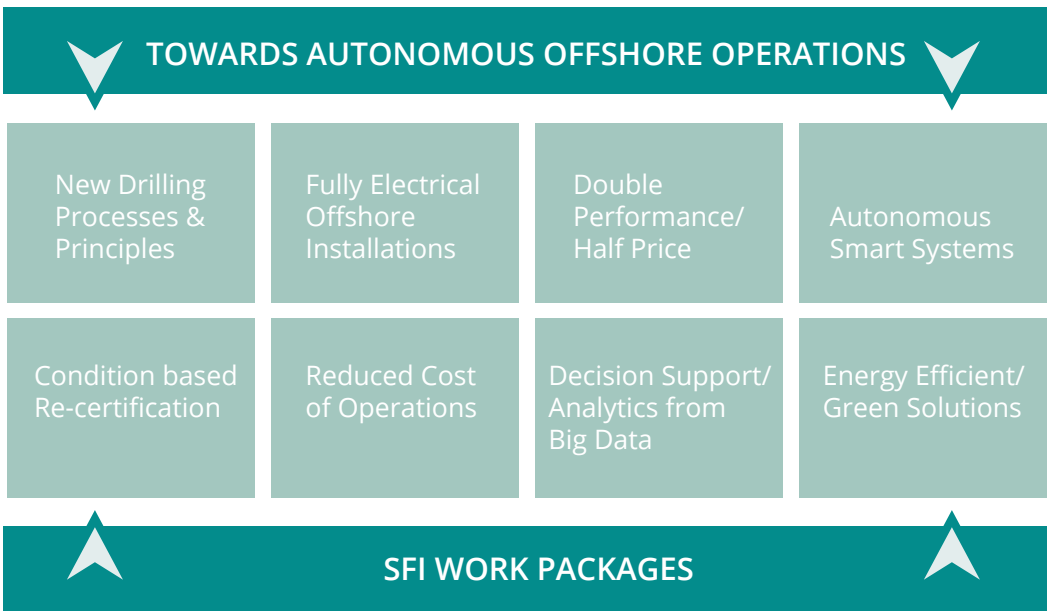
MISSION STATEMENT

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 2016 15 PhD students and one Post.Doc worked in the centre. They were employed at University of Agder, Aalborg University, NTNU and RWTH Aachen.

THE RESEARCH PLAN

The research subjects 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.

During 2016 the following 8 year plans were made for the entire SFI period (2015-2023).



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.
- 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.
- WP3.6** 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).
- 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

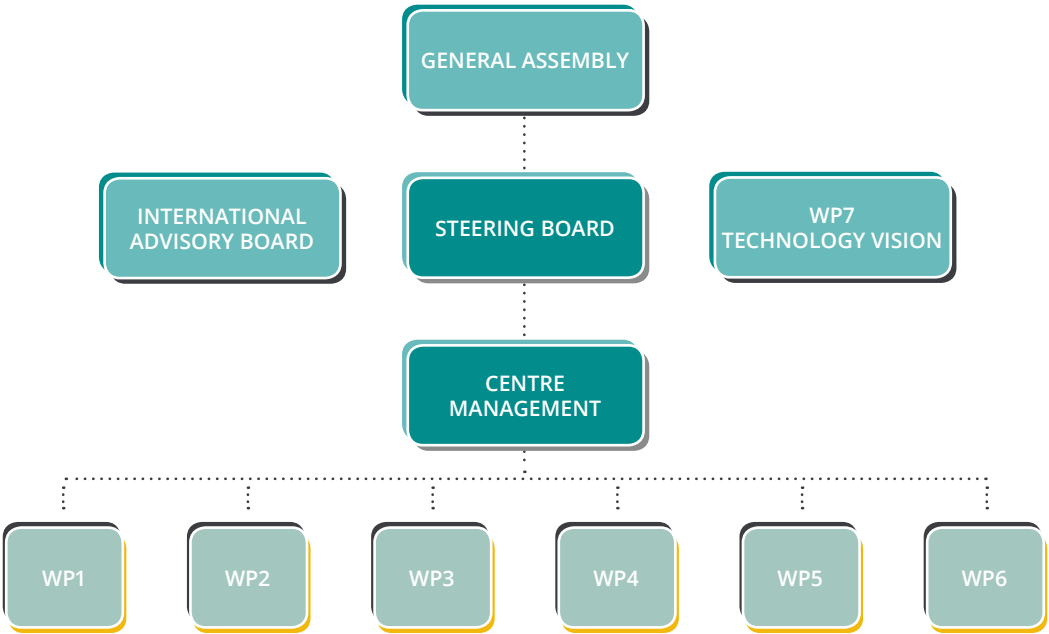
CENTRE MANAGEMENT

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.



