Aalto University

Marine Technology

Annual Report 2018-2019

Foreword

Aalto is getting 10 years old and it has initiated new strategy work which defines Aalto university long-term goals. Marine technology research group has followed closely the Aalto ambitious aims by focusing on high level international research and teaching activities as summarized in this report. RAI 2018 evaluation revealed that Marine Technology is one of the top research groups of the Mechanical Engineering department.

Aalto aims to tackle grand challenges with high societal impact. In Marine field the sustainability and safety of ship design and operations are examples of grand challenges on which also our group is intensively working. The CoE funded by LR Foundation has continued the international co-operation to improve the safety of Polar shipping.

Aalto is looking after new approaches to improve education; Grand challenge is personalized learning, life-long-learning and challenge-based-learning which should be offered with agility for those students studying their first degree, but also increasingly for those who aim to upgrade the professional knowledge, skills and attitude with those needed to act in maritime industries. Due to these fact, the group has been active in establishment of the Finnish Institute of Technology network university. During the period the group received two education awards from its results.

Marine Technology research group has been active on a number of scientific committees and organized large international conferences like IMDC, ISSW, ISSAV and ESWC.

The excellent results of our research group has also resulted to opening of 3 new professorships, of which one has been fulfilled and two are close to be nominated. These enable us to re-focus our activities to be able to study the future challenges of rapidly changing marine field.

Espoo, December 5th 2019

Pentti Kujala

Our core values and mission

Our core values

The core values of Aalto Marine and Arctic Technology shape our research and education. These define the interaction and work approaches in our unit.

Excellence: We constantly promote excellence in research and education. We work as team which encourages, challenges and supports each other. We are open to feedback from our fellow professionals and students to constantly improve and take our research and education to the next level.

Collaboration: The quality of our interdisciplinary and multidisciplinary research and education depends on the collaboration between scientific staff and support staff. We work together with passion for executing excellent research and education.

Creativity and innovation: We promote freedom to be creative and critical. These elements are essential to keep innovating our research and education, providing answers to societal questions and challenges.

Respect: Our research and education is done in an interdisciplinary and multidisciplinary environments. We learn from our colleagues and other disciplines and respect the expertise of the professionals in our community. We value integrity, openness and equality. We accept our differences and do not tolerate discrimination.

Marine technology teachers honoured with Aalto Education Impact Award 2018

Published: 5.9.2018

The FITech students have been able to apply their expertise to a new field of engineering and create unique concepts.

Engagement: We are engaged with our student community. We educate our Bachelor, Master, and Doctoral students to become excellent professionals. We promote an active participation of our students in their degree programs and promote self-responsibility in their learning process.

Relevance: Our research and education have a significant impact in the society. Those who pass by our ecosystem become excellent professionals who contribute to society as engineers. We execute research aligned to the societal challenges rising in the daily work of the stakeholders of the maritime industry. We provide science-based solutions to these challenges.

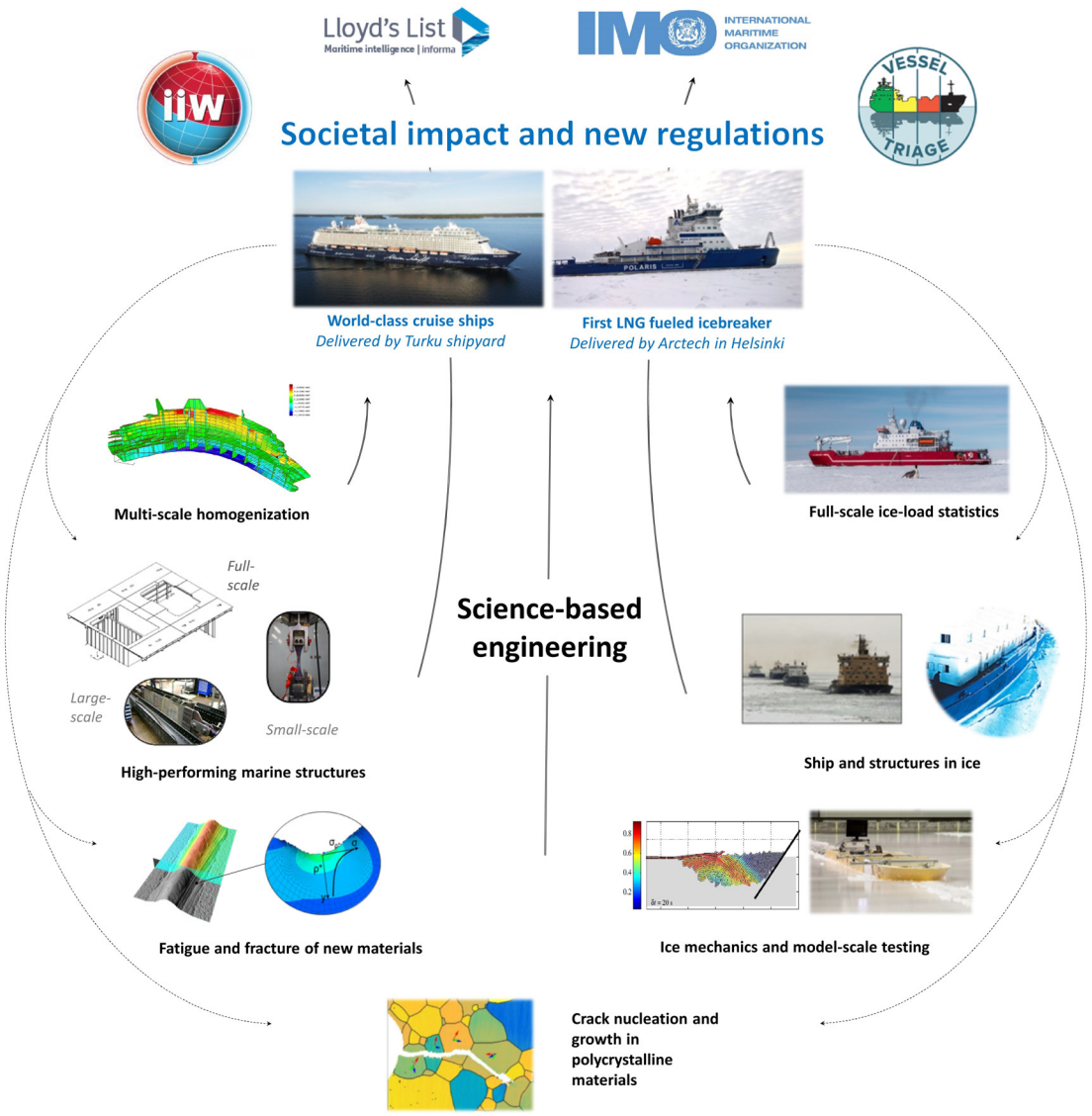
Our mission

The Marine Technology Unit at the Department of Mechanical Engineering of Aalto University School of Engineering has a responsible position in Finland in practicing internationally recognized scientific research and providing education at the highest level in ship and marine technology.

Research group on marine technology performs holistic safety analyses of marine traffic and structures based on first principles of applied mathematics and mechanics. We also develop high-performing futuristic designs in order to meet requirements of the society.

An additional purpose is to advance the development of different fields of ship and marine technology by producing and transferring knowledge to industry and society. Teaching and research are the main duties of the unit and its societal impact takes place through these fundamental activities. The basic ideas followed in scientific activity are passion for the marine technology, courage to face challenging problems of society, freedom to develop new approaches and solutions, responsibility of the actions taken and integrity of the link between research, education and societal/industrial needs.

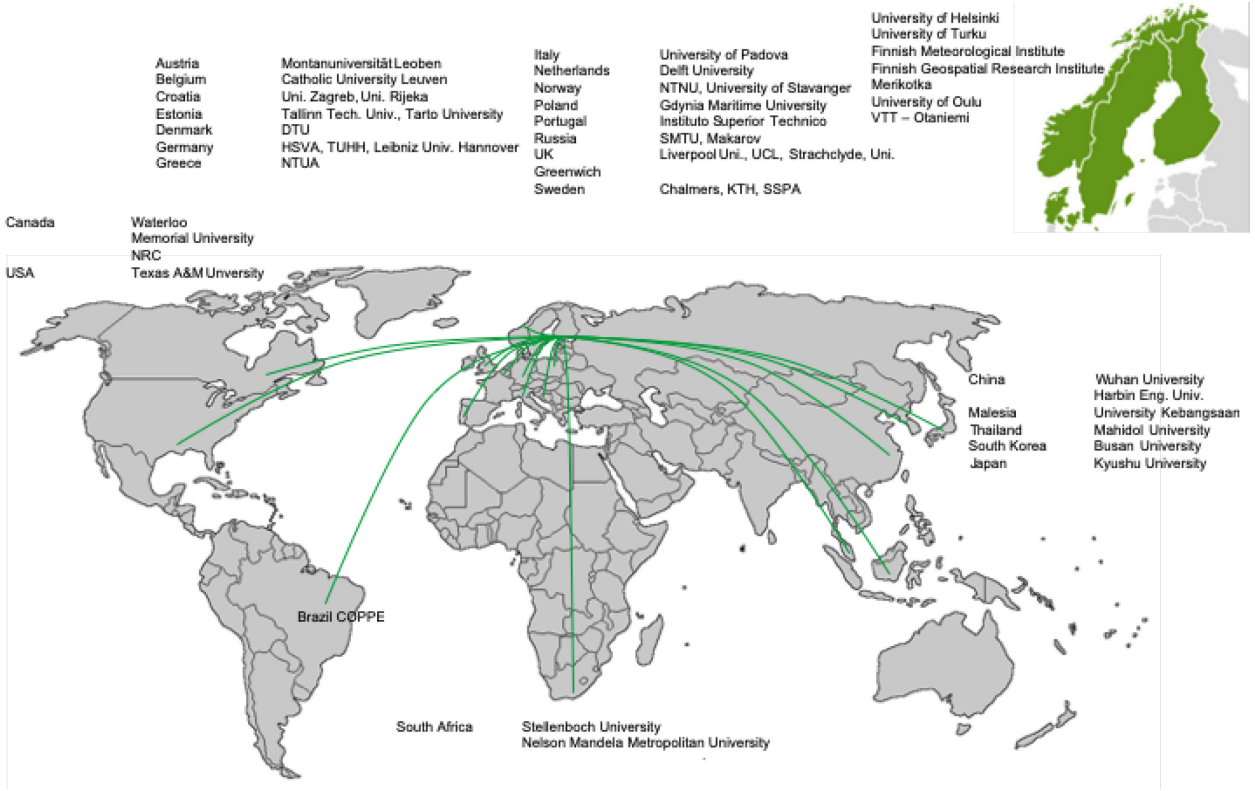
The research is integrated to career paths of professors, lecturers and postdocs, but also to the degree education on B.Sc., M.Sc. And D.Sc. levels. The students are the significant contributors to the research, and post-doctoral researchers and professors advise their work. However, professors and postdocs produce publications also by their own. As a product of the teaching, students will gain a deep understanding of the field of interest and what is necessary to evaluate, gain, and apply their skills and knowledge in practice. The teaching aims to give the students a thorough education on fundamentals in applied mathematics and physics, which does not become outdated and supports lifelong learning and research.



Operating environment

Earth is covered roughly 70% by the seas and 90% of the world trade happens by the seas. Thus, the seas, shipping, and the use of the sea form the basis of everything, yet we often take this sensitive environment as granted. The maritime field has always been, and will remain, global and they are very sensitive to market changes. For this reason the group also operates in a global scale, with partners from all around the world.

The Finnish Maritime Cluster has a strong position nationally and the unit has a strong role in education and research as academic actor, but also as influencer on national and European R&D scene, education networks and scientific and experts committees in various topics. The role of Finnish subcontractors and other companies in the maritime field has become more significant when the cluster is considered as a whole. In order to affect the global markets better on selected themes, the European co-operation has become much stronger. EU funding has concentrated on ship safety, environmental issues, and the development of advanced design and production methods for structures. The funding in the university emphasizes the importance of research aiming at doctoral degrees and publications in refereed journals. The competition for basic funding is getting tighter. Networking and the creation of larger research projects are the ways to cope with the tightened economic situation.



New feature in maritime field is the extension of viewpoint to system level solutions that do not operate anymore at the ship but fleet and regional maritime shipping system levels. At the same time the complexity at the ship level increases. This calls for heavier involvement of systems engineering disciplines to the marine technology with use of data collection, analysis and decision making. The group is dedicated for contributing to the science, technology and education on this emerging field.

Research

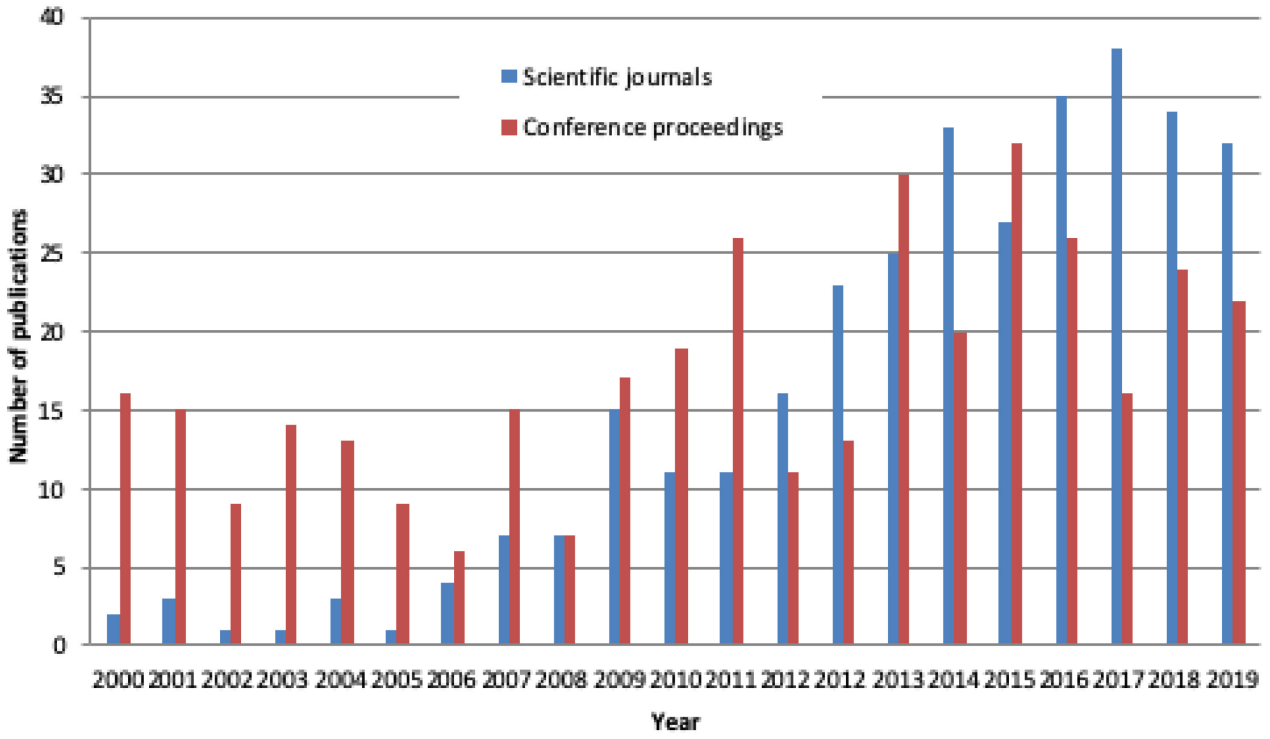
Research Objectives

We are focusing our research on development and application of first principles of solid and fluid mechanics in marine technology and maritime systems. The complex applications require holistic risk- and experience-based designs with game-changing solutions. The fluid mechanics focuses on problems of open water with free surface, hydroelasticity with strong interactions between the structure and the fluid but also interactions with ice. The solid mechanics focuses on interaction between load, response and strength with main applications being fatigue, ultimate and accidental limit states in normal and arctic operation conditions.

