# Eesti Mereakadeemia

# Instituudi 2024. aasta teadus- ja arendustegevuse ülevaade

**Instituudi 2024. aasta kuni 3 kõige olulisemat edulugu**

1. Alustasime konsortsiumi koordineeritava Horisont Euroopa Twinning meetme projektiga BALTIC-FIT. Projekt loob Läänemere piirkonna organisatsioonide vahelise pädevusvõrgustiku, et võimaldada meretranspordil täita „Fit for 55“ eeskirju dekarboniseerimise osas.
2. Algas Interregi projekt REISFER, milles oleme projekti koordinaatori rollis. Uue rahvusvahelise projekti REISFER eesmärk on vähendada $CO_2$ emissiooni 10-20% valitud parvlaeva liinidel Eestis, Soomes, Ahvenamaa ja Rootsis läbi erinevate tehnoloogiliste ja operatiivsete lahenduste rakendamise.
3. Esimene doktoritöö kaitsmine EMERAS - Rasul Niazmand Bilandi, "Efficient High-Speed Small Craft: Performance in Calm Water and Waves"

**TA valdkonna väljakutsed 2025. aastaks**

1. Laevajuhtimise uurimisgrupi loomine ja töö käivitamine
2. Meretehnika uurimisgrupi töö käivitamine
3. Teaming projekti taotlemine
4. Koostöö suurendamine uurimisgruppide vahel
5. 5-10 doktorandikoha loomine uurimisrühmade juurde
6. Uute professuuride loomine (merenduse küberjulgeolek, inimfaktor, mereõigus, jätkusuutlik logistika)

**TA valdkonna 2024. aasta väljakutsed ja nende tulemused**

*Väljakutse*

1. Laevajuhtimise professuuri loomine, et tagada jätkusuutlik teaduspõhine õpetamine ja juhtida kõrgetasemelisi teadusuuringuid ning viia läbi arendustegevust integreeritud laevasüsteemide ning autonoomse ja mehitamata meretehnoloogia valdkonnas. Samuti viia ellu laeva digitaalse kaksiku arendused õppelaeva Sinilind baasil.
2. Veeteede ohutuse uurimisrühma aktiivse töö käivitamine

*Täitmine/tulemused*

Laevajuhtimise nooremprofessori koht täidetud, professor asub tööle 2025. asta mais. Professuuri eesmärk on tagada jätkusuutlik teaduspõhine õpetamine ja kõrgetasemeliste teadusuuringute juhtimine integreeritud laevasüsteemide ning autonoomse ja mehitamata meretehnoloogia valdkonnas. Samuti viia ellu laeva digitaalse kaksiku arendused õppelaeva Sinilind baasil. Veeteede ohutuse uurimisrühma töö on aktiivselt käima läinud ning taotletud on mitmeid

projektitaotlusi. Uurimisrühmaga on liitunud 3 doktoranti. Meretehnika tenuuriprofessori koha täitmine, professor asub tööle 2025. aasta mais. Professuuri eesmärk on tagada jätkusuutlik teaduspõhine õpetamine ja kõrgetasemeliste teadusuuringute juhtimine meretehnika valdkonnas, samuti tugevdada uurimisgruppi ning taotleda rahastust.

**Olulisemad soetatud seadmed**
Õppelaev „Sinilind“, soetusmaksumus 622 022,80

Abipaat õppelaevale „Sinilind“, soetusmaksumus 9 583,33

**Koondhinnang instituudis kasutusel oleva taristu seisundi kohta**

vajab uuendamist

**Selgitus instituudis kasutusel oleva taristu seisundi kohta**

Merenduse kübejulgeoleku labor vaja edasiarendust ning seostamist teiste taristu objektidega. Digikaksiku arendamisel simulaatorikeskuse baasil on vaja teha täiendavaid investeeringuid. Kõik laborid vajavad kaasajastamist.

# 1 Merenduse küberjulgeoleku keskus

## Uurimisrühma juht

Sanja Bauk, sihtrahastusega professor, sanja.bauk@taltech.ee

## Uurimisrühma liikmed

Olaf Manuel Maennel, Doktor, kaasatud professor
Kristel Toom, Kõrgharidus, teadus- ja arendusdirektor
Alvar Kurrel, Kõrgharidus, projektijuht
Dan Heering, Magister, doktorant-nooremteadur
Gabor Visky, Magister, tööstusdoktorant
Risto Vaarandi, Doktor, vanemteadur
Leonidas Tsiopoulos, Doktor, vanemteadur
Hayretdin Bahsi, Doktor, sihtrahastusega professor
Stefan Sütterlin, Doktor, kaasatud professor
Sanja Bauk, Doktor, sihtrahastusega professor
Rain Ottis, Doktor, kaasprofessor tenuuris
Ricardo Gregorio Lugo, Doktor, vanemteadur
Yigit Gülmez, Doktor, järeldoktor-teadur
Triin Muulmann, Magister, doktorant-nooremteadur
Vanessa Vorteil, Magister, doktorant-nooremteadur
Igor Astrov, Doktor, vanemteadur
Shaymaa Mamdouh Khalil, Magister, doktorant-nooremteadur
Pentti Jouko Sakari Kujala, Doktor, professor
Radoje Džankić, Magister, Doktorant-üliõpilane
Kristi Treffner, , partnerlussuhete koordinaator
Tiia Sõmer, Doktor, teadur
Tiia Sõmer, Doktor, järeldoktor-teadur
Aybars Oruc, Doktor, järeldoktor-teadur
Dan Heering, Magister, ekspert
Mahtab Shahin, Doktor, järeldoktor-teadur
Saeed Rahimpour, Doktor, järeldoktor-teadur
Muhammed Erbas, Magister, doktorant-nooremteadur

## Võtmesõnad

**Eesti keeles**
küberturvalisus; merendussektori digitaliseerimine; autonoomsed laevad

**Inglise keeles**
cybersecurity; digitalization of the maritime industry; autonomous ships

## Uurimisrühma kompetentside tutvustus

**Rühma ülevaade eesti keeles**

Merendussektor seisab silmitsi suurte väljakutsetega seoses digitaalsete süsteemide küberturvalisusega, mis on tänapäeval üha enam levinud laevadel, sadamate infrastruktuuris ja laiemalt logistikaahelas. Autonoomsete laevade teke ja laiemalt asjade interneti tehnoloogia laialdane kasutamine laevadel ja merenduse infrastruktuurides on olulised teemad, mis vajavad erilist tähelepanu. Nende küsimustega tegelemiseks on vaja terviklikku lähenemisviisi, mis hõlmaks

meremeeste haridust ja küberturvalisuse inimlikku aspekti, uudse tehnoloogilise lähenemise väljatöötamist laevaehituse jaoks „security by design“, tegevusprotsessi, aga ka strateegiliste otsuste tegemist kõigi sidusrühmade jaoks. Merenduse küberturvalisuse keskuse eesmärk on tegutseda eespool nimetatud tegevuste katalüsaatorina. ELi raamprogrammi Horisont 2020 grant (projekt MariCybERA) võimaldab panustada ja mängida olulist rolli nii teadusuuringute kui ka tehnoloogilise arengu osas Euroopas. Selleks teeb uurimisrühm koostööd kutseorganisatsioonide, tööstusharude, valitsusasutuste ja akadeemiliste struktuuridega nii Eestis, Euroopas kui ka kogu maailma. Konkreetsed fookused ja pädevused on järgmised: • Küberteadlikkus ja laevaohvitseride väljaõpe • Küberturvalisuse ja autonoomsete laevade jaoks mõeldud usaldusväärne tehisintellekt • Küberturvalisuse strateegia, mida rakendatakse merenduse digitaliseerimisel • Merenduse küberturbe operatsioonide keskuse tegevus