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

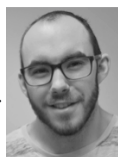
WP1



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



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

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



Knut B Kaldestad,
UiA Technician
Sup. WPs



Charlotte Skourup
ABB
Co.Sup WP3.4



David Anisi
ABB
Co.Sup WP3.2



Hugo Rosano
NOV
Co.Sup WP3.1



WP3.1
Joacim Dybedal
UiA



WP3.2
Atle Aalerud
UiA



WP3.3
Aksel Sveier
UiA



WP3.4
Thiago G. Monteiro
NTNU Aalesund



WP3.6
TBA
UiA



WP3.7
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
TBA, NTNU



WP4.2
TBA, NTNU



WP4.3
Lars Ivar Hatledal
NTNU Aalesund



WP4.4
TBA, NTNU

WP5



WP5 LEADER
Thomas J.J. Meyer
Teknova

Industrial reference group



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»



Espen Oland
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. WP6.1 & WP6.2



Øyvind Mydland
UiA
Part-time Researcher UiA
(collaborating in WP6.1 & WP6.2
topics / link to industry)



WP6.2
Thilina Weerasinghe
UiA



WP6.1
Luis Miguel Muñoz
UiA

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. This formed the foundation for a trend workshop in June, with broad participation from partners. The findings of the trend analysis were summarized in four main themes: 1) project planning, 2) equipment design and production, 3) drilling operations optimization and 4) maintenance.

Results from the first trend workshop and group discussions formed the basis for a second 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. The report from the 2016 workshops contains recommendations and suggestions of possible spin off projects.

Steering board

The Steering board (2015-2017) consisted of 7 members, and 2 deputy members: Leif Haukom (GCE NODE), Charlotte Skourup (ABB), Kari Nielsen (Lundin), Bjarne Sandrip (MH Wirth), Jørn Vatn (NTNU), Felix Strassburger (RWTH Aachen) and Rein Terje Thorstensen (UiA) 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. For the coming 2 years period, a new Steering Board has been appointed by the General Assembly.



Leif Haukom
(GCE NODE)
Chairman



Charlotte Skourup
ABB
Deputy Chairman



Kari Nielsen
Lundin



Bjarne Sandrip
MHWirth



Jørn Vatn
NTNU



Felix Strassburger
RWTH Aachen



Rein Terje Thorstensen
UiA



Klaus Schöffel
Teknova
(Dep. Member)



Stian Myhre
NOV
(Dep. Member)

The General Assembly was held on November 17, 2016, where the budget for the next three years and the WP annual work plans were presented and approved. The Centre has one General Assembly every year, where all partners meet and discuss work-plans for the next year. The new Steering Board for 2017-2019 was appointed by the General Assembly.

KEY NUMBERS 2016

Steering Board Meetings	6
WP leader meetings	11
Workshops	2
Reference Group Meetings	15
Conferences	1
General Assembly	1

Partners

In 2016 Bosch Rexroth joined the project and signed on February 29, 2016.



From Left: Thomas Meyer (Teknova), Mr. Jörg de la Motte (Senior Vice President Sales, Bosch Rexroth AG), Stephen Seiler (Vice-Rector Research, UiA), Lasse Schumann (Bosch Rexroth Norway), Arild Strand (General Manager, Bosch Rexroth Norway), Rolf Najork (Chairman of the executive board of Bosch Rexroth AG), Frank Reichert (Rector, UiA), Rachel Funderud Syrtveit (Administrative Manager, SFI), Geir Hovland (Centre Leader, SFI), Leif Haukom (Chairman of the Board, SFI) and Michael Rygaard Hansen (Dean of Engineering and Science, UiA).



Cooperation Between the Centre's Partners



From Left: Thomas Meyer (Teknova), Felix Strassburger (IME), Achim Feldermann (IME), Matthias Reiter (IRT), Geir Hovland (UiA), Markus Buschmann (MacGregor) and Olav Egeland (NTNU) in front of 4MW motor at CWD, RWTH Aachen.

The project started up April 1, 2015. To get a best possible start with the goal of involving industry partners and make the SFI project relevant for all partners, there were 3 workshops in the beginning of the period. As a result the themes and the scientific focus areas are defined and therefore relevant for all partners. In this Project it is important to align the research with the industry partners, who are 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.