We do extensively experimental research in full-scale and laboratory to deepen our understanding on prevailing physics. Based on these findings, we develop modeling techniques suitable for research and industrial needs. The unit is known for its results in research and teaching and also for its significant societal and industrial impact.

The unit undertakes initiatives in research and it concentrates on problems, which are on a high level scientifically and have a strong technological impact. The focus is on both long- and short-term projects that enable strategic developments as well as rapid actions to the emerging needs of the society.

The research results are excellent. All-together 34/2018 and 32/2019 international, peer-reviewed journal papers have been produced, complemented by 23/2018 and 22/2019 conference papers. Many of these are on the high-impact journals and the number of Scopus citations increases steadily. In addition, the group has had several invited talks in both marine technology related and generic conferences that do not deal directly with marine technology.



Centre of Excellence CEARCTIC/CEPOLAR

The CEARCTIC project ended in 2018. 16 doctoral students have been working on the project, similarly 9 master thesis and 9 bachelor thesis have been conducted. These will be the future experts of Arctic shipping safety. 26 journal papers approved so far and 22 were submitted during 2018. 40 conference papers and presentations have been conducted, of which 3 keynote presentations. In addition to the new experts educated by CEARCTIC funding to be the future experts of Arctic shipping safety and the number of scientific publications.

A special workshop on the topic: "All aboard to the Arctic!, Current Policy and Operational Issues in Arctic Shipping Safety and Environmental Protection" was organized by Aalto in Brussels on 20th March 2018. There was be about 70 participants from European parliament, EU commission, Arctic experts from Finland, and other EU memberstates to discuss the future of Arctic activities and policies and the CEARCTIC results will also be clearly visible there. The final public seminar was in LR premises on the May 16th, 2018 when also the Arctic Council had a meeting in London, indicating that CEARCTIC results have interest on the Arctic community.

The research will continue under a new funding obtained from LRF for the same universities called CEPOLAR. The Centre of Excellence for Scenario-based Risk Management in Polar Waters (CEPOLAR) aims to tackle the issues associated with the new opportunities for ice covered waters through guidelines that take a holistic view of the risks present in icy waters. The project is multidisciplinary, combining expertise in design methods, ice environment, ship-ice interaction, and structural damage and consequence analysis. When shipping moves more towards the North and South Pole, it brings with it an increased interest in the safety and sustainability of polar shipping, as well as in floating offshore installations operating in geographical areas with ice-infested waters. Current rules and regulations for the design of ice- going ships are either deterministic or address risks in a way that is only partly based on performance. All accident-borne limit states are not properly considered by the IMO Polar Code or the IACS unified requirements for polar ships. This necessitates the development of goal-based regulations for ship safety and sea traffic.

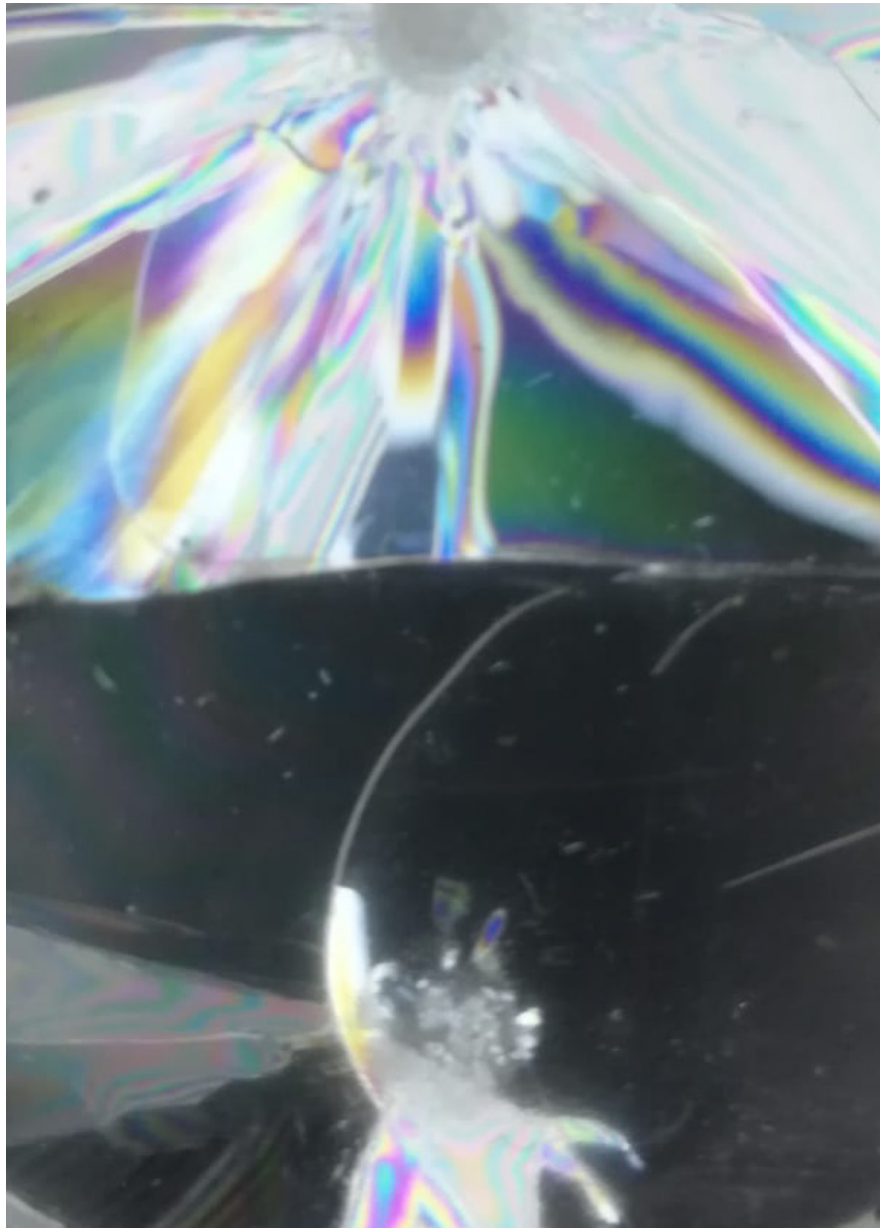
Recommended practices will be developed to cover all key elements of polar ship design. This development work is conducted in collaboration with key stakeholders from the international maritime industry. The scope of this project is to develop guidelines for the safe and sustainable design of ice classed fleets by combining practical knowledge, state of the art engineering methods, and fundamental academic developments pertaining to the definition of safety levels at the early stages of ship design. To achieve the our goal, we study risks of Arctic operations by defining hazard scenarios and quantitatively estimating their impact (probability and consequences) of those at the concept design stage. CEPOLAR was initiated by a kick-off meeting in Otaniemi, early February 2019.

Arctic Marine Technology

To support safe, sustainable, and efficient ice navigation, the Arctic marine technology group is pursuing research on multiple fronts related to the design and operation of ice-going ships. The work is motivated because ice navigation is on the increase, driven by multiple factors including the extraction of Arctic natural resources, trans-Arctic shipping, and Arctic tourism. In addition, ice navigation in regions with seasonal sea ice (e.g. the Baltic Sea) remains very significant.

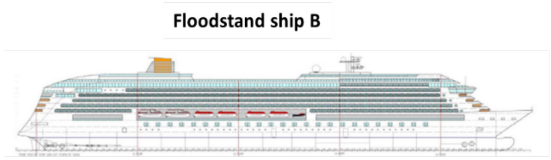
To manage Arctic maritime activity related risks to humans and the polar environment, in January 2017 the International Maritime Organization (IMO) enforced the International Code for Ships Operating in Polar Waters (Polar Code). The code is fundamentally goal-based, allowing designers to deviate from established prescriptive rules, facilitating design optimization and innovation. However, for designers to be able to implement goal-based regulations, they need relevant and validated design tools and approaches and therefore we have presented an approach for holistic goal-based design of Arctic ships.

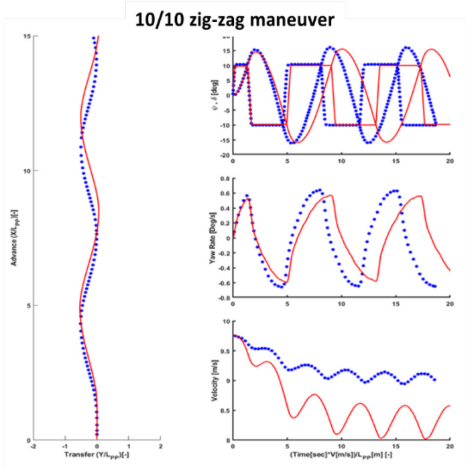
We performed during the period December 2018-March 2019 a significant full-scale measurements in the context of the international Weddell Sea Expedition 2019 with MV S.A. Agulhas II to Antarctica that has been used to validate the new Polar Operational Limitation Assessment Risk Indexing System (POLARIS. We also performed reanalysis if ice-load prediction methods. The outcome of this analysis indicates that the event-maximum method for assessing the maximum ice loading acting on a ship is stable and consistent, and thus in principle fit for goal-based design. A comprehensive study on Arctic maritime accident database was performed (3,362 accidental events from the period 1975-2018).

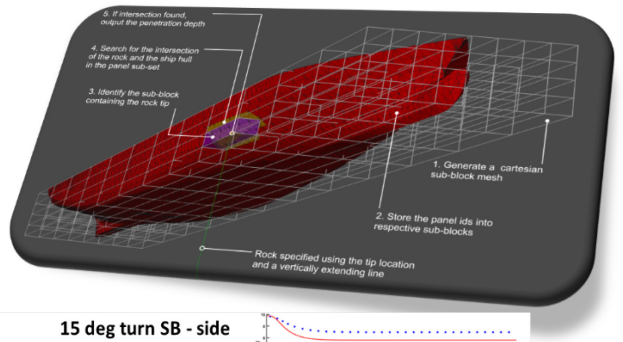


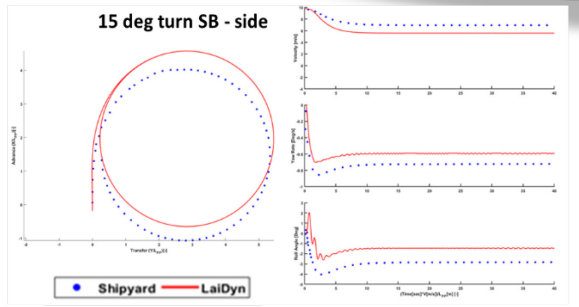
Maritime Risk and Safety

Risk and safety research is focused on developing concepts, methods, tests and frameworks for creating safe technological and socio-technological systems, as well as for managing associated risks. These advances in risk analysis and safety science are applied to specific problems in maritime engineering. Scenario-based risk modelling is essential for the safe operation of ships and maritime ecosystems. Given the rapid developments in marine technologies, with increased automation, digitalization, and system integration, there is a constant need for ensuring the safety of design and operation of new maritime systems. Modern ships require improved designs that consider efficient traffic management systems and navigation safety controls. Our commitment to excellent research on maritime safety will be continued with the preparation of competitive project applications in national, regional and other international fund calls that aim for developing competence and our society in the maritime context. The ultimate aim for our research on maritime safety is to develop a project portfolio that promotes the transfer of new knowledge between academia and industry to advance the field of maritime safety science and engineering, as well as to support the development of the future maritime ecosystem.









With this approach, our research on maritime safety focuses on the analysis of the entire maritime ecosystem. The research on safety aims at influencing the design and operation of ships and their interconnected systems. During the period the excellence of our research on maritime safety was represented by the outcome of ongoing research projects for assessing the reliability and safety of large maritime systems, analyzing the risks in the design of a new autonomous maritime ecosystem and autonomous vessels for urban waterways, assessing the risks related to oil spills in extreme environmental conditions, developing a risk-based methodology for “live” flooding risk assessment, and reviewing the current state of the art in risk analysis and decision support in Baltic Sea.