**Rühma ülevaade inglise keeles**

The maritime industry is confronted with major challenges relative to the cybersecurity of the digital systems that are nowadays more and more pervasive in ships, port infrastructure and more globally in the logistic chain. The emergence of autonomous ships, and more largely the wide use of IoT technology in the ship and maritime infrastructures are major topics that warrant specific scrutiny. Addressing these issues need a holistic approach that would encompass the education of seafarers and the human aspect of cybersecurity, the development of a novel technological approach for “security by design” of ships, the operational process, and strategical decision making for all stakeholders.
The goal of the Maritime Cybersecurity Centre is to act as a catalyst of the above-mentioned activities. Thanks to EU Horizon 2020 grant (project MariCybERA), this research aims to play important role in Europe-wide expertise development of all dimensions of maritime cybersecurity both in research dimensions, as well in technological development and operational means. For this purpose, the research group is working with professional organisations, industries, government agencies, and academic structures both in Estonia, Europe and worldwide. Specific focuses and competences are as following: • Cyber awareness and education of seafarers • Trustworthy AI for cybersecurity and autonomous ships • Cybersecurity strategy applied to maritime digitalisation • Maritime Security Operation Centre

**Viimaste aastate olulisemad projektid:**

VEU23016 Praktiline küberturvalisuse koolitusprogramm Euroopa tööstusharude professionaalidele 2022 - 2025 https://www.etis.ee/Portal/Projects/Display/75295390-139d-4995-a7a4-b730cbe6bd96

VEU23044 Veesektori kriitilise infrastruktuuri kübervastupidavuse suurendamine läbi koolituste ja treeningu 2023 - 2026 https://www.etis.ee/Portal/Projects/Display/3d3e8aad-0cf3-4b39-aa97-8321dc07aa40

VFP20050 ERA Chair in Maritime Cyber Security at Tallinn University of Technology - MariCybERA 2021 - 2025 https://www.etis.ee/Portal/Projects/Display/820aea14-b251-47bf-b3e6-ffd1e1e48c62

**Viimaste aastate olulisemad artiklid:**

Bauk, Sanja; Dzankic, Radoje (2024). Smart cargo container tracking and IT security management: Experimental results. Journal of Maritime Research, 21 (2), 128−134. https://www.etis.ee/Portal/Publications/Display/46526328-b896-45eb-bc53-007b989f8f10

Parish, K., Warnatsch, R., Torgersen, L., Lugo, R. (2024). A Pilot Feasibility Study on The Use of Virtual Reality Simulation Training for Parent-Teacher Consultations to Enhance Self-Efficacy in Pre-Service Teachers. Journal of Teacher Education and Educators, 13 (1), 29−47. https://www.etis.ee/Portal/Publications/Display/161dcc3d-95d2-4eb9-99ad-9e1e6d21a0b5

Astrov, Igor; Bauk, Sanja (2024). Simulating a cyber-attack on an autonomous sea surface vessel's rudder controller. 2024 13th Mediterranean Conference on Embedded Computing (MECO), 11-14 June 2024, Budva, Montenegro. IEEE, 558−564. DOI: 10.1109/MECO62516.2024.10577872. https://www.etis.ee/Portal/Publications/Display/3bddf1af-c8e9-4999-873b-10dd02e0e660

Abner, Mark; Bauk, Sanja (2024). On Underwater Data Centers: Surveillance, Monitoring, and Environmental Management in the Baltic Sea. JITA - Journal of Information Technology and Applications (Banja Luka) - APEIRON, 14, 2, 142−149. DOI: 10.7251/JIT2402142A . https://www.etis.ee/Portal/Publications/Display/acd1a19e-6227-4bbe-ad1b-8195fd51ff50

Paladin, Zdravko; Bauk, Sanja; Mujalović, Rasim; Kapidani, Nexhat; Lukšić, Žarko (2024). Blockchain Technology's Effects on Big Data in Maritime Transportation. 2024 28th International Conference on Information Technology (IT): Zabljak, Montenegro, 21-24 February 2024. Danvers: IEEE, 1−7. DOI: 10.1109/IT61232.2024.10475774. https://www.etis.ee/Portal/Publications/Display/4a5c487d-2eb0-4f98-8e4e-d90bfcfa3c19

## Uurimisrühma lõppenud aasta rahvusvahelisel tasemel väljapaistvad teadustulemused

**Eesti keeles**

Uurimisrühm oli väga edukas teadustööde kirjutamisel ja avaldamisel. 2024. aastal jõudsime vastavates ajakirjades avaldada 8 artiklit; avaldasime ja esinesime rahvusvahelistel teaduskonverentsidel 14 ettekandega. Peaaegu kõik väljaanded on avatud juurdepääsuga, avalikkusele Internetis kättesaadavad. Nii oleme aidanud kaasa objektiivsete teadmiste kasvule merenduse küberjulgeoleku valdkonnas. Väljaannetes käsitletavad teemad puudutavad ohtude modelleerimist, riskide hindamist, IT/OT rünnakute simulatsiooni ja nende neutraliseerimist meresimulaatoril ja MATLAB Simulink keskkonnas, kasutades erinevaid simulatsioonitehnikaid ja tehisintellekti tööriistu. Lisaks on uuringutesse ja publikatsioonidesse kaasatud inimoskuste kujundamine kübertrotsi valdkonnas segareaalsuse keskkondades (V/AR).

**Inglise keeles**

The group was very successful in writing and publishing scientific papers. In 2024, we managed to publish 8 articles in relevant journals; publish and present 14 papers at international scientific conferences. Almost all publications are open access, available to the public via the Internet. In this way, we have contributed to the growth of objective knowledge in the field of maritime cybersecurity. The topics covered by the publications are in the field of threat modelling, risk assessment, simulation of IT/OT attacks and their neutralization on the nautical simulator and in the MATLAB Simulink environment, using different simulation techniques and AI tools. Furthermore, shaping human skills in cyber defiance in mixed (V/AR) reality environments is included into the studies and publications.

## Rühma TA seotus ühiskonnas aktuaalsete probleemidega ning neile lahenduste pakkumisega

**Eesti keeles**

* Merenduskuberturvalisuse kultuuri tõstmine Eesti merenduse sidusrühmade seas
* Suve/talvekoolide ja merenduse küberjulgeoleku töötubade korraldamine
* Uurimisseminarid (iga kuu; salvestatud ja saadaval MariCybERa veebisaidil)
* Merenduse küberjulgeoleku magistritaseme kursus
* Abistamine meremeeste hariduses IT-alase kirjaoskuse lisamisel
* Koostöö teiste mereakadeemiatega merenduse, IT ja küberjulgeoleku õppekavade väljatöötamiseks
* Mereakadeemiate võrgustiku loomine, kus tunnetakse huvi merenduse küberjulgeoleku vastu

**Inglise keeles**

* Raising maritime cybersecurity culture among Estonian maritime stakeholders
* Organizing summer/winter schools and workshops in maritime cybersecurity
* Research seminars (every month; recorded and available on MariCybERa website)
* Joint master level course in maritime cybersecurity
* Help in adding more IT literacy in seafarer education
* Work with other maritime academies to develop curriculum in maritime, IT and cybersecurity
* Building a network of Maritime Academies with interest in maritime cybersecurity

## Info uurimisrühma rakendusliku väljundiga TA kohta

**Senised rakendused ettevõtluses, majanduses, ühiskonnas**

Researchers from the Estonian Maritime Academy were involved in the design of a new ferry to be commissioned by the Estonian government in 2023, with contributions on the ship's cyber security and digital twin.

We work on increasing cybersecurity of the MASS in collaboration with colleagues from Software Engineering Department at TalTech and MindShip company in both nautical and propulsion domains.

We rise level of cybersecurity culture and awareness at maritime industry and governmental entities through talks at relevant meetings and events in maritime.

**Uurimisrühma TA rakenduskompetentsid ettevõtluskoostööks**

* Cybersecurity dimensions of maritime technology
* Security by design of ships and maritime infrastructures

* Trustworthy Ml&AI for autonomous ships and infrastructures

* Testing and evaluation of cybersecurity of ships and maritime infrastructures

* Situational awareness and global monitoring

* Monitoring and intrusion detection in complex maritime systems (OT/IT)

* Multidimensional security operation center (SOC) for maritime applications

* Human aspects of maritime cybersecurity

* Human factors, system usability, and behavioural changes.