There are 6 scientific work-packages in SFI Offshore Mechatronics. For each WP there is a reference group. Effort has been put in to get relevant people from the partners to participate in the WPs. This is important in order to get the SFI activities and result communicated to industrial partners. In January 2016 as much as 8 PhD positions were announced.

In May the SFI Offshore Mechatronics Annual conference was held with over 130 participants. The conference was a cooperation with FME NORCOWE, with some common activities and presentations and also parallel sessions.

In 2016 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.

A technical coordination meeting was held for WP2 and WP5 at February 24, 2016 at RWTH Aachen. The purpose of the meeting was to coordinate and align the research activities at the institutes IME and IRT more closely with the activities in Norway.

Scientific Activities and Results

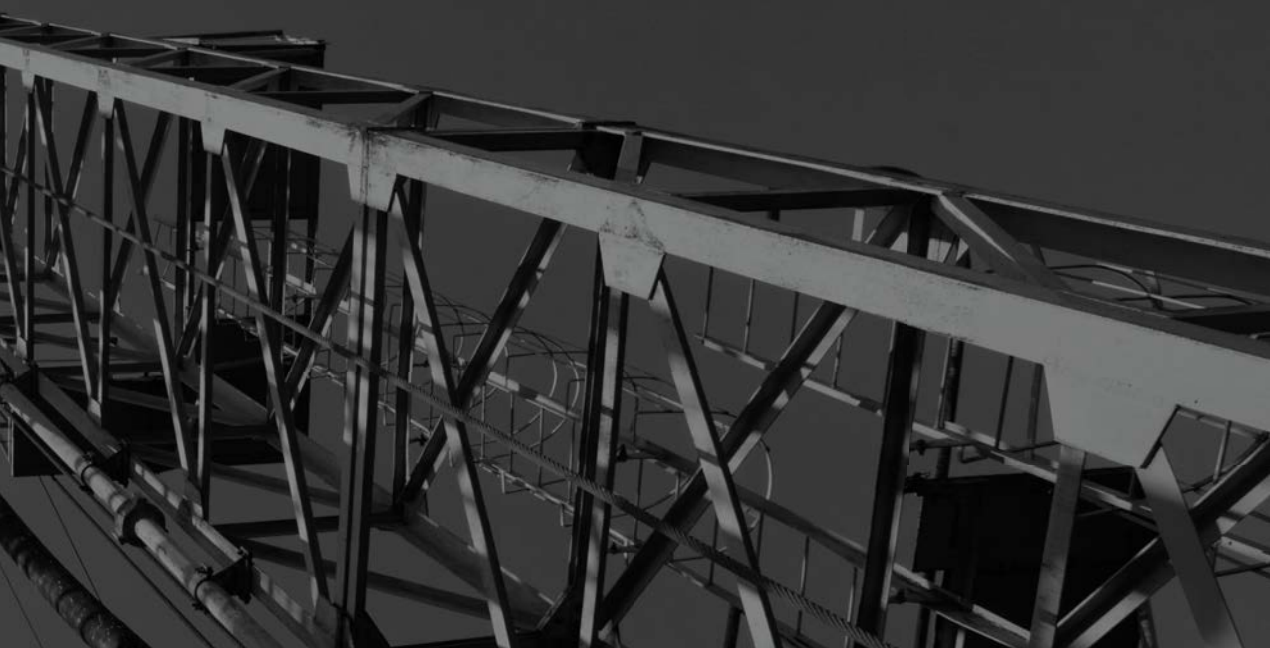


PhD candidate **Sondre Sanden Tørdal** received the best session presentation award at the 42nd Annual Conference of the IEEE Industrial Society (IEEE-IECON 2016), October 2016 at Firenze in Italy. The paper presented at IECON-2016 was joint work between the University of Agder and MacGregor.



SFI Offshore Mechatronics WP3, represented by Knut Berg Kaldestad, attended the **GPU Technology Conference, Silicon Valley**, on April 4-7: www.gputechconf.com

Three researchers in WP3 (Atle Aalerud, Joacim Dybedal and Aksel Sveier) attended the GPU Technology Conference in Amsterdam, September 28-29. The conference addressed topics such as: open autopilot platforms, frontiers in cognitive computing, deep learning, research needs on automated driving, convolutional neural networks, obstacle avoidance, hardware architectures, 3D imaging and virtual reality. This is also a part of activities to connect the PhD-students across the universities.