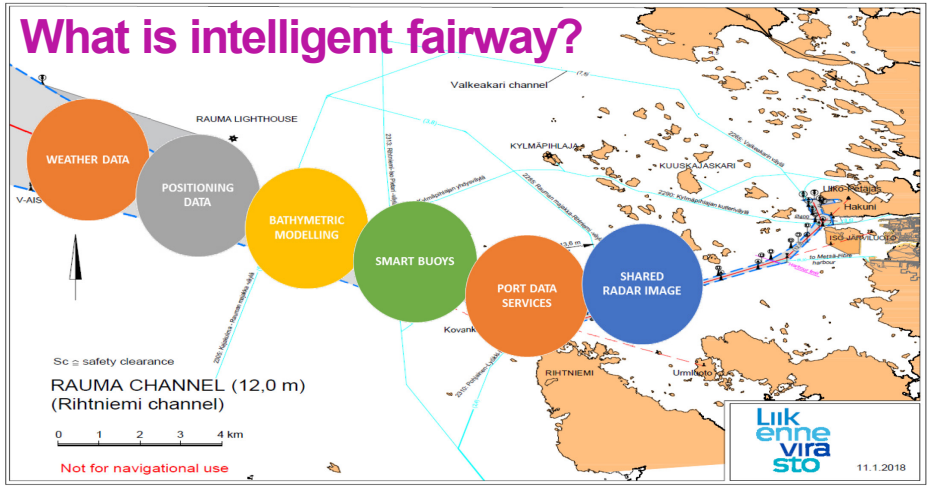
Our work on the mentioned research projects has produced excellent scientific publications in high-level journals. In addition, our research of maritime safety produced guest editorial assignments by Professors Pentti Kujala and Spyros Hirdaris and Postdoctoral researcher Osiris A. Valdez Banda in the journal of Safety Science (Virtual Special Issue: Autonomous Vessels Safety) and Applied Sciences (Special Issue: Recent Advances on Safe Maritime Operations under extreme conditions).

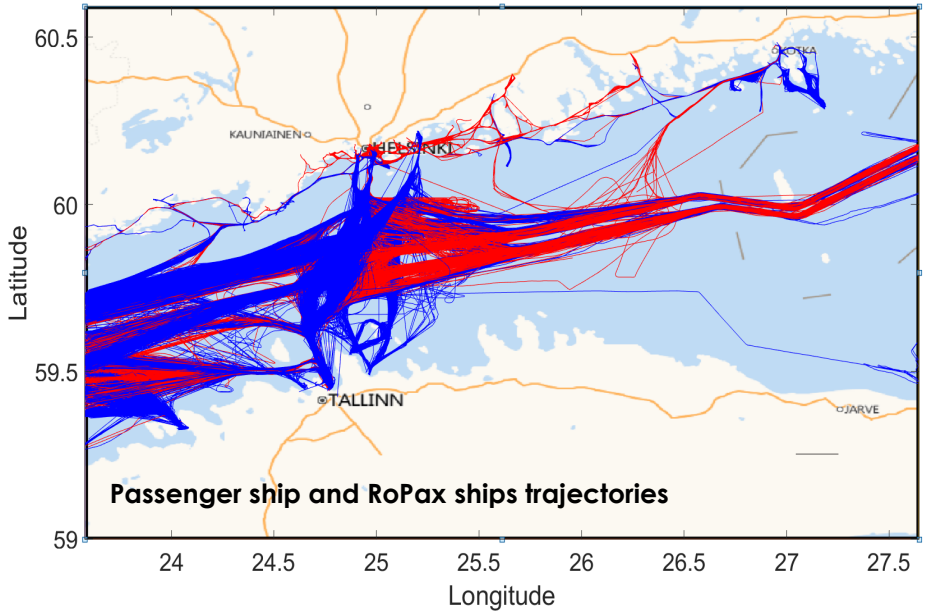
Sustainable Operations

Sustainable maritime operations is emerging field of maritime technology in Aalto and the whole group is dedicated to solve the multitude of sustainability issues associated with maritime operations. The new professors recruitments are expected to strengthen this field. Today, still most of the actions are related to Arctic operations, but we are extending these to open water operations as well as sustainable use of materials in future.

To allow the prediction of ice-induced additional resistance in the design of ships and operations, we modelled the icebreaking process by combining both analytical and numerical approaches as well as advanced fitting techniques. This resulted in an accurate and effective model that makes it possible to simulate a ship's icebreaking process, both on a straight course and during maneuvering. To be able to better assess the risk of an oil spill in extreme conditions, and to reduce the environmental risks related to oil spills, we have initiated the development of an open-access test-bed map. The intention is to make the test-bed map capable of providing spatial information on the vessel traffic in Gulf of Finland, in a format suitable for accidental oil spill analysis in terms of the identification and analysis of probable hot spots, oil spill scenarios, and response scenarios.

Both the Finnish and the Swedish export industries are strongly dependent on efficient winter navigation, and any delays in ship arrivals, for instance caused by extreme ice conditions, or unplanned icebreaker downtime, might result in significant operational disturbance and economic loss. Towards an increased operational robustness and reliability of the Finnish-Swedish winter navigation system, we have developed two different simulation approaches that can be used to analyze the traffic flows of the Finnish-Swedish winter navigation system in various scenarios concerning for instance the prevailing ice conditions, the availability of icebreaking resources, and future propulsion power regulations



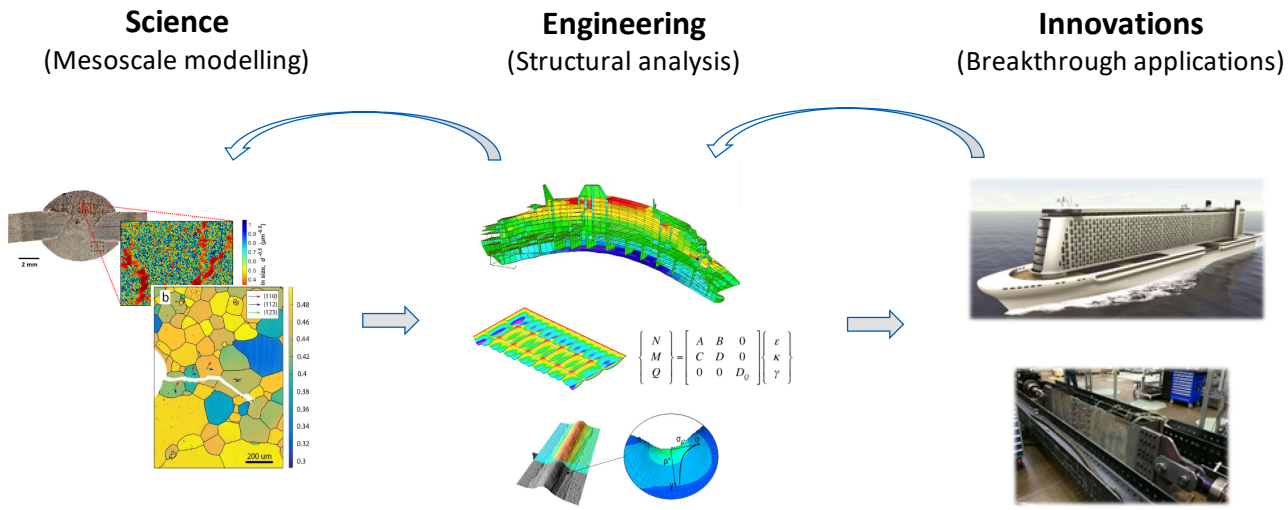


Advanced Structures

Advanced marine structures and materials research focuses on the mechanical behavior of high performance materials, material systems and structures. To meet the increasingly stricter societal requirements for energy efficiency, we develop high-performing structures that utilize new steel materials and manufacturing methods for the maritime industry. In this work it is essential to fundamentally understand the strength properties of steel structures produced in the industrial scale.

We are focusing our research on the load-carrying and failure mechanisms of steel structures under different types of load scenarios, that affect the design of a ship. This requires research at length scales ranging from ship hull girder to material microstructural scale. Thus, we carry out extensive experimental studies across these length scales to gain understanding on material and structural behavior. These experimental material testing methods have synergies with other groups in Aalto.

We use the latest numerical techniques to gain insight into theoretical modelling and prevailing assumptions. To simplify the design process of ships, we develop efficient theoretical models for complex structural systems. The development of these methods are motivated by the challenges of large, complex marine structures and short design cycles. Although developed in the maritime field, they also have applications in other fields, such as nano technology, aeronautical and civil engineering.



At present, the most of our research activities are focused on high strength steel structures as well as thin-plated and lattice-type sandwich steel structures. These solutions have the highest potential to improve the energy efficiency of ships. In these areas, the focus is on how the materials' microstructure and structural topology affect strength and stiffness. In particular the interfaces between structures, e.g. welded joints, are of key importance to structural safety and they are thus in a major role in our research activities.

The group currently holds three Academy of Finland projects on fatigue and fracture of steel structures, and one Marie Curie Global fellow project on the micromechanics of sandwich structures. These academy projects support our long-term research strategy, and they have resulted in several scientific publications, invited talks, awards, and doctoral theses. To complement the scientific research, we have a major EU-project on the application of advanced materials to the ship's primary structures. In this project, we transfer the knowledge and skills gained from basic research to use in the industry, and simultaneously build the next generation of research questions for our group.

Finances and Projects

The basic research in the unit is carried out mainly through projects that are funded by the Academy of Finland. The applied research is mainly funded by Business Finland or the European Union. Beside these projects, professors and postgraduates perform their own unprompted research, which is mainly funded by the tenure tracks and graduate school positions of School of Engineering. Marine Technology is also linked to the center of excellence, CEARCTIC–center funded by Lloyd's Register Foundation.

2018

Total budget of the Marine Technology unit is 2,64 M€. The external budget funding is 54%, of which 23% is funding from EU, 20% from Academy of Finland and 11 % from Business Finland.

The division of the external project funding portfolio is as follows:

Business Finland	11%
Academy of Finland	20%
EU	23%
Others	46%
Total	**100%**

2019

Total budget of the Marine Technology unit is 2,49 M €. The external budget funding is 37 %, of which 31 % is funding from EU, 20 % from Academy of Finland and 3 % from Business Finland.

The division of the external project funding portfolio is as follows:

Business Finland	3%
Academy of Finland	20%
EU	31%
Others	46%
Total	**100%**

Projects: MarineDamping, SEDNA, Marine, LOURA, MIRROR, LRF Center, LRF Center II, RAAS, IMDC2018, Meriklusteri, MERLOG 2030, WINMOS II, BALTIMARI, ÄlyVESI, MEROS, INFUTURE, SIMREC, JOULES, HYDRALAB-PLUS, MSCA-RISE-RESET, MSCA SANDFECH, RAMSSES, FLARE, MKS Teollinen väitöskirjatyö, Vieraileva professori, Infra, Cruise & Ferry 2.0, Joint Accruals, D4V, Innovation Booster ENG, FI-Tech, mFAT, StrainPaths, NanoCrack, BSA ODIGIS, Hydralab-PLUS, A!OLE, Profi 3, Profi2, A!OLE 2019

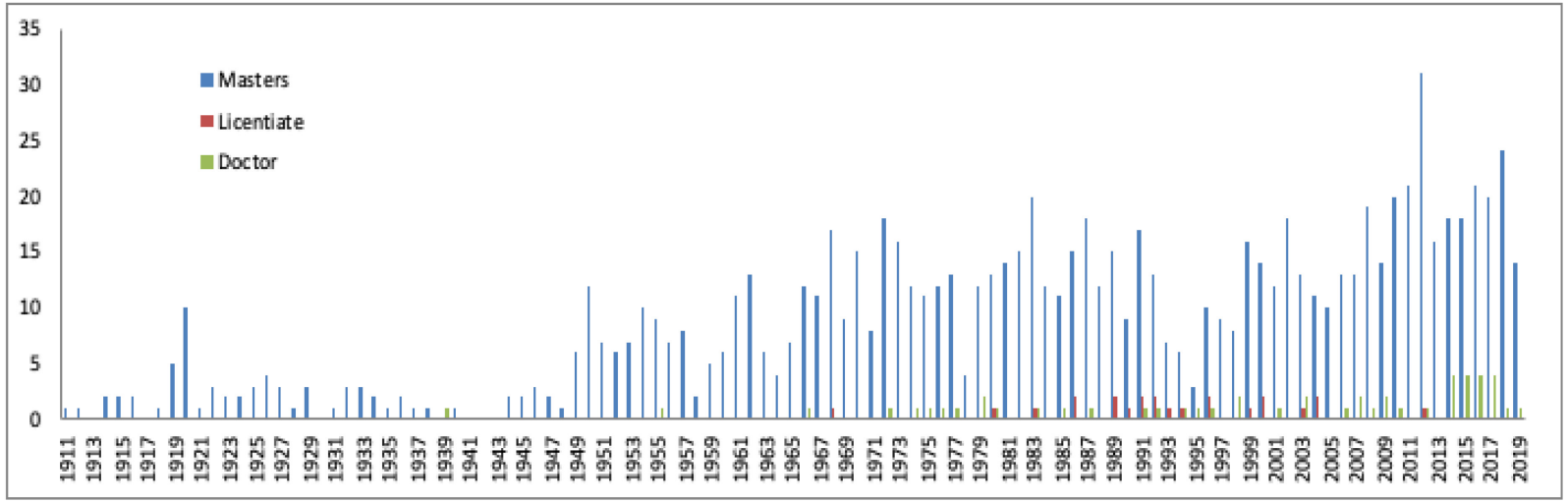
Education

Education and students

Our ambition is to educate students to become professionals who contribute to a better society and have excellent work prospects after graduation. We also understand our over 100 year old position in Finland. Our role is internationally recognized science-based education at the highest level in on ship and marine technology. We follow our core values in education, are proud of our students and alumni and their successes and capabilities to act as game-changers internationally. As a product of the teaching, students will gain a deep understanding of the field of interest and what is necessary to evaluate, gain, and apply their skills and knowledge in practice. The teaching aims to give the students a thorough understanding in basics on applied mathematics and physics, which does not become outdated and supports lifelong learning and research.