* Evaluating and quantifying education and large-scale exercise outcomes

* Learning analytics, automatic evaluation in safety and security domains

* Use of nautical simulator for cybersecurity analysis

**Ettevõtluskoostöö eesmärk**
Our research aims to provide the maritime industry with the newest knowledge secure their networks, vessels, and supply chain infrastructure from cyber threats and attacks.

## Täiendav info:

**Uurimisrühma seotus TalTech TA prioriteetse suunaga (kuni kaks olulisemat suunda):**

- 6. Nutikas merendussektor ja jätkusuutlik merekeskkond
- 1. Targad ja energiatõhusad keskkonnad

**Uurimisrühma tegevusega seotud teadusvaldkond – kuni 2 alamvaldkonda Frascati Manuali klassifikaatori alusel ja kuni 3 teaduseriala CERCS klasifikaatori alusel.**
Frascati Manauali teadusvaldkonnad:

5.2 Majandusteadus ja ärindus
2.11 Teised tehnika- ja tehnoloogiateadused

CERCSi teaduserialad:

T300 Veetransporditehnoloogia
S190 Ettevõtete juhtimine
S180 Majandus, ökonomeetrika, majandusteooria, majanduslikud süsteemid, majanduspoliitika

**Hinnang rühma kasutuses olevale TA taristule (sh kollektsioonid ja andmekogud), piisavus ja seisund**

Hinnang seisundile:

vajab uuendamist

Seisundi selgitus:

* Nautical simulator (Wärtsila ver. 5.45)
* CyberLab – AIS receiver analysis
* Research vessel "Bluebird"

* Research autonomous vessel “Nymo”

**Uurimisrühma liikmete osalus oluliste TA&I-ga seotud välisorganisatsioonide töös lõppenud aastal**
A series of MaricybERA Research Group’s online meetings with colleagues from Estonian and Singapore relevant institutions on cybersecurity research and training:

* Singapore iTrust/SUTD (MariOT) on 1 August 2024
* Estonian Transportation Office on 13 August 2024
* Estonian Ministry of Foreign Affairs on 21 August 2024
* Estonian Ministry of Climate on 29 August 2024 Singapore
* Estonian Information System Authority (RIA) on 16 September 2024
* Mr. Roomet Leiger – Singapore-Estonia MoU on 17 September 2024
* Singapore MPA on 24 September 2024
* Singapore iTrust/SUTD (MariOT) on 25 October 2024

Events and meetings with different external organizations related advanced training and R&D:

* 16 January 2024 – Tallinn, Estonia

We were happy to host 28 students from the CYBERUS Erasmus Mundus Cybersecurity Joint Master Programme on January 16th. The students attended lectures focusing on the digitalization and cybersecurity in the shipping sector by Sanja Bauk, Dan Heering and Yigit Gülmez.

* 27-28 May 2024 – Tallinn, Estonia

We were honored to host our colleagues from Norwegian University of Science and Technology (NTNU). In-person, we welcomed Vasileios Gkioulos and Marie Haugli-Sandvik, while Ahmed Amro joined us online. Representing MariCybERA were Ric Lugo, Sanja Bauk, Gabor Visky, Aleksei Šiganov, Leonidas Tsiopoulos, Dan Heering, Yigit Gülmez, and Kristi Treffner. Our discussions centered around prospective collaborations on joint projects.

* 17-19 June 2024 – Constanta, Romania

Sanja Bauk has taken part in the 8th Black Sea Cybersecurity Conference, Cybersecurity Synergies in a Digitalized World, which took place in Constanta,

Romania. In her keynote address, she discussed the Estonian perspective on the EU cybersecurity landscape. Additionally, she participated as a panelist in the session "Cyber resilience across borders - lessons from international cyber incidents".

* 24 June 2024 – Valletta, Malta

Sanja Bauk participated in the interdisciplinary forum on “Maritime Transport and Cybersecurity” at the University of Malta (Valletta Campus). She thanked the organizers, Prof. Alessandro Mantelero and Prof. Joseph Cannataci, as well as the speakers, Brig. Clinton O'Neill, Dr. Ann Fenech and Mr. Alessandro Politi. Inspiring presentations, constructive discussions, and the launch of the MariCybERA project - these are the results of this one-day meeting with distinguished experts in maritime affairs, law and cybersecurity.

* 21 August 2024 – Tallinn, Estonia

We had an opportunity to host Jarkko Paavola and his dynamic research team from Turku University of Applied Sciences. From the MariCybERA team, Sanja Bauk delivered an overview of our achievements, while Dan Heering and Aleksei Šiganov showcased the innovations at our cyberlab. With both project groups involved in ongoing partnerships, it was a natural step to explore exciting future collaborations.

* 28 August 2024 – Tallinn, Estonia

We met with representatives from the Singapore Institute of Technology. It was a pleasure to connect with Arthur Poh, Yong-Lim Foo and Shawn Wee from SIT. MaricybERA group was presented by Sanja Bauk, Kristel Toom, Dan Heering, Yigit Gülmez, Leonidas Tsiopoulos, and Kristi Treffner. The meeting was both interesting and mutually beneficial, and we are excited about the potential for future collaborations. Together, we hope to advance the development of maritime cybersecurity and foster innovation in R&D.

* 27 September 2024 – Banja Luka, Republic of Serpska

Sanja Bauk presented the MariCybERA project during the plenary session of the 16th Information Technology for e-Education (ITeO) Conference, organized by Pan-European University APEIRON in Banja Luka, Republic of Serpska. It was a privilege to also have TalTech Estonian Maritime Academy's ex-master student Mark Abner and PhD student Radoje Džankić showcase their innovative research at the same event.

* 2 October 2024 – Tallinn, Estonia

We had the pleasure and honor of meeting our esteemed colleagues from the Ministry of Defence of Singapore, Singapore University of Technology and Design (SUTD), and iTrust SUTD at TalTech Estonian Maritime Academy. Kristel Toom, Alvar Kurrel, and Kristi Treffner warmly welcomed the delegation, and Dan Heering arranged an insightful visit to the deck simulator. Presentations were given by Sanja Bauk and Muhammed Erbas, while Yigit Gülmez shared his innovative ideas on Digital Twin with our Singaporean colleagues. Exciting future collaborations with SUTD and iTrust were proposed, and we look forward to deepening our partnership.

* 18-19 October 2024 – Podgorica, Montenegro

Sanja Bauk had the pleasure of presenting her research on maritime digital transformation and cybersecurity at the Days of Scientific Diaspora in Podgorica, Montenegro. The audience included experts from diverse fields, distinguished professors, and enthusiastic students. This event not only provided a platform for sharing knowledge but also opened doors to potential future collaborative research opportunities.

* 23 October 2024 - Tallinn , Estonia

Andrian Prisacaru from the Technical University of Moldova visited EMERA, where Sanja Bauk and Dan Heering presented EMERA facilities and activities, with a focus on the MariCybERA project.

* 28 October 2024 – Gjøvik, Norway

Sanja Bauk and Yigit Gülmez visited the Critical Infrastructure Security and Resilience (CISaR) research group and SFI-NORCICS at NTNU (Norwegian University of Science and Technology) in Gjøvik. They presented the MariCybERA project and their plans for the development of digital twins. The team leader at NTNU, Ahmed Amro, with his colleagues Aida Akbarzadeh, Jéssica Barbosa Heluany, Gizem Erceylan and Tommy Helland Berg presented their advanced research in cybersecurity.

* 29-30 October 2024 - Trondheim , Norway

Sanja Bauk and Yiğit Gülmez participated into the 6th MTEC-ICMASS conference organized by NTNU (Norwegian University of Science and Technology) and SINTEF at

Trondheim in Norway. Yiğit Gülmez presented the paper "Exploring the impact of a cyber attack targeting the thermostatic control valve in a marine main engine's lubricating oil system" (written by Yigit Gülmez, Olgun Konur, and Sanja Bauk). It was an excellent opportunity to meet many distinguished researchers and maritime industry representatives from around the world.