WP5 arranged **Rope Seminar** on September 27. The rope seminar was sold out and attracted 50 delegates from Urdal Services AS, MacGregor Norway AS, Cameron Sense AS, MHWirth AS, National Oilwell Varco Norway, DNV GL, Siem Offshore AS, AXTech AS, Bexco, Maersk Supply Service AS, TTS Bergen, Rolls-Royce Marine, Red Rock AS, W. Giertsen Services AS, TTS Marine AS, Ropeblock B.V., John Dahle Skipshandel AS and DEP Engineering. The feedback from the participants was very good, and a demand for a second rope seminar was announced.



On October 27, **Klueber Lubrication held a webinar** on the topic Lubrication and Tribology. This was a webinar open for all SFI Offshore Mechatronics partners, in addition to student and staff at UiA. This is a very good way to include international partners, and to learn and get insight in the knowledge that are special and useful for the rest of the partners.



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

The representatives participated in the SFI Offshore Mechatronics Annual conference in May and gave an evaluation of the work so far.

NORTEX DATA SCIENCE CLUSTER

SFI Offshore Mechatronics participate 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 will finance 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.

OTHER ACTIVITIES



Klueber Lubrication, Teknova and UiA had a full-day meeting in München on January 27. Klueber are world-leading specialists in lubrication and tribology competences, and bring mechanical engineers and chemists together. Sensors for lubricant condition monitoring were discussed, and UiA and Teknova were shown the extensive labs and test facilities available for the SFI partners. Klueber's main interests within the SFI are mainly linked to WP5 Condition Monitoring. Several areas for future collaboration within Condition Monitoring were identified.

WP 5 had a visit to Bridon Technology Centre (BTC). The Centre is a world leading centre of excellence for rope technology development, analysis and verification. The visit to BTC was triggered by the potential opportunities in utilising Bridon large diameter rope test equipment to validate the work performed under the SFI WP5. Topics such as: correlation between downscaled test rigs using ropes 1cm diameter versus full sized test rigs using 15 cm diameter ropes and lubrication of strands were discussed.





AALBORG UNIVERSITY
DENMARK

Prof. Michael Rygaard Hansen presented the SFI Offshore Mechatronics WP1 at the HyDrive Workshop at Aalborg University, Denmark, on March 2nd 2016. The HyDrive project is a research project on hydrostatic drive train transmissions for renewable energy applications such as wave power systems or wind turbines. The project is led by Department of Energy Technology, Aalborg University, Denmark. The WP1 in the SFI is working on topics such as drives technology similar to the topics in the HyDrive project. The aim of the participation was

to gain knowledge about the research front and inspiration to the work in the SFI WP1.

WP5 had a visit to Redaelli October 26. Redaelli is a world leading designer and producer of steel wire ropes, and has over 200 years of experience. The visit to Redaelli was triggered by recommendations from the work package reference group, holding Redaelli as an important supplier of steel wire ropes. The visit took place at Redaelli's design- and production facility in Gardone Val Trompia located in north of Italy. Redaelli has invested considerable resources in modern production equipment with enormous capabilities, displayed through setting a Guinness world record. Topics discussed included strategy for rope testing, failure mechanisms, inspection, non-destructive testing and discard criteria. Future opportunities include possible SFI spin-off projects including Redaelli as a natural consortium partner.

On November 23rd the SFI WP1 held a workshop for researchers from the research group Fluid Power in Wind- and Wave Energy at Aalborg University and from the Mechatronics group at UiA. In total 17 researchers participated. The aim of the workshop was to share experiences and find common ground for cooperation on experimental equipment, subtasks regarding specific research questions and papers and to discuss the possibilities for future cooperation and research projects. It is expected to follow up on this workshop by having a similar day in Aalborg in 2017.

Recruitment

The following researchers and technicians were hired in SFI Offshore Mechatronics in 2015-2016.

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
Lothar Wöll	PhD, RWTH Aachen	2016-2019

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 over 460 followers.



SFI Offshore Mechatronics has a lot of visits from the regional high schools, such as KKG and Vågsbygd videregående skole for tutorial sessions and demonstrations in the Mechatronics lab.



SFI Offshore Mechatronics WP3 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



The two judges next to the UiA Drillbotics machine on May 26, 2016.
Tor Inge Waag from MHWirth (Kristiansand) and Mike Herbert from ConocoPhillips (Stavanger).

The Drillbotics student competition was carried out as a friendly competition between two teams located at UiA and the University of Stavanger (UiS). The student teams built a scaled-down drilling rig from scratch, including mechanical design, electrical actuation, control system and human-machine interface. The prototype was able to perform drilling experiments in a formation consisting of marble, sandstone and limestone. The UiA team consisted of the students Yvonne Kjellelland, Maxime Marien, Terje Molnes and Emil Mühlabratt Sveen.