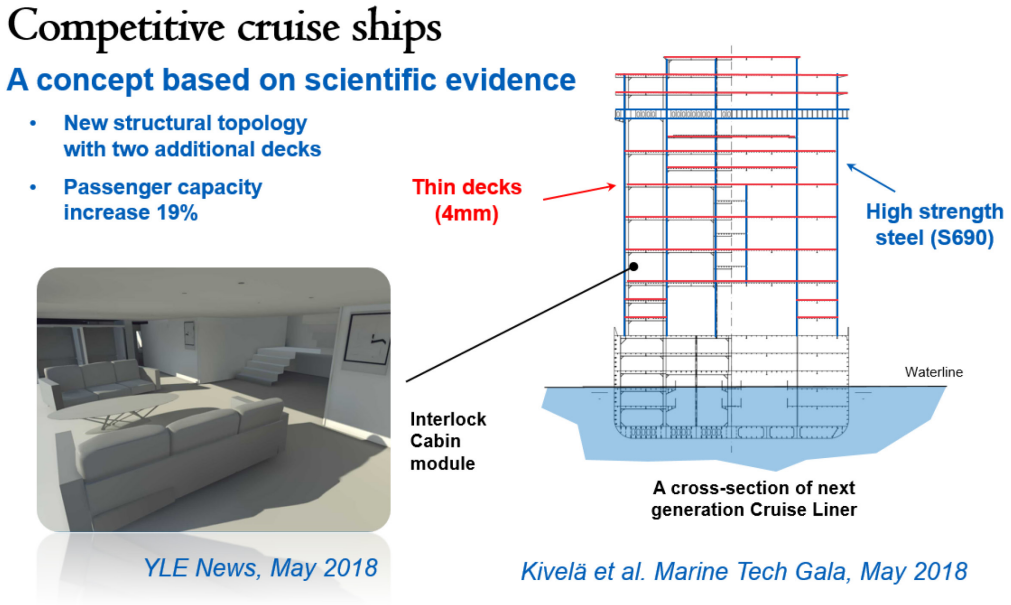
The education is based on the main idea of developing career-based personalized study plans for our students through academic advising. This starts already at the Bachelor level where maritime studies are not yet within the program and the focus is in on the fundaments of engineering. At the Master level the marine technology professors advise every student with their study plans. In Doctoral and post-doctoral education the intensity of the advising increases. The same principles are applied to the academic staff in their career paths. This philosophy has been proven to create the game-changers that society needs at all levels of academia and industry.

Our education has a strong basis on the collaboration between the schools of Aalto and efficient utilization of networks within Finland and Scandinavia. This allows us to transfer the latest knowledge and best education offered by our partner universities to our students. This work gave the unit the Aalto Education Impact Award 2018. Another School of Engineering Education Award 2019 was granted to Lecturer Tommi Mikkola for his excellent performance on teaching fluid mechanics at the Bachelor and Master level, and hydrodynamics at the Master level.



Master level education

Our ambition is to educate M.Sc. students to become engineering professionals who contribute to a better society and have excellent work prospects in the industry. Those majoring at the M.Sc. level to maritime field are encouraged to learn the fundaments on mechanical and/or civil engineering at their B.Sc. studies. This gives us as educators the possibility to focus on the teaching of knowledge, skills and attitudes that a modern naval architect must posses when entering the job market. For those taking a minor study on marine technology, the core idea is to enable the student to utilize their major field in the context of maritime industries. The idea is to give just enough knowledge of the specifics of marine technology to be able to operate in this interesting yet challenging field of engineering. Due to this split, we have seen a significant increase in the number of starting students being 26 in 2018 and 38 in 2019. There were 24 graduated students in 2018 and 16 in 2019.

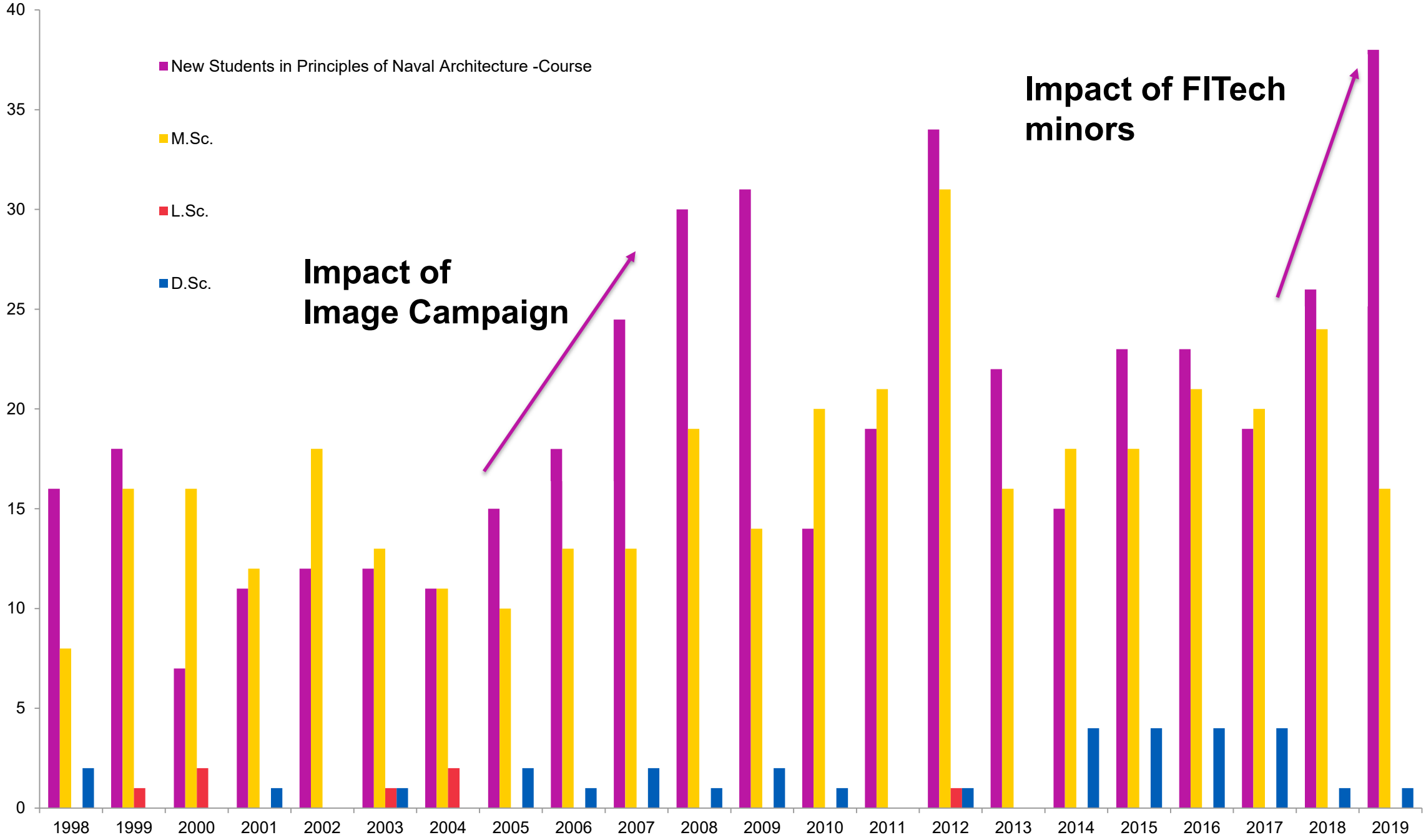


YLE News, May 2018

Kivelä et al. Marine Tech Gala, May 2018

Currently the marine technology intake for major M.Sc. studies is mainly enabled through the Mechanical Engineering program where maritime students can select different study options ranging from classical naval architecture to emerging fields of smart and sustainable maritime engineering. Altogether we offer 5 study tracks which can be flexibly modified based the on student's career plans. The international collaboration networks for major studies are the Nordic Masters in Maritime Engineering and Cold Climate Engineering, which are education networks with the Nordic Five tech Universities (Aalto, Chalmers, DTU, KTH and NTNU). On top of this, we have established two minors within a Finnish technical network university for those interested in the field, i.e. the Marine Technology, and Smart and Sustainable Marine Operations minors.

The education is problem and challenge-based which means that the students work as groups on their project ships throughout their studies. This simulates the situation faced in the ever changing industry, where life-long-learning is one of the main skills one must possess to succeed as a game-changer in the international job-markets. The student projects are assessed twice a year in the marine technology gala in which industry and other stake-holders give constructive and critical feedback to the student projects. This together with strong basic education secures the success of our students. The creative efforts of the students have resulted also in considerable public interest.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Doctoral education and postdoctoral training

Our ambition is to educate D.Sc. students and postdocs whose advanced expertise contributes to a better society and whom have excellent prospects in the academic and industrial expert positions. For Doctoral studies each student is recruited through a competitive processes in which the motivation letter, research plan and a financial plan is executed prior the thesis process starts. This way, the thesis process has a solid foundation and research direction from the beginning, making graduation in the objective time of 4 years possible. For those making D.Sc. studies part time, a similar process is made with the distinction of graduation time being extended to 8 years and the process carried out while working in the industry. As in the case of Master level education, the thesis topics are selected carefully by analyzing the academic, industrial and societal needs. Currently, the unit holds 23 full and 6 part time students. Both in 2018 and 2019 1 D.Sc. Degree was awarded, Mikko Suominen 2018 and Pauli Lehto 2019.

In post-doctoral training the unit considers two different motivations for this career stage at academia. The main reason for academic postdoctoral training is to enable the participants to advance to academic careers in Aalto, elsewhere in Finland or internationally. The aim of training is to systematically develop an academic profile which place our alumni as top candidates for highly competitive academic positions. During 2018-2019 the following alumni got their professorship: Miguel Goncalez Calle in Brazil, Floris Goerlandt in Canada and Mihkel Körgesaar in Estonia. The second target of postdoctoral training is to enable those with doctoral degree to enter the industry and accelerate the R&D cycles of companies with their expertise, and to help society to form new policies, rules and regulations based on scientific evidense.

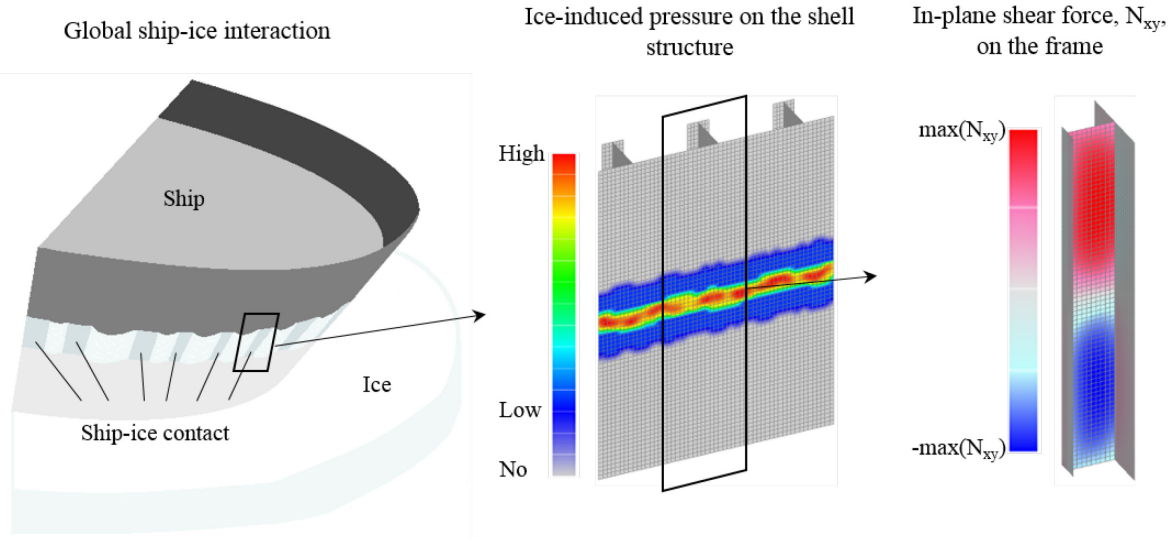
Example of a Doctoral thesis

Uncertainty and variation in measured ice-induced loads on a ship hull

Mikko Suominen

Retreating Arctic sea ice offers new opportunities for harvesting natural resources and new shipping routes. However, securing the safety and sustainability of maritime operations in Arctic sea requires knowledge of ice-induced loads on the ship hull. Although ice-breaking is a complex process, full-scale measurements offer an opportunity to study the ice-induced loads on a ship hull as all the complexities of the breaking process are embedded in the measurements. Unfortunately, full-scale measurements contain additional uncertainty and variation related to the measurement techniques. One of the main uncertainties is the length of contact between ice and the ship hull, which affects the load transfer between structural elements.

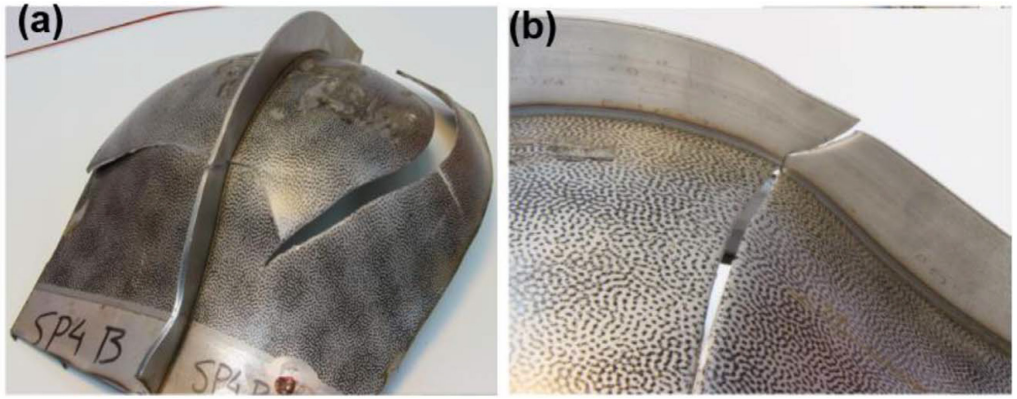
This thesis focused on the uncertainty and variation in the measured loading on the ship hull when in contact with ice. The focus was on the ice load measurements based on the shear strain difference in instrumented structural elements. The structural parameters affecting the load transfer were identified and the possible error and uncertainty related to the length of contact with ice were estimated theoretically. The full-scale experiments on board S.A. Agulhas II in the Baltic Sea were analyzed showing that the loading on a frame increases as a function of contact length, and that the shape of the probability density function changes. In addition, the measurement uncertainty related to the extension of the instrumentation was studied and recommendations were given. This type of basic research is fundamental when the accuracy of big data received from ship operations in considered.



Example of postdoc training towards a professorship

Aalto Alumni Professorship in Tallinn University

Dr. Mihkel Kõrgesaar got pointed as the Assistant professorship in Estonian Maritime Academy, Tallinn University of Technology in April 2018. He is the head of the recently established Naval Architecture and Hydrodynamics research group. The research is focused on the behavior of small crafts, ships and marine structures in normal and extreme environments with a focus on safety. The driving motivation is to enable better, safer, and more energy efficient future ship concepts that serve the societal and industrial needs.