* 5 November 2024 – Online

Sanja Bauk presented the EMERA and MariCybERA project at the CYSOS project kickoff meeting. This meeting was organized by RISE in Gothenburg, Sweden, and in parallel online in Teams.

* 11 November 2024 – Tallinn, Estonia

Sanja Bauk and Yigit Gulmez met with Henri Schasmin at EMERA. Mr Schasmin is a defiance and security coordinator at TalTech. Sanja Bauk presented the MarCybERA team and its achievements, while Mr Schasmin shared the highlights of the NATO Science for Peace and Security call for research grants.

* 13 November 2024 – Riga, Latvia

Sanja Bauk and Alvar Kurrel presented the MariCybERa project at the Institute of Solid State Physics (ISSP) in Riga, Latvia, during the meeting of ERA Chairs Holders/Coordinators. Representatives from thirteen additional ERA Chair projects attended this meeting. It aimed discussion regarding moving forward with ERA Chair projects at TUT and within the EU area.

* 19 November 2024 – Tallinn, Estonia

Kristel Toom, Sanja Bauk and Muhammed Erbas presented the EMERA and MariCybERA project to the Ambassador and Minister of Transport of Cyprus. The objective of the meeting was the establishment of a co-operation through a Memorandum of Understanding (MoU), which will be the basis for future joint research and development projects.

* 26 November 2024 - Online

“DRIVEN by DATA Workshop” brought together several experts to tackle maritime mobility challenges during crises. On this occasion, MariCybERA Chair holder, Sanja Bauk, delivered a talk: "MariCybERA (H2020) – Coordination of resources in the area of maritime cybersecurity".

**Kolm kõige olulisemat välis- ja kolm kõige olulisemat Eesti koostööpartnerit**
**Välispartnerid:**

- XAMK- South-Eastern Finland University of Applied Sciences; TUAS - Turku University of Applied Sciences; Kotka Maritime Research Centre (SEA EAGLE)
- SUTD - Singapore University of Technology and Design, SMI - Singapore Maritime Institute
- Aalto University; NTNU; French Maritime cybersecurity chair; University of Pirraeus; University of Constanta; Constanta Maritime University

**Eesti partnerid:**

- Tallink
- Port of Tallinn
- SRC group AS; Mind Chip; Naval Group; Talgen: Nortal; NATO Cooperative Cyber Defence Centre of Excellence; CR14

**Rühma liikmete TA populariseerimisega seotud tegevused**
Popular Talk:
Kuber Cast, Dan Heering & Sanja Bauk, 01 August 2024
"Navigating cyber storms: phantom ships, GPS deceptions, and maritime cybersecurity"
https://podtail.com/en/podcast/kubercast/navigating-cyber-storms-phantom-ships-gps-deceptio/

Popular Article:
Bauk S., Heering D., Gülmez Y. (2024). Satelliitnavigatsioonisüsteemide haavatavused ja alternatiivsed lahendused [Satellite navigation systems' vulnerabilities and alternative solutions]. Kreem, Enn (Toim.). Meie meri. (85−88). Sekstant. (Eesti Laevanduse Aastaraamat).

Publishing posts on LinkedIn and Twitter profiles

**Rühma liikmete rahvusvahelisel ja riiklikul tasemel olulised tunnustused lõppenud aastal**
**Riiklikud:**

Dan Heering has received a special recognition at TalTech Estonian Maritime Academy's 105th anniversary celebration in 2024 - "Aasta Purjede Puhuja" – "The Wind in Our Sails of the Year".

**Rahvusvahelised:**

**Rühma liikmete osalemine TA tegevusega seonduvalt ettevõtete nõustamistes**
* On 28 March 2024, Dan Heering and Ricardo Gregorio Lugo delivered a talk on Maritime Cybersecurity and Cyber Hygiene to the Maritime Division of the Estonian Transport Administration.
* Participation in scientific conferences and seminars (for details, please see the block "Teadusorganisatoorne tegevus")

* Regular meetings with advisory board members. The external Advisory Board provides specialist advice to the Project Coordinator and Project Management Team on specific topics addressed by the project.

## Uurimisrühma veebilehe aadress

**Eesti keeles**
https://taltech.ee/merenduse-kuberjulgeolek?_ga=2.31165309.318907058.1679390090-1892847070.1650612785

**Inglise keeles**
https://taltech.ee/en/estonian-maritime-academy/areas-of-advance/maritime-cyber-security?_ga=2.83315990.1002192323.1702287646-256913150.1689577189

# 2 Mereveondus

## Uurimisrühma juht

Ulla Pirita Tapaninen, kaasprofessor tenuuris, ulla.tapaninen@taltech.ee

## Uurimisrühma liikmed

Ulla Pirita Tapaninen, Doktor, kaasprofessor tenuuris
Olli-Pekka Hilmola, Doktor, kaasatud professor
Tõnis Hunt, Magister, doktorant-nooremteadur
Mari-Liis Tombak, Magister, doktorant-nooremteadur
Andres Laasma, Magister, doktorant-nooremteadur
Jonne Kotta, Doktor, kaasatud professor
Suvi-Tuuli Lappalainen, Magister, tööstusdoktorant
Riina Otsason, Magister, doktorant-nooremteadur
Kristel Rauk, Kõrgharidus, projektide koordinaator
Kadi Kasepõld, Magister, doktorant-nooremteadur
Seçil Gülmez, Doktor, järeldoktor-teadur
Eliise Toomeoja, Magister, doktorant-nooremteadur
Kristīne Carjova, Doktor, vanemteadur
Andres Laasma, Magister, tööstusdoktorant
Kristin Kerem, Magister, doktorant-nooremteadur
Deniece Melissa Aiken, Doktor, järeldoktor-teadur

## Võtmesõnad

**Eesti keeles**
merendus; transport; majandus; keskkonnamõjud; sadamaheidete hindamine; sinimajandus

**Inglise keeles**
maritime; transport; economiy; environmental impacts; port emission assessment; blue economy

## Uurimisrühma kompetentside tutvustus

**Rühma ülevaade eesti keeles**
Uurimisrühma teadusuuringud on keskendunud kahele põhilisele valdkonnale: • Arukad ja energiatõhusad keskkonnad. Kuidas mõjutavad karmistuvad keskkonnaalased eeskirjad laevandusettevõtteid, sadamaid ja merendusturge? Uuringutes analüüsitakse praegust laevandusäri ning uuritakse, kuidas uued kütused, laevade konstruktsioon ja operatiivsed muutused mõjutavad laevanduse ärimudeleid ja tegevust. Uuringud on multidistsiplinaarsed ja kasutada saab erinevaid meetodeid. • Tulevikule suunatud juhtimine. Laevandusettevõtete, sadamate ja merendussektori toimimine ja konkurentsivõime erinevates laevandusturu olukordades: kauba- ja reisijate maht, finantsolukord, laevastiku kättesaadavus, isegi poliitika ja avalik arvamus. Seda tööd tehakse tihedalt kas ametiasutuste või ettevõtetega ja sageli ka otse nende tellimusel.

**Rühma ülevaade inglise keeles**

The research focuses on two main areas: 1. Smart and energy efficient environments. How tightening environmental regulations affect shipping companies, ports and maritime markets? The studies analyse the present shipping business, and study how the new fuels, vessel design and operative changes will affect the shipping business models and operations. Research is multidisciplinary and various methods can be used. 2. Maritime and port governance. The functioning and competitiveness of shipping companies, port, and maritime sectors in various shipping market situations: cargo and passenger volumes, financial situations, availability of the fleet, even policies and public opinion. This work is closely done with either authorities or companies, and often also directly from their request.