Arendalsuka takes place in Arendal every August, and is a week filled with lectures, meetings, political debates and conferences. SFI Offshore Mechatronics was represented on several events, and used the opportunity to discuss relevant issues with different stakeholders.

◀ Monica Mæland, Minister of Trade and Industry) and Geir Hovland (SFI Offshore Mechatronics Centre Director)

ONS is an important arena for all partners in SFI Offshore Mechatronics. It was two days with a lot of meetings and presentations, both with companies and research institutions outside the project, and with internal partners. This was a good arena to show both structure and results for the Centre's activities, but also a possibility to discuss further related topics and work on spin-off projects.



Dissemination Activities

PUBLICATIONS

JOURNAL PAPERS

Torstein Myhre and Olav Egeland, **"Tracking a Swinging Target with a Robot Manipulator Using Visual Sensing"**, MIC, 2016, Vol 37, No 1, pp. 53-62, doi: 10.4173/mic.2016.1.5

S. Neumann, L. Wöll, A. Feldermann, F. Strassburger and G. Jacobs, **"Modular System Modeling for Quantitative Reliability Evaluation of Technical Systems"**, MIC, 2016, Vol 37, No 1, pp. 19-29, doi: 10.4173/mic.2016.1.2

Sondre Sanden Tørdal, Geir Hovland and Ilya Tyapin, **"Efficient Implementation of Inverse Kinematics on a 6-DOF Industrial Robot using Conformal Geometric Algebra"**, Advances in Applied Clifford Algebras, 2016, doi:10.1007/s00006-016-0698-2

Eric Bechhoefer, Rune Schlanbusch and Tor Inge Waag, **"Techniques for Large, Slow Bearing Fault Detection"**, International Journal of Prognostics and Health Management, ISSN 2153-2648

Torstein Myhre and Olav Egeland, **"Tracking a Swinging Target with a Robot Manipulator Using Visual Sensing"**, MIC, 2016, Vol 37, No 1, pp. 53-62

Grigoris Tsagkatakis, Baltasar Beferull-Lozano and Panagiotis Tsakalides, **"Singular Spectrum based Matrix Completion for Time-series recovery and prediction"**, EURASIP Journal on Advances in Signal Processing, doi: 10.1186/s13634-016-0360-0

PUBLISHED CONFERENCE PAPERS

D. Alonso-Román, B. Beferull-Lozano, **Adaptive consensus-based distributed detection in WSN with unreliable links**, IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP), 2016

Torstein Myhre and Olav Egeland, **"Collision Detection for Visual Tracking of Crane Loads"**, IECON 2016 - 42nd Annual Conf. of the IEEE Industrial Electronics Society, doi: 10.1109/IECON.2016.7793396

Sondre Sanden Tørdal, Per-Ove Løvsland and Geir Hovland, **"Testing of Wireless Sensor Performance in Vessel-to-Vessel Motion Compensation"**, IECON 2016 - Proc. 42nd Annual Conference of the IEEE Industrial Electronics Society, doi: 10.1109/IECON.2016.7793951

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1. Alexander Meyer Sjøberg, **Development and implementation of a real-time 6 DOF pose estimation algorithm for a MS Kinect 2**, UiA.
2. Svein Gjermund Tveide, **3D sensor data acquisition and fusion for automatic gas sample taking**, UiA.
3. Perumawatte Gedara Sudeera Ranjan Wijetunga, **Development of an efficient approach to robotic welding of low-volume production**, UiA.
4. Arild Amland, **Conceptual development of parallel robot for outfitting of drilling module**, UiA.
5. Helen Pettersen, **Wireless drilling equipment**, UiA.
6. Asger Bjørkedal and Kristoffer Larsen, **Robotic assembly using 3D and 2D computer vision**, NTNU.
7. Emil Dale Bjørlykhaug, **Robotic cleaning system for salmon slaughterhouses**, NTNU.
8. Simen Hagen Bredvold, **Robotic welding of tubes with correction from 3D vision and force control**, NTNU.
9. Bjørn Emil Evensen, **Robotic Multiple-Pass Welding of V-Groove Butt Joints**, NTNU.
10. Thomas Helland, **Robot vision for automatic inspection of permanent magnets**, NTNU.
11. Ole Jørgen Jørgensen, **Industrialisering av robotisert bøying av PVC rør**, NTNU.
12. Sindre Raknes, **3D robot vision using multiple cameras**, NTNU.
13. Kasper Ahlbeck and Viktor Hristov Donkov, **Fault Tolerant Control of a Hydraulic Servo-System**, Aalborg University.

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