Under the umbrella of this general theme, the focus lies on two core topics. The first basic research topic focuses on hydrodynamics and fluid-structure interaction behavior of small crafts. The goal is to increase the energy efficiency and behavior of small crafts in different operational conditions. This research is supported by the experimental testing in the towing tank where we deepen our understanding regarding ship behaviour in different conditions. We are also currently investigating different options on how to represent the experimental findings in the simulation environment.

The main research activities started in the beginning of 2016 with the investigation of sprayrail deflection in small crafts, which enables reduced operational resistance in water at higher speeds. At the end of 2017, a joint grant together with researchers from the Department of Civil Engineering and Architecture was secured to investigate fluid structure interaction in ships. The second basic research topic focuses on the load response and failure mechanisms of materials and welded structures under different types of loadings. This basic research is supported by experiments and numerical assessments. Numerical simulations are used to get insight into theoretical modelling and prevailing assumptions, while experiments provide the supporting validation data. The application cases are the accidental limit states of ship structures. This involves internal and external mechanical behavior assessment of ship collision and grounding accidents, residual strength evaluation of damaged ship and fluid structure interaction during and after accidental event.

Special courses organized

Rapidly changing needs of the society calls for advanced and timely measures for education. During 2018-2019 the unit organized several international events to complement the existing course curriculum.

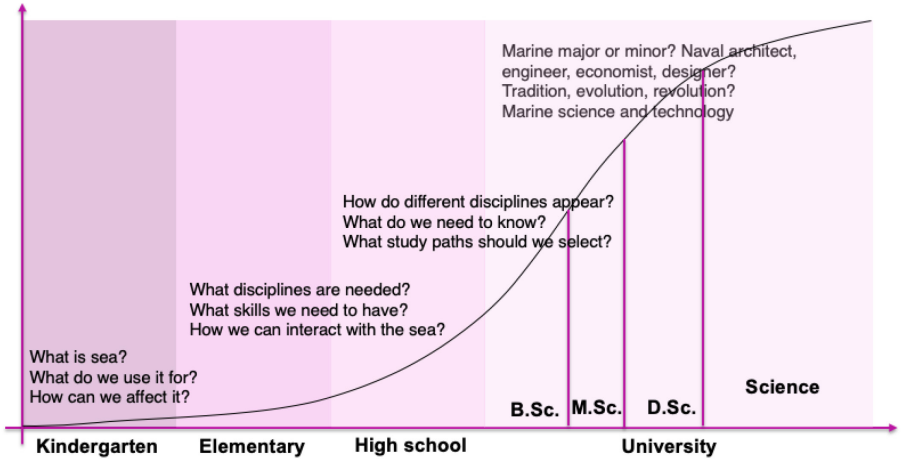
In May-August 2018 the unit organized FITech 2018 **Summer Boost on Technology and Business Models of Autonomous Ships (10 ECTS)** in which 26 students around Finland took part. The aim of the course was to give students from various backgrounds a possibility to learn the basics of naval architecture and ship systems, with some ideas of how automation and use of artificial intelligence will affect the future ship design. The students formed large, multidisciplinary design teams to work on novel concepts for this emerging field of technology. The concept was a part of the Finnish Institute of Technology (FITech), for the development of which marine technology received the Aalto Impact Award on Education 2018.

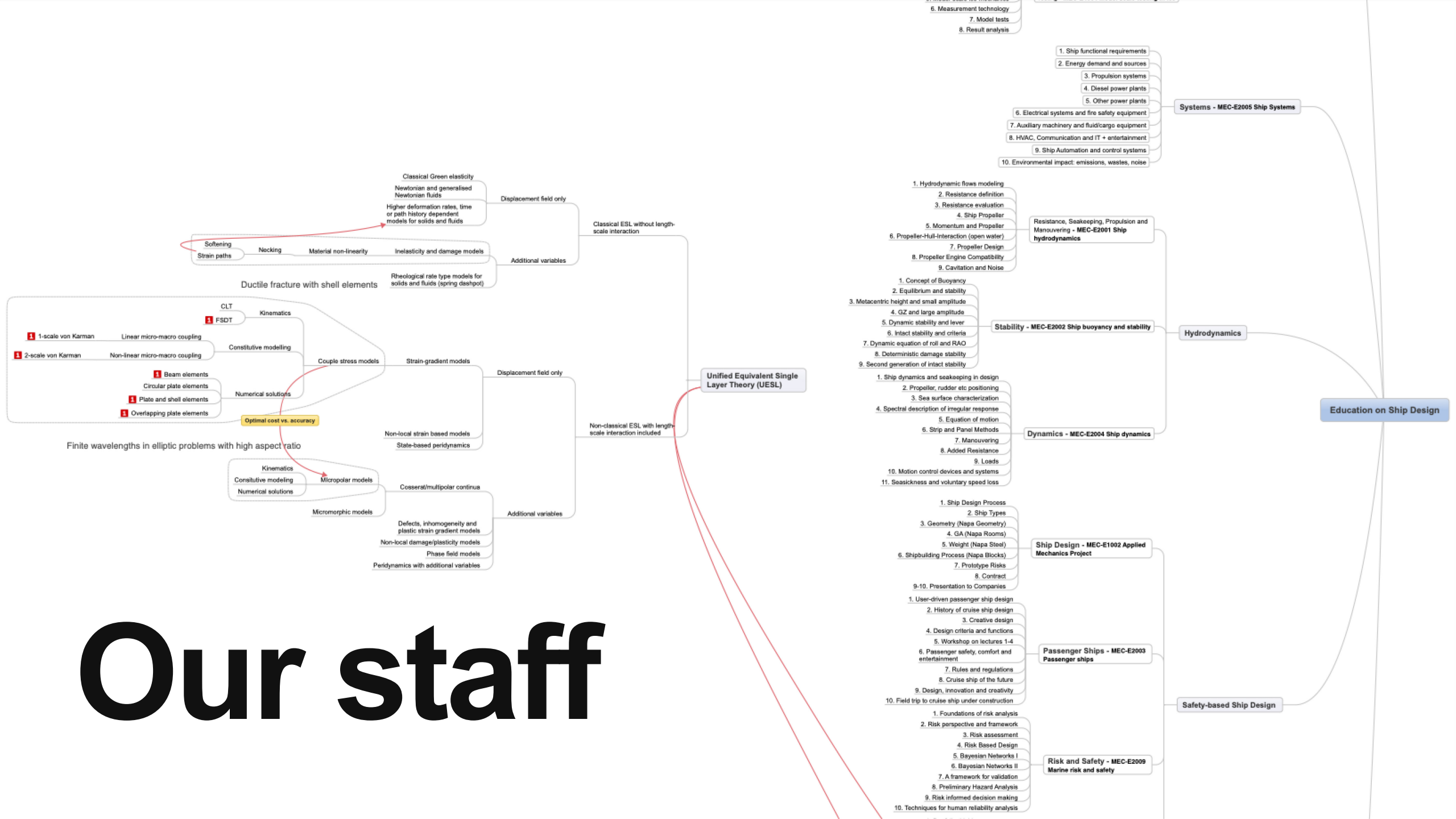
During June 23rd to 26th 2019 the unit organized a short course on **Non-local theories (3 ECTS): Mathematical models and computational approaches**. The course was aimed to give Doctoral students, researchers and junior professors ideas how to utilize the possibilities of non-classical continuum mechanics in different fields of structural engineering. During September 14th to 23rd 2019 Aalto organized a graduate seminar with the State Maritime Technical University of St Petersburg Russia for 30 students from China, Russia, Germany and Finland on **Marine Robotics**.

Recruitment of Future Talent by Involvement in Elementary and High school

Marine technology needs new talent to tackle the problems we face in maritime operations. In the end of the day, maritime is all around us and it is by far the most sustainable form of transportation, although being also a slow one. Often the field is associated with biased public image of polluting ships, dirty shipyards and accidents harming the environment. What is not known, is the current state of the field with technology being very clean and the fact that Finland is known globally for the game-changing technical solutions, processes and agile innovation ecosystem where the pioneering solutions are introduced to the global markets.

Due to these issues, the group has taken an active role to educate and impact children and teenagers about maritime activities. The group has hosted groups from kindergarten and elementary schools from the capitol region in the Aalto Ice tank and given classes in the format of Aalto Juniors activities. The group has also given visiting lectures for high-school students in Turku (TurkuSteam), Espoo (Olarin lukio) and Shaking Up Tech Event held in October 22nd 2019, where female students around Finland took part to the one day event with technical studies being at focus. The group has also started collaboration with Otaniemi high school in format of laboratory exercises at the Aalto Ice tank.

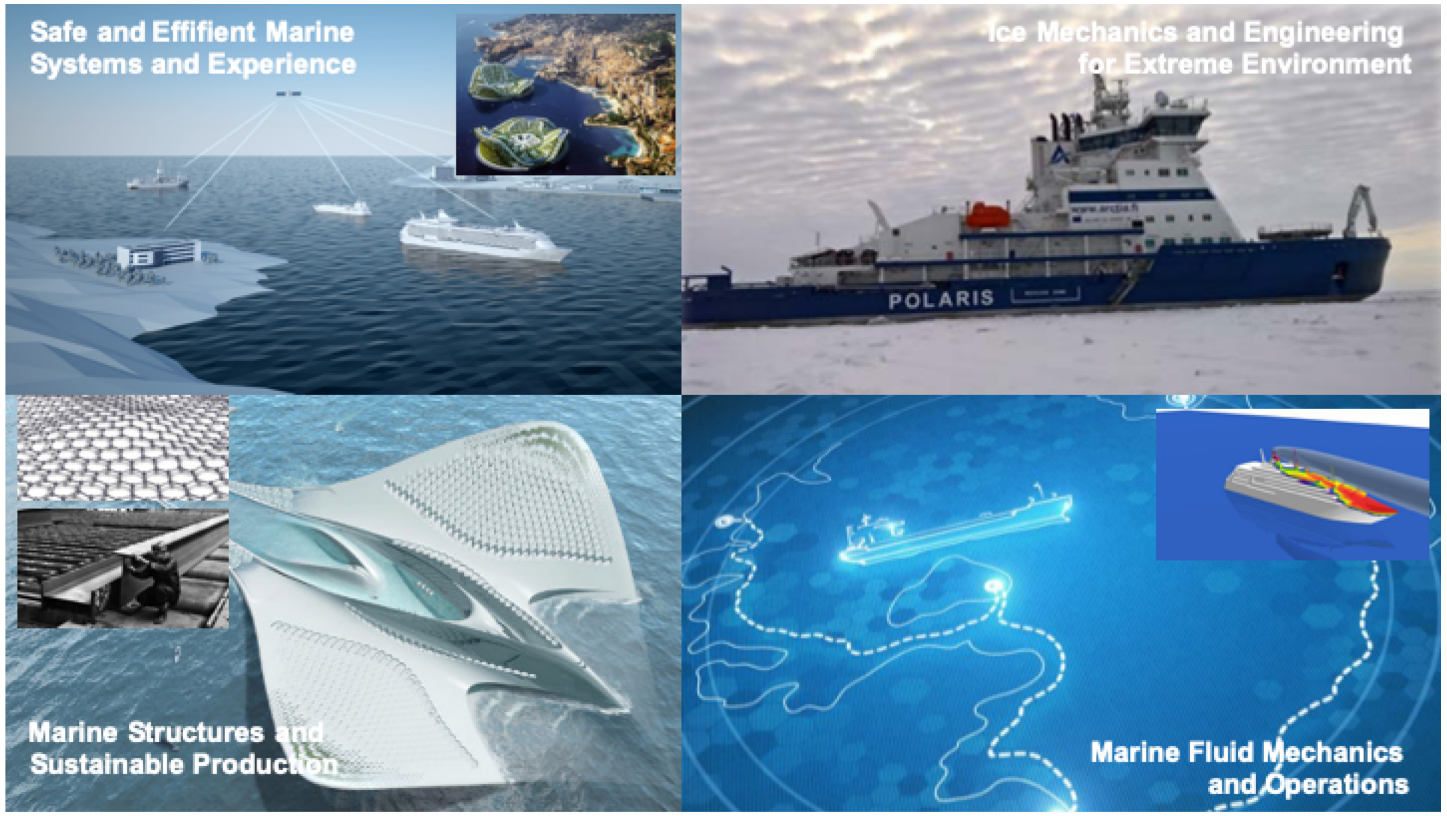



6. Measurement technology
7. Model tests
8. Result analysis
1. Ship functional requirements
2. Energy demand and sources
3. Propulsion systems
4. Diesel power plants
5. Other power plants
6. Electrical systems and fire safety equipment
7. Auxiliary machinery and fluid/cargo equipment
8. HVAC, Communication and IT + entertainment
9. Ship Automation and control systems
10. Environmental impact: emissions, wastes, noise
Systems - MEC-E2005 Ship Systems
Classical Green elasticity
Newtonian and generalised Newtonian fluids
Higher deformation rates, time or path history dependent models for solids and fluids
Displacement field only
Softening
Strain paths
Necking
Material non-linearity
Inelasticity and damage models
Rheological rate type models for solids and fluids (spring dashpot)
Additional variables
Classical ESL without length-scale interaction
Ductile fracture with shell elements
1. Hydrodynamic flows modeling
2. Resistance definition
3. Resistance evaluation
4. Ship Propeller
5. Momentum and Propeller
6. Propeller-Hull-Interaction (open water)
7. Propeller Design
8. Propeller Engine Compatibility
9. Cavitation and Noise
Resistance, Seakeeping, Propulsion and Manouvering - MEC-E2001 Ship hydrodynamics
1. Concept of Buoyancy
2. Equilibrium and stability
3. Metacentric height and small amplitude
4. GZ and large amplitude
5. Dynamic stability and lever
6. Intact stability and criteria
7. Dynamic equation of roll and RAO
8. Deterministic damage stability
9. Second generation of intact stability
Stability - MEC-E2002 Ship buoyancy and stability
Hydrodynamics
CLT
FSDT
Kinematics
1-scale von Karman
Linear micro-macro coupling
2-scale von Karman
Non-linear micro-macro coupling
Constitutive modelling
Couple stress models
Strain-gradient models
Beam elements
Circular plate elements
Plate and shell elements
Overlapping plate elements
Numerical solutions
Optimal cost vs. accuracy
Finite wavelengths in elliptic problems with high aspect ratio
Displacement field only
Non-local strain based models
State-based peridynamics
Non-classical ESL with length-scale interaction included
Unified Equivalent Single Layer Theory (UESL)
1. Ship dynamics and seakeeping in design
2. Propeller, rudder etc positioning
3. Sea surface characterization
4. Spectral description of irregular response
5. Equation of motion
6. Strip and Panel Methods
7. Manouvering
8. Added Resistance
9. Loads
10. Motion control devices and systems
11. Seasickness and voluntary speed loss
Dynamics - MEC-E2004 Ship dynamics
Education on Ship Design
Kinematics
Consitutive modeling
Numerical solutions
Micropolar models
Cosserat/multipolar continua
Micromorphic models
Defects, inhomogeneity and plastic strain gradient models
Non-local damage/plasticity models
Phase field models
Peridynamics with additional variables
Additional variables
1. Ship Design Process
2. Ship Types
3. Geometry (Napa Geometry)
4. GA (Napa Rooms)
5. Weight (Napa Steel)
6. Shipbuilding Process (Napa Blocks)
7. Prototype Risks
8. Contract
9-10. Presentation to Companies
Ship Design - MEC-E1002 Applied Mechanics Project
1. User-driven passenger ship design
2. History of cruise ship design
3. Creative design
4. Design criteria and functions
5. Workshop on lectures 1-4
6. Passenger safety, comfort and entertainment
7. Rules and regulations
8. Cruise ship of the future
9. Design, innovation and creativity
10. Field trip to cruise ship under construction
Passenger Ships - MEC-E2003 Passenger ships
1. Foundations of risk analysis
2. Risk perspective and framework
3. Risk assessment
4. Risk Based Design
5. Bayesian Networks I
6. Bayesian Networks II
7. A framework for validation
8. Preliminary Hazard Analysis
9. Risk informed decision making
10. Techniques for human reliability analysis
Risk and Safety - MEC-E2009 Marine risk and safety
Safety-based Ship Design