**Viimaste aastate olulisemad projektid:**
VHE24043 Partnelus Läänemere laevadel „Fit-for-55"-eeskirjade täitmiseks 2024 - 2027
https://www.etis.ee/Portal/Projects/Display/a37f4bcd-6068-42bb-b901-0710d165e490

VIR24014 Süsinikuheitmete vähendamine saartevahelises parvlaevaliikluses 2024 - 2027
https://www.etis.ee/Portal/Projects/Display/0d575176-b176-4798-bd23-ba1caa09a3fd

VHE22066 AUTONOOMSED LENDAVAD LAEVAD SAARTEVAHELISEKS JA SISEVEETRANSPORDIKS 2023 - 2026 https://www.etis.ee/Portal/Projects/Display/4aed505f-51b1-453c-800f-1fab90a25dcf

VIR23031 Jätkusuutlik kaubavoog ja transpordi CO2 heitkoguste vähenemine 2023 - 2026
https://www.etis.ee/Portal/Projects/Display/4118c9ce-7efe-42a9-ad23-a08c0dd5fafa

**Viimaste aastate olulisemad artiklid:**
Hunt, Tõnis; Tapaninen, Ulla; Palu, Riina; Laasma, Andres (2024). Small Island Public Transport Service Levels: Operational Model for Estonia. TransNav the International Journal on Marine Navigation and Safety of Sea Transportation, 18 (2), 315−322. DOI: 10.12716/1001.18.02.07. https://www.etis.ee/Portal/Publications/Display/1a1dba90-3d25-4023-aa67-f4f818d921f4

Lappalainen, S.-T.; Kotta, J.; Tombak, M.-L.; Tapaninen, U. (2024). Using machine learning methodology to model nutrient discharges from ports: a case study of a fertilizer terminal. Journal of Marine Science and Engineering, 12 (1), 143. DOI: 10.3390/jmse12010143. https://www.etis.ee/Portal/Publications/Display/dd25dbf3-4282-4834-97ab-0c574d46b00c

Lappalainen, S.-T.; Kotta, J.; Tapaninen, U. (2024). Nitrogen and phosphorus discharges from cargo ships' black and grey waters—A case study of a Baltic Sea port. Oceans, 5 (3), 560−570. DOI: 10.3390/oceans5030032. https://www.etis.ee/Portal/Publications/Display/ed908778-ef6f-43ae-8597-86c662608db2

Otsason, Riina; Hilmola, Olli-Pekka; Tapaninen, Ulla; Tovar, Beatriz (2024). Business Opportunities for a Ground Effect Vehicle - Case of Canary Islands. Transport and Telecommunication Journal, 25 (4), 473−482. DOI: 10.2478/ttj-2024-0034. https://www.etis.ee/Portal/Publications/Display/9d2efc0b-63c6-494a-9a46-502198464711

Tapaninen, Ulla; Hilmola, Olli-Pekka (2024). Profitability of Shipping and the Role of Fleet Ownership—North European Company Case Study. In: Handbook of Digital Innovation, Transformation, and Sustainable Development in a Post-Pandemic Era. (311−329). CRC Press. DOI:

10.1201/9781003438748-18. https://www.etis.ee/Portal/Publications/Display/73cd295c-a593-4b67-bc11-7d131067568e

## Uurimisrühma lõppenud aasta rahvusvahelisel tasemel väljapaistvad teadustulemused

**Eesti keeles**

Merendusäri on üks Eesti ühiskonna nurgakive. Uurimisrühm on läbi viinud mitmeid olulisi uuringuid, mis toetavad merendussektori otsuste tegemist. Näiteks võib tuua jäämurdja teenused. 2024.a on uurimisrühm alustanud kahe uue projekti rakendamisega: REISFER (VIR24014), mille keskmes on süsinikuheitmete vähendamine saartevahelises parvlaevaliikluses ning BALTIC-FIT (VHE24043), mis loob Läänemere piirkonna organisatsioonide vahelise pädevusvõrgustiku, et võimaldada Läänemere meretranspordil täita „Fit for 55“ eeskirju dekarboniseerimise osas.

**Inglise keeles**

Maritime business is one of the cornerstones of Estonian society. The research group has carried out several important studies that support decision-making in the maritime sector. One example is icebreaker services. In 2024, the research group has started implementation of two new projects: REISFER (VIR24014), which focuses on reducing carbon emissions in inter-island ferry traffic, and BALTIC-FIT (VHE24043), which creates a competence network between organizations in the Baltic Sea region to enable Baltic Sea maritime transport to meet the “Fit for 55” regulations regarding decarbonization.

## Rühma TA seotus ühiskonnas aktuaalsete probleemidega ning neile lahenduste pakkumisega

**Eesti keeles**

Enamikul juhtudel on uuringute tellijateks olnud Eesti ministeeriumid (nii Keskkonna- kui ka Kliimaministeerium). Samuti on uuringuid tellinud Tallinna sadamad.
Lisaks sellele on merendustegevus seoses süsinikdioksiidi heite vähendamise eesmärkidega tohutult muutumas. Avaldatud artiklid on sellele väljakutsele kaasa aidanud, tuues akadeemilistele ringkondadele ja tööstusele olulisi teadmisi, eelkõige laevade elektrifitseerimise mõju ja sadamate heitkoguste arvutusmeetodid.

**Inglise keeles**
In most of the cases the customers of the research have been Estonian ministries (both Ministry of Environment and Ministry of Climate). Also ports of Tallinn have been ordering studies.
Moreover, the maritime business is undergoing tremendous change due to the decarbonization targets. The published articles have contributed to this challenge by bringing important knowledge for the academia and industry, in particular impacts of electrification of vessels and calculation methods of port emissions.

## Info uurimisrühma rakendusliku väljundiga TA kohta

**Senised rakendused ettevõtluses, majanduses, ühiskonnas**
* Civitta Eesti AS - Sillamäe-Kotka reisiliikluse taastamise teostatavus-tasuvusanalüüsi ja sotsiaalmajanduslike mõjude analüüsi koostamine
* Transpordiamet - Eesti jäämurdeteenuse osutamise alternatiivide analüüs
* Partner Satakunnan ammattikorkeakoulu Oy koostöö “Research cooperation in the Älymeri project” raames.

**Uurimisrühma TA rakenduskompetentsid ettevõtluskoostööks**
competence in maritime transport

**Ettevõtluskoostöö eesmärk**
Ettevõtluskoostöö raames keskendutakse Eesti väikelaevade ja saarte parvlaevaliikluse dekarboniseerimisele

## Täiendav info:

**Uurimisrühma seotus TalTech TA prioriteetse suunaga (kuni kaks olulisemat suunda):**

- 6. Nutikas merendussektor ja jätkusuutlik merekeskkond
- 1. Targad ja energiatõhusad keskkonnad

**Uurimisrühma tegevusega seotud teadusvaldkond – kuni 2 alamvaldkonda Frascati Manuali klassifikaatori alusel ja kuni 3 teaduseriala CERCS klasifikaatori alusel.**

Frascati Manauali teadusvaldkonnad:

5.2 Majandusteadus ja ärindus

2.11 Teised tehnika- ja tehnoloogiateadused

CERCSi teaduserialad:

T300 Veetransporditehnoloogia

S190 Ettevõtete juhtimine

S180 Majandus, ökonomeetrika, majandusteooria, majanduslikud süsteemid, majanduspoliitika

**Hinnang rühma kasutuses olevale TA taristule (sh kollektsioonid ja andmekogud), piisavus ja seisund**

Hinnang seisundile:

Seisundi selgitus:

**Uurimisrühma liikmete osalus oluliste TA&I-ga seotud välisorganisatsioonide töös lõppenud aastal**

Ulla Tapaninen

* 05.04.2024 - Participation in panel in Connecting Europe Days 2024 days in Brussels (a conference over 1000 EU transport experts, authorities and officers).
* April 2024 - Participation of EU CINEA CEF application evaluation as an expert.
* Member of EUSBSR PA Ship Operational Group.
* Member of journal editorial boards WMU Journal of Maritime Transport and Journal of Shipping and Trade.
* Ulla is active in the maritime and logistics communities, contributing to various foundations, award committees and national strategies.
* Ulla has been the Chair of the Professor Recruitment Committee at the Estonian Maritime Academy in 2023 and 2024.

* Ulla actively collaborates with other EMERA research groups and research groups in other faculties. Internationally, she currently has research project partners with 6 Finnish, 2 Swedish, one Latvian and one Estonian universities or research institutes, as well as research institutes in Spain and Luxembourg.
* Ulla has actively contributed as an expert to several collections and networks both in Estonia and internationally.
* Ulla is an evaluator of research and development projects for the European Commission and through this contributes to European research and development

activities more broadly.

Starting from 2024, Olli-Pekka Hilmola has been fulfilling the role of Associate Editor in International Journal of Shipping and Transportation Logistics, Scopus and Wos/Clarivate indexed journal,https://www.inderscience.com/jhome.php?jcode=ijstl

Participation in R&D activities of a project "Baltic Fit" Research Group:
12.09.2024: Innovation Workshop Day 1 on Maritime Decarbonization
The BALTIC-FIT project hosted a workshop focused on maritime decarbonization, with over 70 experts from the Baltic region. Sessions explored digitalization, sustainable port practices, and emission-reduction technologies. A training on EU funding for green maritime projects was also provided. The event fostered knowledge-sharing and cross-sector collaboration to advance decarbonization in the Baltic Sea.
13.09.2024: Innovation workshop Day 2, Marine Hackathon “Green Corridors”
The Marine Hackathon, organized by the Estonian Maritime Academy and Port of Tallinn, focused on creating climate-neutral Green Corridors between Estonia and Finland. Teams worked on solutions for traffic flow, waste sorting, and air quality monitoring in ports. The event, supported by BALTIC-FIT members, highlighted collaborative innovation for sustainable port infrastructure.

26.09.2024: 20th International Maritime Conference

Attendees from our team joined the International Maritime Conference in Tallinn, organized by the Estonian Shipowners' Association, TalTech Estonian Maritime Academy, Tallink Grupp, and Corpore Conferences. The event gathered maritime professionals from across the Baltic region to discuss industry trends, sustainability, and technological advancements. The hybrid format allowed participation from a wider audience, fostering knowledge exchange and networking across the maritime sector.

03.10.2024: Call the Agent - October Summit
Professor Ulla Tapaninen represented the Research Group at the 'Call the Agent' October Summit, which focused on current trends, challenges, and innovations within maritime operations. The summit provided a platform for in-depth discussions on ship brokerage, industry networking, and the evolving role of maritime agents. This event was an opportunity to gain insights from industry leaders, share knowledge on sustainable practices, and explore collaborative approaches to decarbonization and digital transformation in maritime logistics.

08.10.2024: Baltic-FIT Presentation at EUSBSR PA Ship Operational Group Meeting

The Research Group presented the Baltic-FIT project at the EUSBSR PA Ship Operational Group meeting, focusing on the project’s objectives to decarbonize maritime transport in the Baltic Sea by aligning with EU Fit-for-55 regulations.

The presentation covered Baltic-FIT's strategic aims, ongoing investigations, and plans to engage maritime stakeholders from Estonia, Sweden, and Finland in collaborative research and innovation for sustainable shipping. The project was introduced as a newcomer to the PA Ship's lineup, providing an opportunity to align with EU funding streams and cross-border initiatives. This presentation helped raise awareness of Baltic-FIT and its objectives within the broader Baltic maritime community.

24-25.10.2024: 4th IMO-UNEP-Norway Innovation Forum

Members of the Research Group attended the 4th IMO-UNEP-Norway Innovation Forum online, which focused on driving maritime innovation for a low-emission future. The forum featured high-level sessions on maritime decarbonization, particularly targeting the needs of developing countries, Small Island Developing States (SIDS), and Least Developed Countries (LDCs). Key sessions explored technology cooperation models, the IMO 2023 GHG Strategy, and financing mechanisms for decarbonization initiatives.

12.11.2024: CSRD Reporting in Maritime Logistics

Hosted by Rödl & Partner, this webinar focused on CSRD (Corporate Sustainability Reporting Directive) compliance and reporting requirements specific to the maritime logistics sector. Key discussions included sustainability reporting standards, regulatory challenges, and best practices for implementing CSRD in maritime operations. The event provided participants with critical insights on regulatory obligations and practical approaches to effective CSRD reporting.

05.12.2024: Women in Transport Forum
Kristine Carjova represented the BALTIC-FIT project as a speaker at the Women in Transport Forum in Riga, Latvia. Her presentation, "International Cooperation - Together We Can Do More!", highlighted the importance of international collaboration in maritime research and innovation across the Baltic region.

09.12.2024: Virtual Watch Tower (VWT) Open Forum - Phase 1 Wrap-Up

The Virtual Watch Tower (VWT) initiative, co-led by RISE Research Institutes of Sweden and key community partners such as TalTech, VTT, and others, celebrated the successful conclusion of its first phase. Key milestones include growing the VWT community to 50 partners, conducting 20 International LivingLabs, and piloting VWTnet for global supply chain visibility. The event featured presentations, demos, and discussions on the future of VWT.

10.12.2024: Uudenmaan Liitto Event

Professor Ulla Tapaninen represented the BALTIC-FIT project during the second day of the Uudenmaan Liitto event, delivering a presentation on maritime transport. The presentation highlighted challenges in emissions reduction, electrification, and the transformative potential of sustainable innovations in the Baltic region.

10-12.12.2024: Fifth Baltic Sea Conference 2024

The Maritime Transport Research Group from TalTech Estonian Maritime Academy participated in the Fifth Baltic Sea Conference in Tallinn, Estonia, and Kotka, Finland. Team members Kadi Kasepõld, Kristine Carjova, and Kristin Kerem shared insights on maritime sustainability, logistics, and regional collaboration. The conference addressed challenges such as environmental impacts, energy solutions, and the evolving maritime logistics landscape.

Participation in R&D activities of a project "Sustainable Flow" Research Group:

* Meremess 2024
* Green Corridors - Framing the Scene
* Central Baltic Connect in Tallinn
* Åland Maritime Day
* Visit to Port of Riga
* Lithuanian Maritime Academy (Presentation) + Lithuanian Stevedoring Companies Association
* BLRT Shipyard
* EGSME seminar
* Maritime Conference in Tallinn
* French Embassy meeting with Estonian Maritime Academy
* Estonian Maritime Cluster
* Smart Sea Center

Participation in R&D activities of a project "AIRSHIP " Research Group:
* 25.01.2024: Smart Sea Excellence meeting, presenting AIRSHIP to the industry
* 16.04.2024: Maritime Cluster Days, in Tallinn, presentation of AIRSHIP
* 06.06.2024: Dissemination and clustering Workshop in Tallinn
* 18.06.2024: Meeting with Inspira in Tallinn, presenting AIRSHIP to the industry
* 27.11.2024: Clustering workshop, Teams
* 10.12.2024: Conference Baltic Sea in Traditions, in Tallinn and Kotka, presentation of AIRSHIP to stakeholders

**Kolm kõige olulisemat välis- ja kolm kõige olulisemat Eesti koostööpartnerit**
**Välispartnerid:**

- Aalto Ülikool, Soome
- Soome Transpordi- ja Kommunikatsiooniministeerium
- Satakunta Rakenduskõrgkool; Turu Ülikool; Rootsi Veeteedeamet; Ahvenamaa Rakenduskõrgkool; Läti Rahvusvaheline Transpordiarendusühing; Fintraffic VTS ltd (FI); Rootsi Transpordiettevõtete Konföderatsioon

**Eesti partnerid:**

- Majandus- ja Kommunikatsiooniministeerium
- Transpordiamet
- Tallinna Sadam; Tartu Ülikool, Meresüsteemide osakond

**Rühma liikmete TA populariseerimisega seotud tegevused**
* Ulla Tapaninen is an active R&D popularizer, writing a popular maritime blog and participating in public discussions.
* Ulla Tapaninen has a personal blog www.ullatapaninen.net [http://www.ullatapaninen.net], which has thousands of readers. Also over 70 blog posts on other platforms. The blogs are in English, Finnish and many also in Estonian.
* Ulla Tapaninen holds weekly meetings and interviews with maritime specialists, authorities, journalists and students. Several interviews in magazines, newspapers, television and radio, including Estonian media outlets.