Our staff

Our staff

We are proud of the commitment and ambitions of our employees - and we are always looking for the best employees. Those employees who love the challenge to work in interdisciplinary and multidisciplinary environments. Employees who can efficiently connect research and education, making bridges between teaching, science and society in scope of maritime actions. Employees that are committed to high academic standards and high quality education, intellectual freedom to teach and learn, and who behave in a responsible manner and respect the rights of the other members of our community. In the coming years, we want to continue investing in our employees, who together form the marine community at Aalto. We will devote more attention to career development, and we will do so in a systematic and structured way.



In 2018-2019, professors Pentti Kujala, Spyros Hirdaris, Heikki Remes and Jani Romanoff directed the research and education of marine technology, with assistance from the professor of practice Pekka Ruponen part time, and from two full-time lecturers on ship design and fluid mechanics. In addition, post-doctoral researchers, postgraduate students, research assistants, and the permanent laboratory staff participate to teaching and research activities. Pentti Kujala continued his work in the position of Professor in marine traffic safety; Spyros Hirdaris (started September 2019) on marine safety and hydrodynamics, Heikki Remes in advanced marine structures and production and Jani Romanoff as the professor of advanced marine structures and design. Martin Bergström and Floris Goerlandt as a lecturer of Ship Design and Tommi Mikkola as lecturer of fluid mechanics. Emeritus Professor Jerzy Matusiak stayed active after retirement, participating in teaching and research and helping younger colleagues on defining future directions of marine technology.

The excellent results of our research group has also resulted to opening of 3 new professorships, of which one has been fulfilled and two are close to be nominated. These enable us to re-focus our activities to be able to study the future challenges of rapidly changing marine field.

Our Staff

Professors

Pentti Kujala, Jani Romanoff, Spyros Hirdaris, Heikki Remes, Pekka Ruponen (part-time), Jerzy Matusiak (emeritus), John Dempsey (visiting), Jakub Montewka (visiting)

Lecturers

Martin Bergström, Floris Goerlandt, Tommi Mikkola

Postdocs and Visiting Researchers

Pauli Lehto, Miguel Calle Gonzalez, Pasquale Gallo, Tomasz Hinz, Anssi Karttunen, Sang Jim Kim, Ketki Kulkarni, Mihkel Körgesaar, Arun Lakshmynarayanana, Jairan Nafar Dastgerdi, Janne Ranta, Otto-Ville Sormunen, Osiris Valdez Banda

Doctoral Students

Sabina Akter, Sunil Basnet, Kennie Berntsson, Meriam Chaal, Lei Du, Mateusz Gil, Ali Hazrati Niyari, Mikko Kotilainen, Jakke Kulovesi, Pauli Lehto, Fang Li, Sami Liinalampi, Morten Lindeberg, Liangliang Lu, Federica Mancini, Bruno Goncalves Reinaldo, Roman Repin, Alexander Rogers, Farhang Shamaei, Mikko Suominen, Ghalib Taimuri, Mikko Vihlman, Mingyang Zhang, Mari Åman

Research Assistants

John Brown, Julio Cesar Gavito Munoz, Michael Dearing, Werner Hämäläinen, Gabor Gulyas, Arttu Haapiainen, Juri Huuhtanen, Sabina Idrissova, Zongyu Jiang, Eeva Lilja, Mikael Manner, Ana Maria Manzur Tirado, David Bradley Mullen, Godwin Oamen, Pekka Palokangas, Panagiotis Psycharis, Samuel Siljama, Miko Sutinen, Petri Suurnäkki, Aaron Tam

Support Staff

Marissa Lundström, Pirkko Suominen, Otto Puolakka, Teemu Päivärinta, Lasse Turja

New leading personal and nominations

Vice Dean of Research (School of Engineering)

Professor Pentti Kujala has been appointed Vice Dean for Research of the School of Engineering (ENG) for the period of 1.07.2018-31.12.2021. The position of vice dean for research duties are related mainly to coordinate the research activities of ENG and take part in planning joint research activities with other schools of AALTO and especially to initiate research co-operation between Aalto and other relevant national and international stakeholders.

Associate Professor of Maritime Safety

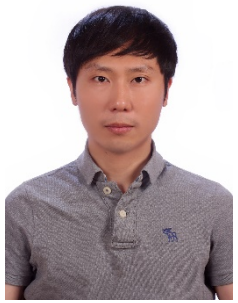
Dr. Spyros Hirdaris is Associate Professor of Maritime Safety with teaching duties on naval architecture, ship dynamics, wave loads and responses. He is interested in research on both deterministic and risk based ship safety. On the deterministic front he mostly works on Fluid Structure Interaction models for the determination of wave loads that may impact design for safety. His work on risk based ship safety looks into the de-risking of emerging technologies and safety science concepts for enhanced maritime operations and ship functional performance under extreme conditions. Before joining Aalto University Spyros worked for 14 years for Lloyd's Register at UK, Europe and the Far East. He is Chartered Engineer, European Engineer, Member of the Royal Institution of Naval Architects (UK), The Institution of Mechanical Engineers and the Technical Chamber of Greece. His international appointments include membership of the International Ship and Offshore Structures Congress, Visiting Research Fellowship at the University of Southampton (UK) and Associate Editorship of the IMechE Journal Part M on Engineering for the Maritime Environment.

Lecturer in ship design (New)

Martin Bergström held the position of lecturer in ship design for the period 01.08 – 31.12.2018. He completed a Master's degree in Marine Technology at Aalto University in 2010, and started thereafter his professional career as a research associate at the Center of Maritime Technologies (CMT) in Hamburg (Germany). In 2017, he completed a doctoral degree at NTNU - Norwegian University of Science and Technology. In his PhD work, he presented a simulation-based approach for holistic goal-based design of Arctic maritime transport systems. In his postdoctoral research, he focused on the development of tools and approaches supporting holistic goal-based ship design. In this context, holistic design means a design approach that treats a ship as an interconnected part of a wider maritime system. Goal-based design, in turn, means a design process applying goal-based design rules, which instead of prescribing a specific solution, prescribe functional requirements to meet a specific goal. As lecturer in ship design, he was involved in the teaching of basic naval architecture, as well as of the application of goal-based ship design rules and regulations. Since January 2019 he is working in the European shipbuilding industry.

New postdocs in the group

Dr. Arun Lakshmynarayanana is currently a post-doctoral fellow in the Marine and Arctic Technology group since March 2019. His research focuses on the deterministic evaluation of functional safety of ships and floating structures by advanced hydroelastic methods. As part of his PhD studies at the University of Southampton he implemented a coupled RANS CFD and FEA models to understand the hydroelastic behaviour of ships in regular and irregular waves. He is teacher in-charge for the postgraduate course ship hydrodynamics at Aalto University. Arun also undertakes doctoral advisor role to a PhD student who works on hydroelasto-plastic dynamics of damaged ships. Previously, he worked as a Research Fellow in the University of Southampton from 2016-2019 where he completed his doctoral studies. In this role, he worked closely with the industrial partner Shell Shipping and Maritime on ship performance management and vessel efficiency improvement of LNG ships.



Dr. Sangjin Kim joined Aalto's Maritime & Arctic Technology Group as post-doctoral fellow in August 2019. His major is Naval Architecture and Ocean Engineering. He received his BSc, MSc and Ph.D degrees from Pusan National University of the Republic of Korea. His Ph.D focused on understanding the nonlinear responses of topside structures on FPSOs subject to hydrocarbon explosions. His research interests are the nonlinear structural behaviour, structural safety assessment and risk assessment of ships and offshore structures under extreme loads (e.g. explosion, fire, collision and grounding). He is currently involved with the development of crashworthiness assessment models for passenger vessels under the EU Horizons 2020 project FLARE (FLooding Accident REsponse), teaching ship structures and PhD supervisions on fluid structure interactions.

Dr. Ketki Kulkarni joined Aalto's Maritime & Arctic Technology Group as post-doctoral fellow in September 2018. Her field of specialization is Industrial Engineering and Operations Research. She received her BE degree from Pune University, India, MS degree(Industrial Systems Engineering) from Georgia Institute of Technology, USA and PhD degree from Indian Institute of Technology Bombay, India. She has worked as a Research fellow in Singapore Management University in Smart Port Operations. Her research interests are marine traffic safety, transportation related risk assessment and decision support systems. She is currently involved with the review and uptake of research and innovation in maritime risk assessment in the Baltic region under the BONUS synthesis project BONUS BALTIMARI: Review, Evaluation and Future of Baltic Maritime Risk Management, along with research in harbor intelligence and modelling for marine traffic safety.

New postdocs in the group

Dr. Pauli Lehto started as a post-doctoral researcher after receiving his D.Sc degree in November 2019 from the Aalto University. His work has been focused on the experimental investigation of welded steel's mechanical properties, in combination with developing novel microstructural characterisation methods utilising scanning electron microscopy. His ambition is to link information from the microstructural length scale to the design process of welded steel structures, enabling efficient utilisation of high strength steels and new structural topologies. At present, he is carrying out research in the Finnish Academy project and an EU funded project related to Advanced Material Solutions for Sustainable and Efficient Ships.

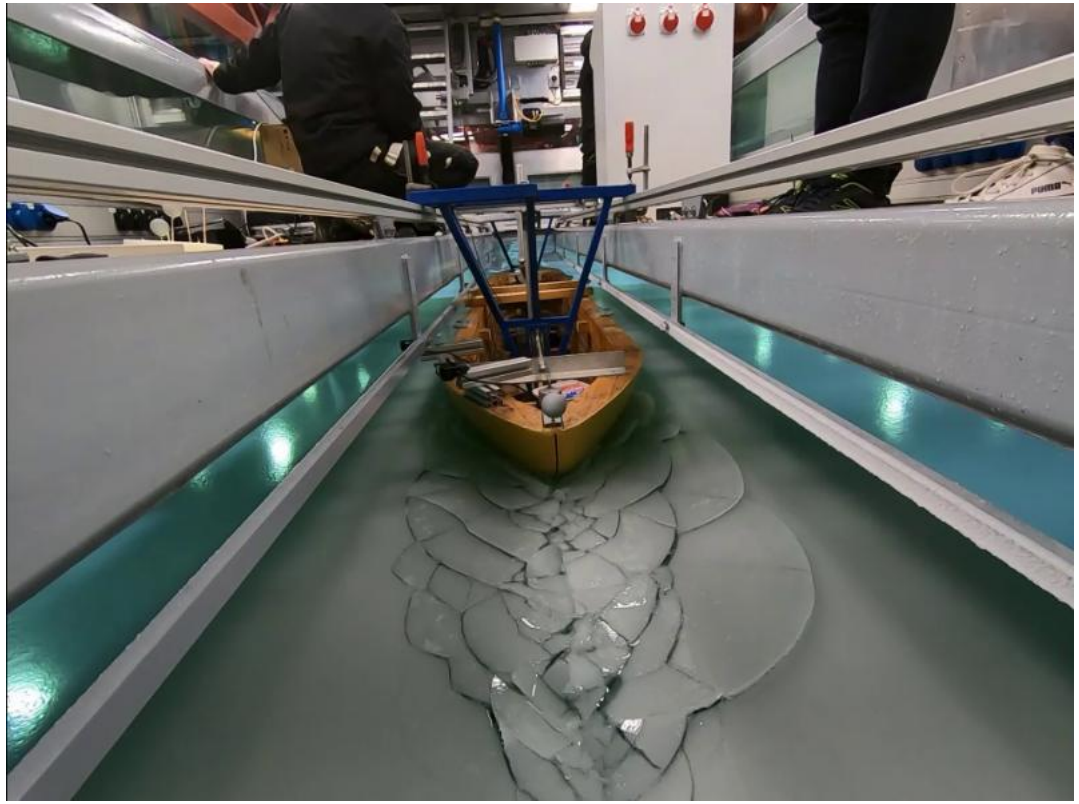
Dr. Miguel Calle joined Aalto's Maritime & Arctic Technology Group as Visiting Researcher fellow from January 2018 to September 2019. He received his BSc degree from Pontifical Catholic University of Peru (Peru) and his MSc and PhD degrees from Polytechnic University of Sao Paulo (Brazil) in Mechanical Engineering. After PhD, he worked as project manager dealing with scientific and technical tasks related to the Ship Collision project in the Group of Solid Mechanics and Structural Impact (Brazil). His research work in Aalto's group was the development of an experimental similarity technique to reproduce the structural response of marine structures subjected to collision using reduced scale models built by additive manufacturing techniques. He is currently working as a Visiting Professor in the Federal University of ABC (Brazil) teaching subjects related to manufacturing processes.

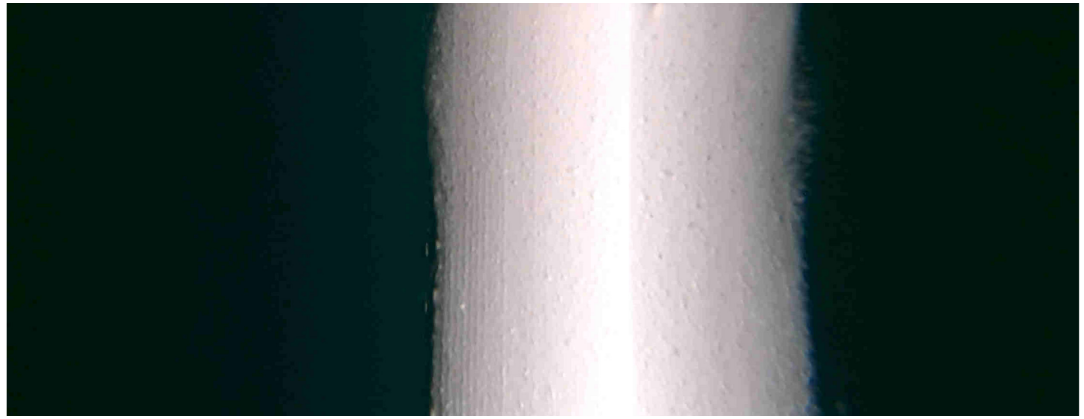
Our facilities

Aalto Ice Tank

After an extensive renovation beginning 2014, Aalto Ice Tank resumed testing in March of this year. Remodeling of the facility, undertaken with a 8 million euro funding from the Finnish Ministry of Education and Culture and the Academy of Finland, has included a new high-power refrigeration system, a new ice production system, retrofitting the test bridge with new automation and a new carriage, installation of a new optical 3D positioning system, and updates to the wavemaker, the shop spaces and the building. These investments allow higher test accuracy and productivity, extending and strengthening the tank's position as the world's largest ice test facility.

In addition to calibrating the new model ice production systems and finalizing the renovation, two major test campaigns were carried out successfully this year with international researcher groups within the European Union (FP7) project Hydralab+. The transnational access projects H+-Aalto-02-Wave and H+-Aalto-06-UNIS, dealing with wave-ice-interaction and ridge consolidation, benefited from the extended capabilities of the tank. The year saw also resuming of commercial testing and experiments in other multi-year campaigns. With state-of-the-art systems, the renovated Aalto Ice Tank is entering 2020 well set for a decade of world-leading research and testing.

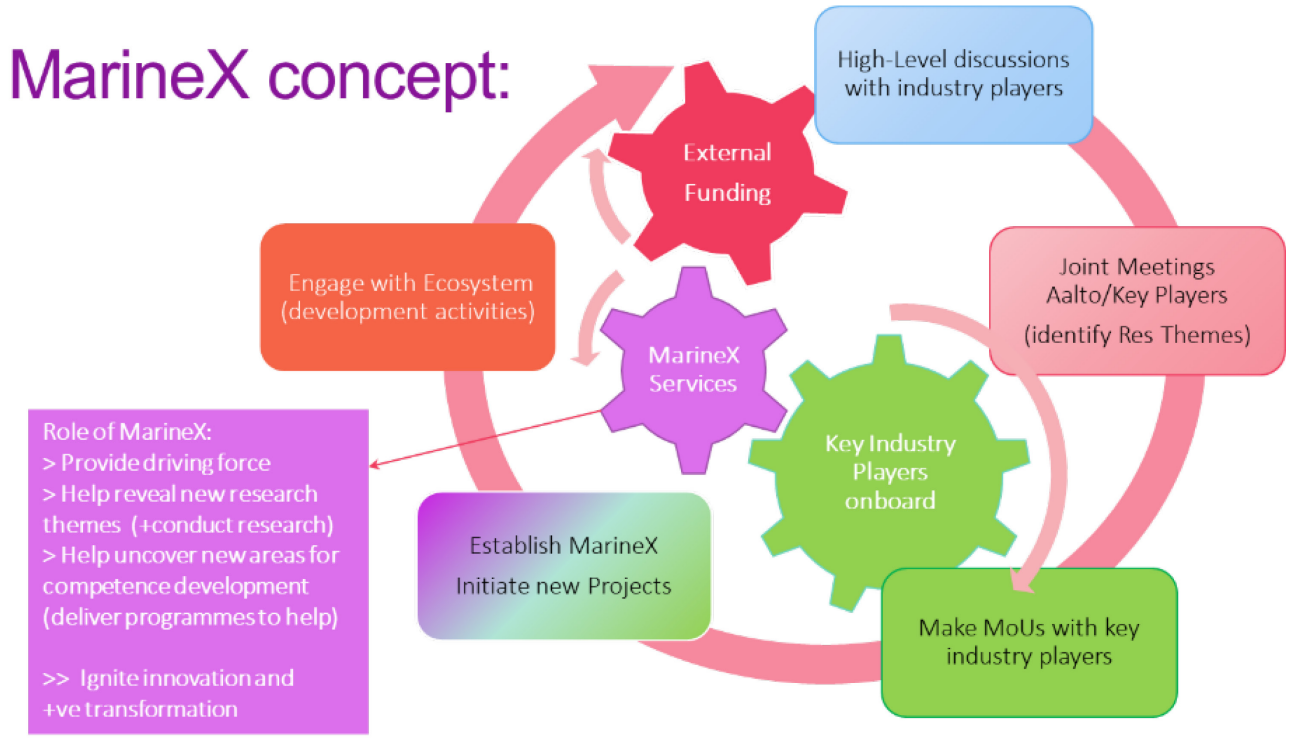




MarineX Collider

Like most global industries today, the Maritime industry is confronted by additional uncertainty and complexity stemming from emerging megatrends, such as digitalization, climate change and sustainability, in combination of a growing demand for high-tech skills required to exploit the potential of new technologies (e.g. Artificial Intelligence, big data, Augmented Reality). While these changing conditions provide many challenges, the question is how can organizations in the Marine industry best navigate these changing conditions to take advantage of the opportunities?

The MarineX Collider (research and innovation centre) is being established at the Aalto University to help tackle these issues. Where MarineX differs from others is that it strives to tap into the knowledge and expertise of the Maritime Ecosystem (currently out of reach of any single actor) to help tackle the uncertainty and complexity. By utilising the combined knowledge and expertise across the entire Maritime Ecosystem, MarineX jointly develops solutions to solve technological issues as well as jointly developing guidance and mechanisms to handle the softer side of innovation management and change, within the industry.



During 2018-19, a number of significant development steps have been laid, to provide firm foundations for the establishment of MarineX. These steps include the following: discussions with key executive industrial partners; making agreements on research themes and collaboration practices; hiring of a full-time manager to drive the developments forward; additional research, via interviews and brainstorming sessions, to identify common challenges across the maritime industry; discussions with actors in the ecosystem (Business Finland, and other Universities) whom have vested interests in developing the Maritime ecosystem and further discussions have taken place within the wider Aalto community.

Impact and service

Service

The Marine Technology research group aims to interact with society actively and service it with the capabilities it has. National and international networks are seen essential for high-quality research and education and service activities are always strongly related to these core elements of academia.

Inside Aalto University, cooperation was practiced on the at all organizational levels ranging from structural research activities within Department on structures, Arctic technology and energy-efficiency to the university level through Aalto Ice Tank and MarineX collider. Within Finland the unit was active in the formation of the Finnish Institute of Technology (FITech) in the scope of two minors associated with the marine technology. Within the research projects coordinated by the Kotka Maritime Research Centre (Merikotka), the cooperation in selected fields of research with the University of Helsinki and University of Turku was continued. The development of the new strategy for the Merikotka co-operation finalized during 2018-2019. The Marine Technology research group also actively supports Finnish, regional and international regulatory actors in policy issues related to its scientific expertise, e.g. concerning ship design and operational safety and environmental pollution. For instance, group members have participated in expert working groups at the International Maritime Organization. The cooperation between the Western European Maritime Universities continued in the form of executive committee position by prof. Kujala, complemented by memberships on WATERBORNE that creates European level research agenda. This involves a great deal of coordinated activity and Network of Excellence-type projects. The LRF research centre of excellence in Arctic Shipping and Operations, headed by Aalto University, with the partnering universities, the University of Helsinki, the Norwegian University of Science and Technology, Hamburg University of Technology, and Memorial University of Newfoundland, got extension and continued its work.

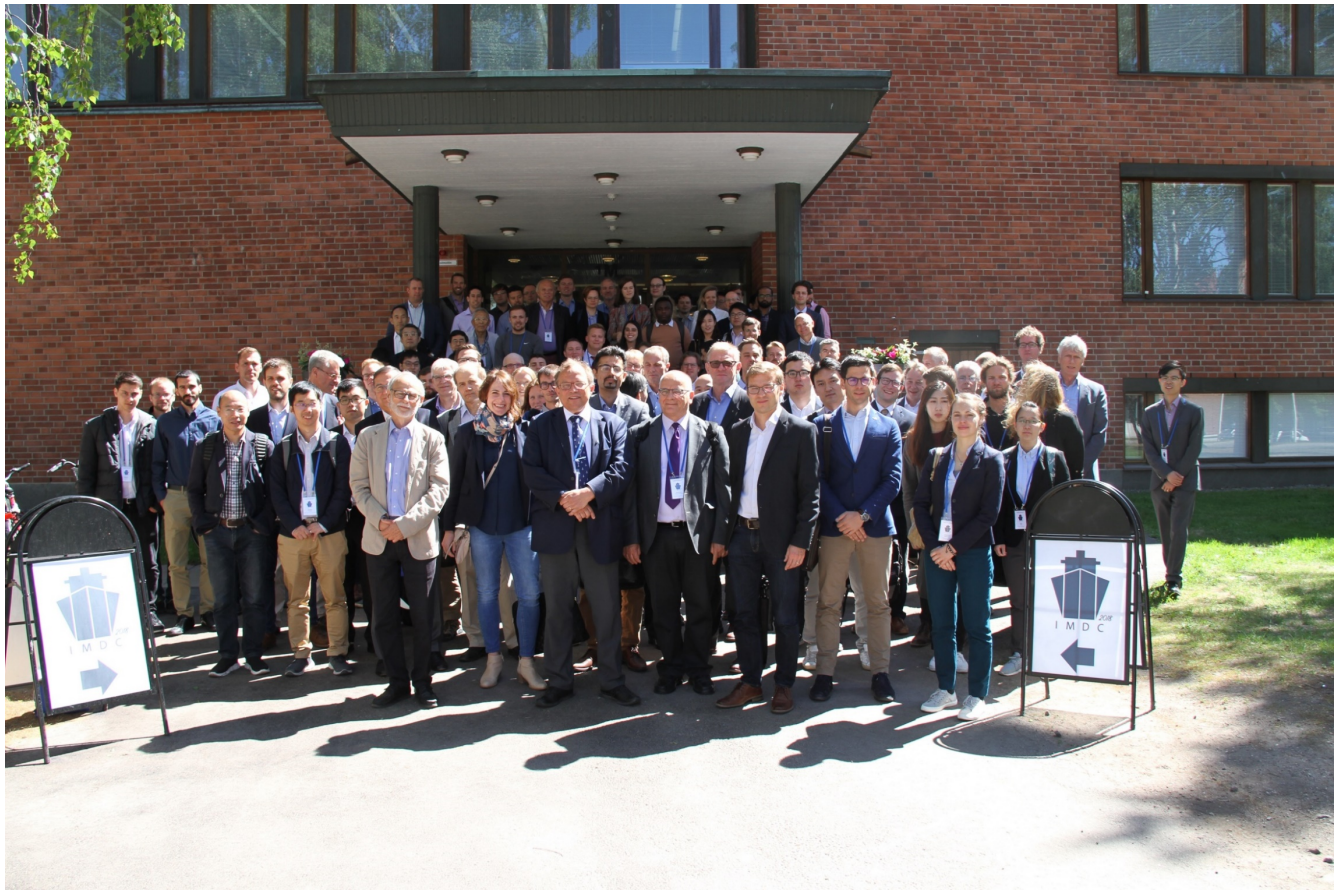
Many staff members of the Marine Technology Unit serve the scientific community by acting as peer reviewers in international scientific journals and conferences. Several editorial positions are also within the group (Journal for Engineering in Maritime Environment, Welding in the World), complemented by editorial board memberships (e.g. Marine Structures, Ship Technology Research, Ocean Engineering, Ships and Offshore Structures). Senior faculty members have also been recognized both nationally and internationally through invitations to act as examiners and opponents of several doctoral theses and acting as official discussers for the work performed by international scientific committees (ISSC). Also the faculty members have been active on assessing research in different countries (e.g. Norway) and act as chairman of different institutions (e.g. Publications forum). The unit has membership in Association of Finnish Marine Industries to interact with key industrial partners on creation of future research agenda for applied research and acts also in international scientific committees (International Institute of Welding, International Towing Tank Conference, and International Ships and Offshore Structures Congress) which perform state of the art reviews and benchmarks that can be used as background work of regulatory development. The unit has members also in global professional institutions for naval architects and engineering (Society of Naval Architects and Marine Engineers, The Institute of Marine Engineering Science and Technology, The Royal Institution of Naval Architects, The Federation of National Engineering European Associations, The Technical Chamber of Greece, The Engineering Council UK) to follow and impact the professional development of the field globally.

13th International Marine Design Conference, June 10th – 14th 2018

In June 10th to 14th 2018, Aalto University organized the 13th International Marine Design Conference with around 200 participants from all over the world. The aim of the conference was to promote all aspects of marine design as an engineering discipline. The focus was laid on the key design challenges and opportunities in today's rapidly changing maritime markets with special emphasis on:

- The challenges in merging ship design and marine applications of experience-based industrial design
- Digitalization as technological enabler for a stronger link between efficient design, operations and maintenance in future
- Emerging technologies and their impact on future designs
- Cruise ship and icebreaker designs including fleet compositions to meet new market demand
- State of the art reports: Cruise ship design, Icebreaker design, Design methodology

and continuity in following topics of: Design methodology; Hull form design; Energy Efficiency; Structural design; Hydrodynamic design; Risk and safety; Education; Propulsion equipment design; Ship concept design; Autonomous ships; Navy ships; Production and Arctic design



http://imdc2018.aalto.fi/

17th International Ship Stability Workshop ISSW2019, June 10th – 12th 2019

In June 10th to 12th 2019, Aalto University and NAPA jointly organized the 17th International Ship Stability Workshop ISSW2019 in Helsinki. These events are organized in the years between the larger STAB conferences, and the focus is on extensive discussion and ongoing research topics.