Articles and interviews of the Research Group members in public media channels, including newspapers, radio stations, ship magazines, LinkedIn etc in 2023-2024:
* Customer magazine of port of Helsinki Kaija, article by Ulla Tapaninen, February 2024: "The future of sea freight looks very uncertain", https://kaija.portofhelsinki.fi/p/kaija-1/18-12-2024/r/1/1/6937/1777709 .

* Estonian national radio station KUKU, "Ilmaparandaja" programme, interview by Kadi Kasepõld, May 2024: introduction of the Research Group's project REISFER that has been launched in 2024, https://kuku.pleier.ee/podcast/ilmaparandaja/174399 .

* Newspaper Postimees, opinion by Ulla Tapaninen, June 2024: "Eestist võib saada hoopis «süsiniku käejälje maailmariik»" https://arvamus.postimees.ee/8041868/professor-ulla-tapaninen-eestist-voib-saada-hoopis-susiniku-kaejalje-maailmariik
* Magazine Meremees, article by Kristin Kerem, October 2024: "Robotlaugurite kasutuselevõtu õiguslikud aspektid" (in Estonian, "Legal aspects of robot wing-in-ground crafts").

* LinkedIn platform, Professional Publication by Deniece M. Aiken, November 2024: "Unravelling the Complexities of Life Cycle Assessment for MEPC 82", https://www.linkedin.com/pulse/unravelling-complexities-life-cycle-assessment-mepc-82-aiken-phd-jrwye/?trackingId=XYgL1B%2B2dghvOmEKf0j%2BvQ%3D%3D .
* Magazine Teejuht, article by Kristin Kerem, December 2024: "Robotlaugurite kasutuselevõtu õiguslikud aspektid Eestis" (in Estonian, "Legal aspects of robot wing-in-ground crafts in Estonia").
* Estonian Public Broadcasting, opinion by Ulla Tapaninen, December 2023: "Saastekvootidega kauplemine muudab laevandust", https://www.err.ee/1609187236/ulla-pirita-tapaninen-saastekvootidega-kauplemine-muudab-laevandust .

* Finnish newspaper Kauppalehti, article by Ulla Tapaninen, December 2023: " Valtiovalta ei saa hidastaa merenkulun vihreää siirtymää" (In Estonian, "Government should not slow down the green transition of shipping"), https://www.kauppalehti.fi/uutiset/valtiovalta-ei-saa-hidastaa-merenkulun-vihreaa-siirtymaa/21be614e-7206-4352-8e70-5387a7773b82 .
* Magazine Meremees, article by Kadi Kasepõld, September 2023: "Akulaevade areng ja tulevikuväljavaade", https://issuu.com/ajakirimeremees .

**Rühma liikmete rahvusvahelisel ja riiklikul tasemel olulised tunnustused lõppenud aastal**
**Riiklikud:**

Ulla Tapaninen, 2024 recognitions:

* Chairman of the selection committee of Tenured Professor of Marine Technology, Estonian Maritime Academy, Tallinn University of Technology
* Chairman of the selection committee of Assistant Professor of Ship systems and Marine Technology, Estonian Maritime Academy, Tallinn University of Technology
* Nomination to Tenured Full Professor (before that Tenured Associate Professor).
* Nomination to 2024 Maritime Leader of the Year, appreciation event "Maritime Month 2024" of Estonian Maritime Academy, Tallinn University of Technology

**Rahvusvahelised:**

Ulla Tapaninen:

* 2023: The logistics professional of the Year (Vuoden logistikko), Finnish Association of Purchasing and Logistics LOGY
* 2021: Knight of the Order of the White Rose of Finland
* 2019: Gold medal, Finnish Association of Purchasing and Logistics LOGY

**Rühma liikmete osalemine TA tegevusega seonduvalt ettevõtete nõustamistes**
Ulla Tapaninen participation in advisory boards and other governing bodies:
* CHNL (Centre for High North Logistics), Nord University, board member, 2018 – present
* SeaFocus International, member of the supervisory board, 2020 – present
* Member of board of leading Baltic bulk shipping company ESL Shipping in 2012-2024
* Member of the editorial board of Journal of Shipping and Trade, 2023-
* Member of the editorial board of WMU Journal of Maritime Affairs, 2023-
* Member of the steering group of "Electrification of city water traffic" – project of City of Helsinki.

Consulting on socially important topics:

02.10.2024: Meeting with REGENT Craft Inc.,. USA

This online meeting was the second collaboration between the Maritime Transport research group team (further Research team) and REGENT Craft, Inc., following an initial discussion in June 2024. The meeting focused on the ongoing collaboration to publish a research article on decarbonization of maritime vehicles using wing-in-ground (WIG) technology. REGENT Craft was studied in detail as a case example in the research article to identify success factors in the commercialization of sustainable WIG craft. REGENT was chosen for its high level of technological innovation, strong commitment to sustainability, and extensive network of international partnerships. Key outcomes from this partnership include insights into REGENT's rapid advancements in WIG technology,

significant R&D investments, and focus on environmentally-friendly production practices.

07.10.2024: Meeting with Port of Tallinn

Research Group members Kristine Carjova and Secil Gulmez met with Hele-Mai Metsal, Advisory Board member and Head of Development at the Port of Tallinn, to discuss and narrow down the outcomes of the recent Innovation Workshop on Maritime Decarbonization. Topics included short-, mid-, and long-term goals for operational actions, technological solutions, and research directions. The meeting explored specific areas such as AI and big data for CO2 tracking, digital twins, green corridors, alternative fuel infrastructure, and cybersecurity measures, with a focus on aligning port initiatives with EU decarbonization targets.

29-30.10.2024: Baltic Ports for Climate Conference

Research Group members attended the Baltic Ports for Climate Conference in Tallinn, focused on the role of ports in the EU's energy transition, alternative fuels, offshore wind development, and Carbon Capture and Storage (CCS). Key connections were established, including Staffan Forsell from Ports of Stockholm, who was invited to join the Baltic-FIT Advisory Board. Contacts were also made with Shorelink, Tallink, Greenport North, and the Bioenergy Association of Finland, setting the stage for follow-up meetings in November to discuss potential collaborations in green technologies and decarbonization strategies

October 2024: TalTech Estonian Maritime Academy Joins Virtual Watch Tower

TalTech Estonian Maritime Academy joined the Virtual Watch Tower (VWT) initiative, a collaborative project that connects key players in maritime innovation to enhance safety, sustainability, and operational efficiency in the Baltic region. VWT focuses on areas such as emission reduction, digital transformation, and sustainable transport solutions. Through this partnership, TalTech strengthens its role in maritime safety and digital innovation, bringing together a network of stakeholders dedicated to advancing the clean maritime industry. The initiative supports the Baltic-FIT project's goals of fostering collaboration for decarbonization and advancing sustainable port technologies.

01.11.2024: Uusimaa Regional Parliament

Prof. Ulla Tapaninen presented on the importance of emission reduction in maritime transport, highlighting electrification potential in both maritime and road transport. The Tallinn Tunnel project was also discussed as part of sustainable regional transport initiatives.

25.11.2024: Meeting with Tallink

Research Group members Kristine Carjova and Kadi Kasepõld met with Andrus Vaher from Tallink to discuss and narrow down the outcomes of the recent Innovation Workshop on Maritime Decarbonization. Key topics included short-, mid-, and long-term goals for operational actions, technological solutions, and research directions.