There were about a hundred participants from all over the world, representing both academia and industry. The workshop contained 41 presentations, covering all aspects of intact and damage stability of ships. In addition, a dedicated session was organized to celebrate the 80 year anniversary of Prof. Jaakko Rahola's famous doctoral dissertation, including a short overview of his research and career, as well as presentations and discussion about the relevancy this pioneering work on ship stability.

The full workshop proceedings are freely available at

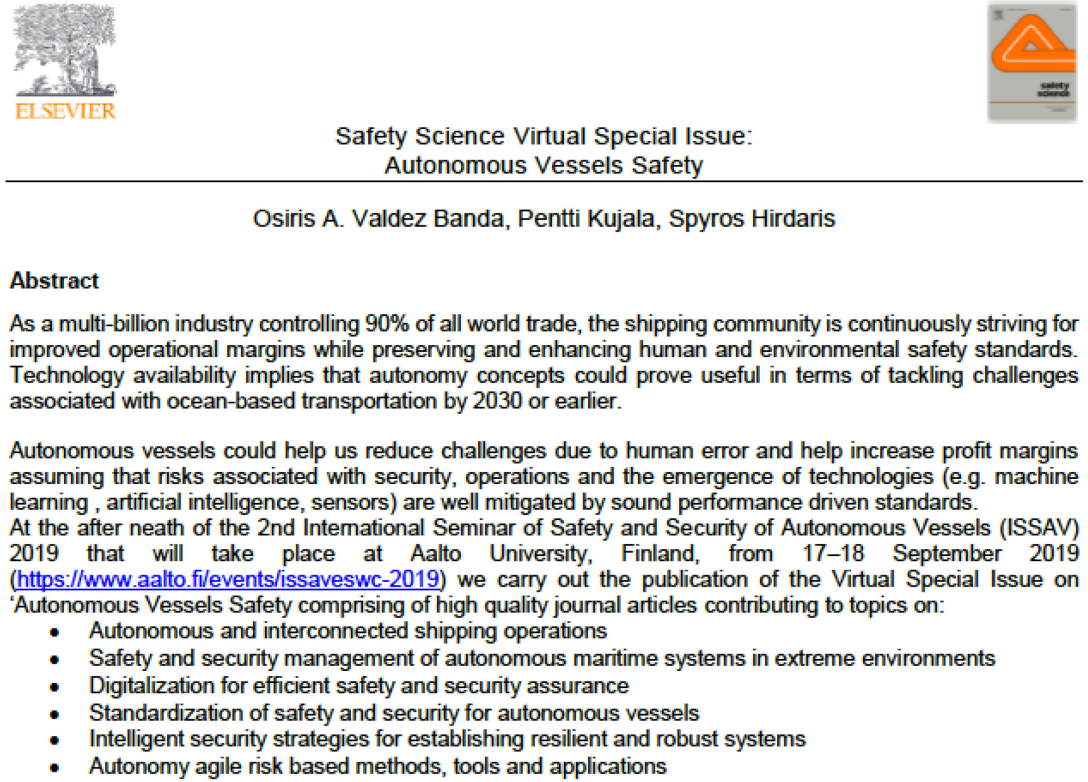
http://shipstab.org/index.php/conference-workshop-proceedings/issw2019-helsinki

International Seminar on Safety and Security of Autonomous Vessels (ISSAV) & European STAMP Workshop and Conference (ESWC), September 17th – 20th 2019

Aalto University was proud to host the 2nd edition of the International Seminar on Safety and Security of Autonomous Vessels (ISSAV) together with the 7th edition of the European STAMP Workshop and Conference (ESWC). The ISSAV promotes all aspects of maritime safety and security in the context of autonomous vessels and maritime ecosystem. The ESWC focused on applications and studies related to the Systems-Theoretic Accident Model and Processes (STAMP) which is a new systems-thinking approach to engineer safer systems.

The high-level scientific activities of the workshop got a special issue for top international journal of Safety Science where selected papers are published during 2020.

More information about the conferences can be found from
https://www.aalto.fi/en/events/issaveswc-2019



ELSEVIER

Safety Science Virtual Special Issue:
Autonomous Vessels Safety

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Abstract

As a multi-billion industry controlling 90% of all world trade, the shipping community is continuously striving for improved operational margins while preserving and enhancing human and environmental safety standards. Technology availability implies that autonomy concepts could prove useful in terms of tackling challenges associated with ocean-based transportation by 2030 or earlier.

Autonomous vessels could help us reduce challenges due to human error and help increase profit margins assuming that risks associated with security, operations and the emergence of technologies (e.g. machine learning , artificial intelligence, sensors) are well mitigated by sound performance driven standards.
At the after neath of the 2nd International Seminar of Safety and Security of Autonomous Vessels (ISSAV) 2019 that will take place at Aalto University, Finland, from 17–18 September 2019 (https://www.aalto.fi/events/issaveswc-2019) we carry out the publication of the Virtual Special Issue on 'Autonomous Vessels Safety comprising of high quality journal articles contributing to topics on:

- Autonomous and interconnected shipping operations
- Safety and security management of autonomous maritime systems in extreme environments
- Digitalization for efficient safety and security assurance
- Standardization of safety and security for autonomous vessels
- Intelligent security strategies for establishing resilient and robust systems
- Autonomy agile risk based methods, tools and applications

Special Issue on Ship Dynamics for Perfomance Based and Risk Averse Operations in Journal of Marine Science and Engineering

The concept of ship dynamics has a very wide meaning, embracing the fundamentals of both deterministic and performance-based methods with ship safety. As such, the subject is of paramount importance for its wide implications in the design and operation of ships and floating offshore installations. Contemporary developments in this specific field tend to be collected and thoroughly debated especially considering uncertainties associated with multi-physics modeling and simulation as well as the emergence of modern technologies. With the aim of analyzing the current status and possible future perspectives of research in the field of ship dynamics and safety, in this Special Issue we invited high-value original research publications in the following consolidated research topics and emerging subjects:

- Wave loads and dynamic response with emphasis on hydroelastic methods, nonlinear hydrodynamics, and CFD methods
- Marine cybernetics with focus on motion suppression of ships and speed boats,
- Navigation monitoring unified maneuvring/seakeeping, and control methods with a focus on operational performance validation methods by model tests and full-scale measurements using state of the art methods and monitoring equipment (e.g., design of experiments, sensors, radar systems, etc.)
- Combined strength and stability with a focus on damaged conditions and the influence of crashworthiness.

Papers that promote emergency response methods and future SOLAS requirements are especially welcome. Intact stability and resonance phenomena (e.g., parametric roll, broaching) with a focus on the use of nonlinear methods (bifurcation and chaos) within the context of future IMO standards. Risk management methods for the assurance of safety in ship design and operations The role of emerging technologies for ship performance monitoring (machine learning, artificial intelligence, big data, digital twins, etc.)

Guest Editor

Prof. Dr. Spyros Hirdaris

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1. **On the alternative approaches to stability analysis in decision support for damaged passenger ships,** Ruponen, P., Pennanen, P. & Manderbacka, T., 12 Nov 2019, In : WMU JOURNAL OF MARITIME AFFAIRS. 18 p.
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4. **Correction of local deformations in free vibration analysis of ship deck structures by equivalent single layer elements,** Laakso, A., Avi, E. & Romanoff, J., 1 Oct 2019, In : Ships and Offshore Structures. 14, sup1, p. 135-147
5. **Toward a Method Evaluating Control Actions in STPA-Based Model of Ship-Ship Collision Avoidance Process,** Gil, M., Wróbel, K. & Montewka, J., 1 Oct 2019, In : JOURNAL OF OFFSHORE MECHANICS AND ARCTIC ENGINEERING. 141, 5, 11 p., 051105.
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11. **Strain energy density approach for brittle fracture from nano to macroscale and breakdown of continuum theory,** Gallo, P., Hagiwara, Y., Shimada, T. & Kitamura, T., 4 Jul 2019, In : Theoretical and Applied Fracture Mechanics. 103, 7 p., 102300.
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13. **A multi-ship following model for icebreaker convoy operations in ice-covered waters,** Zhang, W., Zou, Z., Goerlandt, F., Qi, Y. & Kujala, P., 15 May 2019, In : Ocean Engineering. 180, p. 238-253 16 p.
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15. **Improving stand-on ship's situational awareness by estimating the intention of the give-way ship,** Du, L., Goerlandt, F., Valdez Banda, O., Yamin, H., Wen, Y. & Kujala, P., 5 Apr 2019, (Submitted) In : Ocean Engineering.
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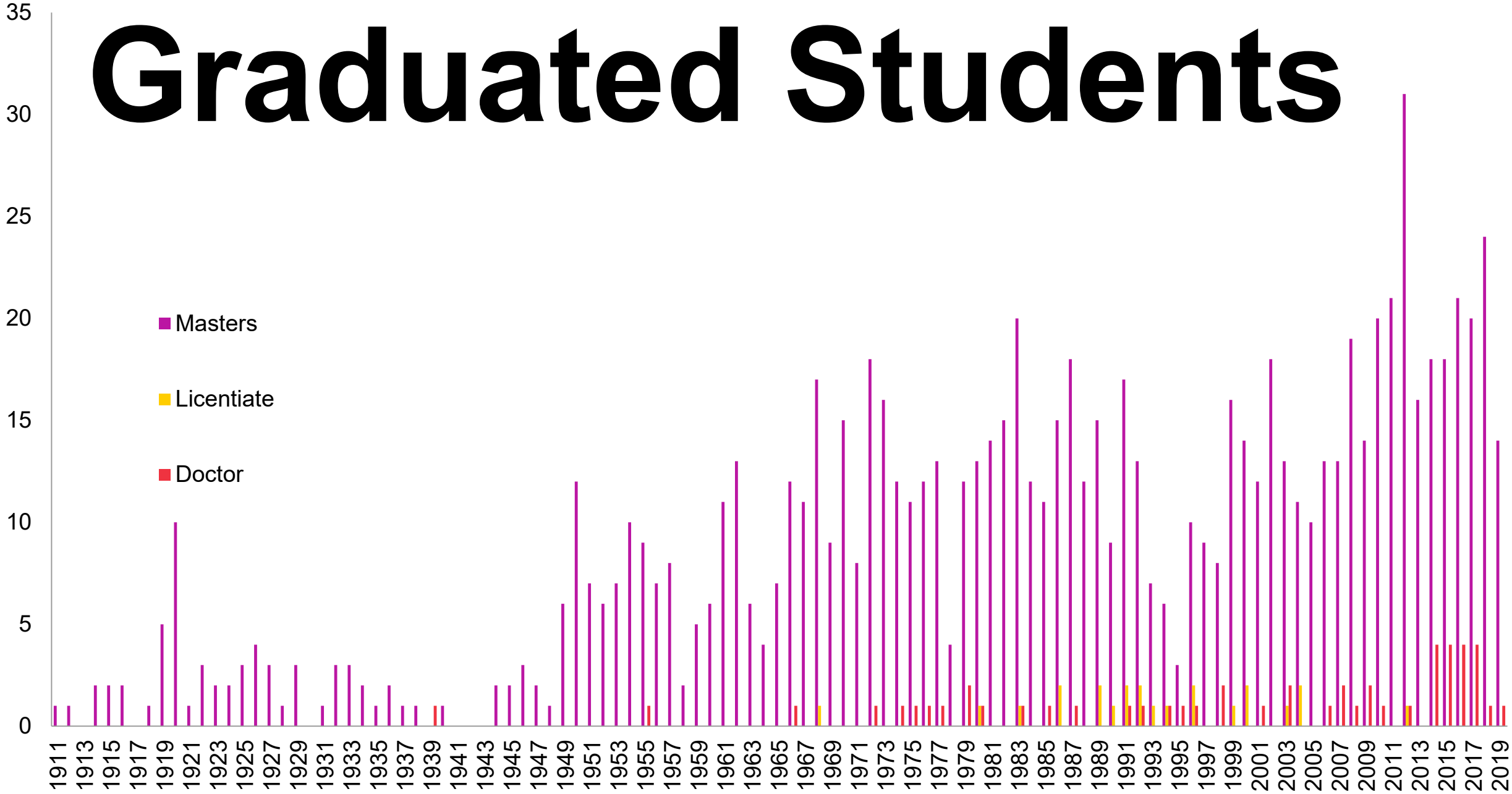
Graduated Students



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3. Henri Palosuo, ”Käyttäjälähtöinen matkustajalaivasuunnittelu”, Aalto University, School of Engineering, 2018.
4. Heinolainen, Joakim, “Todennäköisyyden laskeminen epäsäännölliselle aallokolle”, Aalto University, School of Engineering, 2018.
5. Lehtinen, Alisa, “Laivojen pakokaasujen puhdistusjärjestelmät”, Aalto University, School of Engineering, 2018.
6. Niemikaija, Pasi, “Laivan hidaskäyntisen dieselmoottorin apujärjestelmät ja niiden ohjaustekniikat”, Aalto University, School of Engineering, 2018.
7. Tala, Vesa-Matti, “Pelastautumisvälineet ja matkustajien turvallisuus matkustaja-aluksissa”, Aalto University, School of Engineering, 2018.
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11. Mustaniemi, Joonas ”Mittalaitteet laivojen jääkuormien määrityksessä”, Aalto University, School of Engineering, 2019.
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7. Sarainmaa, Olli, “Large Efficient Maritime Propeller without Hull Pressure Excitations”, Aalto University, School of Engineering, 2018.
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38. Wang, Xuwen, “Dynamic analysis of floating wind turbines subjected to deterministic wind gusts”, Aalto University, School of Engineering, 2019.
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Professors to other universities

1. Miguel Conzales Calle, Professor in the Federal University of the ABC (Department of Instrumentation, Automation and Robotics, Brazil, 2019.
2. Floris Goerlandt, Professor in Dalhouse University, Canada, 2018.
3. Mihkel Körgesaar, Professor in Estonian Maritime Academy, Tallinn University of Technology, Estonia, 2018.

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