## Uurimisrühma veebilehe aadress

**Eesti keeles**
https://taltech.ee/mereakadeemia/uurimissuunad/mereveonduse-uurimisruhm

**Inglise keeles**
https://taltech.ee/en/estonian-maritime-academy/areas-of-advance/maritime-transport?_ga=2.155018360.1942191073.1699254527-256913150.1689577189

# 3 Sinimajandus ja veeressursid

## Uurimisrühma juht

Loreida Timberg, vanemteadur, loreida.timberg@taltech.ee

## Uurimisrühma liikmed

Loreida Timberg, Doktor, vanemteadur
Annmarii Hakkaja, Kõrgharidus, õppearendusspetsialist
Doris Nurk, Kesk, laborant
Jonne Kotta, Doktor, kaasatud professor
Indrek Adler, Magister, doktorant-nooremteadur
Kristel Rauk, Kõrgharidus, projektide koordinaator

## Võtmesõnad

**Eesti keeles**
sinimajandus, keskkond ja sotsiaalmajandus; vee bioloogiliste ressursside innovatsioon; tarbijad ja sinimajanduse tooted; vee bioloogiliste ressursside ohutus ja kvaliteet

**Inglise keeles**
blue economy, environment and social economy; the innovation of water's biological resources; consumers and products of blue economy; safety and quality of water's biological Resources

## Uurimisrühma kompetentside tutvustus

**Rühma ülevaade eesti keeles**

Sinimajanduse ja veeressursside uurimisrühm viib läbi rannikupiirkondade ja veekeskkonna tootmistehnoloogiate ja tooraine väärindamise arendustegevusi. Teadustöö eesmärk on leida võimalused jätkusuutlikuks veekeskkonna rakendamiseks, kus arvestatakse ökoloogiliste tingimustega ning prognoositakse inimtegevusest tulenevad ohud ja riskid. Veeressursside optimaalseks väärindamiseks analüüsitakse nende bioloogilisi, keemilisi ja füüsikalisi omadusi ning kirjeldatakse funktsionaalsed omadused. Veeressursside toorainete (kalad, vetikad ja karbid) väärindamiseks eksperimenteeritakse erinevate tehnoloogilistega protsessidega. Sinimajanduse majanduslikke ja sotsiaalmajanduslikke võimalusi analüüsitakse ja mudeldatakse arvestades ELi strateegiad, kehtivat seadusandlust ning tarbijate teadlikkust ja ootuseid kaardistades.

**Rühma ülevaade inglise keeles**

The research group carries out development activities on production technologies and raw material enhancement in coastal areas and the aquatic environment. The aim of the research is to find opportunities for the sustainable application of the aquatic resources, whereas ecological principles and conditions are taken into account and hazards and risks from human operations are predicted. In order to valorise aquatic resources, their biological, chemical, and physical properties are analysed, and their functional properties will be described.

Technological processes are tested and developed for valorisation of the aquatic recourses. Economical and socioeconomical opportunities of blue economy are analysed and modelled in view of EU strategies, existing legislation and most importantly consumers awareness and expectations.The research group is currently conducting three studies:

**Viimaste aastate olulisemad projektid:**
PRIA20029 Kalaõli ja kalajahu kvaliteet ja väärindamise võimalused antioksüdantide kasutamisega 2020 - 2022 https://www.etis.ee/Portal/Projects/Display/90047b1f-0336-42fd-a5ce-5d53f086ae90

PRIA20030 Kalatoodete soolasisalduse vähendamine ja põisadrulisandi arendus 2020 - 2022 https://www.etis.ee/Portal/Projects/Display/ee0584f2-e45d-4510-82f1-d313ff46c37b

LVAE22048 Külmutamise ja sulatamise mõju kala pikkusele 2022 - 2023 https://www.etis.ee/Portal/Projects/Display/73496bf0-879a-4ad1-96c5-d7227c4de4a2

**Viimaste aastate olulisemad artiklid:**
Adler, I.; Kotta, J.; Tuvikene, R.; Kaldre, K. (2022). Optimizing the processing of shellfish (Mytilus edulis and M. trossulus hybrid) biomass cultivated in the low salinity region of the Baltic Sea for the extraction of meat and proteins. Applied Sciences, 12 (10), 5163. DOI: 10.3390/app12105163. https://www.etis.ee/Portal/Publications/Display/4096a9b8-7187-4aa9-93fd-92b9699b3041

Adler, Indrek; Kotta, Jonne; Robal, Marju; Humayun, Sanjida; Vene, Kristel; Tuvikene, Rando (2024). Valorization of Baltic Sea farmed blue mussels: Chemical profiling and prebiotic potential for nutraceutical and functional food development. Food Chemistry X, 23, 1−14. DOI: 10.1016/j.fochx.2024.101736. https://www.etis.ee/Portal/Publications/Display/030d67f8-40ad-458b-b2e5-24e62374d59b

Adler, I.; Kotta, J.; Tuvikene, R.; Orav-Kotta, H. (2024). Unlocking the potential of shellfish biomass: Refining protein extraction from Baltic blue mussels for sustainable food applications. Cogent Food & Agriculture, 10 (1), #2405880. DOI: 10.1080/23311932.2024.2405880. https://www.etis.ee/Portal/Publications/Display/d2980c9e-f64b-4d3d-af43-e7462a409ee4

## Uurimisrühma lõppenud aasta rahvusvahelisel tasemel väljapaistvad teadustulemused

**Eesti keeles**
BlueGreenFeed projektis on jätkatud töödega jahumardika vastsete kasvatamisel erinevate rohu- ja sule söötadel. Jätkuvad tegevused on projektipartnerite poolt toodetud uute heina- ja sulekomponentidel jahumardika vastsete kasvatamine, kasvuprotsessi kirjeldamine, väljatulekute määramine, jahumardikate kogumine järgmisteks projektikatseteks. Alustati jahumardika vastsete töötlemistehnoloogiate kasvatamiseks vajalike tehnoloogite testimisega. Alustati töödega LCA hindamiseks jahumardikate kasvatamisel ja töötlemisel.

Säästva Arengu Eesmärkide ja uute merendusregulatsioonide testimine õppe- ja

teadustöös on viidud läbi koostöös Eesti mereakadeemia akadeemilse personaliga.

**Inglise keeles**
In the BlueGreenFeed project, work has continued on rearing mealworm larvae on various grass and feather feeds. Ongoing activities include rearing mealworm larvae on new hay and feather components produced by project partners, describing the growth process, determining emergence rates, and collecting mealworms for subsequent project experiments. Testing of technologies necessary for processing mealworm larvae has begun. Work has also started on LCA assessment for mealworm rearing and processing.

The testing of Sustainable Development Goals and new maritime regulations in teaching and research has been carried out in collaboration with the academic staff of the Estonian Maritime Academy.

## Rühma TA seotus ühiskonnas aktuaalsete probleemidega ning neile lahenduste pakkumisega

**Eesti keeles**
Säästlikkus: arendame sinimajanduse tehnoloogiaid ja õpime rakendama olemasolevaid ressursse võimalikult tõhusalt, vähendades seeläbi jäätmeid ja keskkonnamõju ning leides uusi toormaterjale.
Innovatsioon: Uute tehnoloogiate ja protsesside väljatöötamine võimaldab sinimajanduses kasutada toormaterjale uudsel ja tõhusamal viisil.
Ringmajandus: sinimajanduses loome süsteeme, kus toormaterjalid ja ressursid pöörduvad tagasi tootmistsüklisse, vähendades seeläbi vajadust uute ressursside järele.

**Inglise keeles**
The societal impact of the blue economy raw materials working group is:

Sustainability: We develop blue economy technologies and learn to apply existing resources as efficiently as possible, thereby reducing waste and environmental impact and finding new raw materials.

Innovation: The development of new technologies and processes allows the use of raw materials in the blue economy in a novel and more efficient way.

Circular Economy: In the blue economy, we create systems where raw materials and

resources return to the production cycle, thereby reducing the need for new resources.

## Info uurimisrühma rakendusliku väljundiga TA kohta

**Senised rakendused ettevõtluses, majanduses, ühiskonnas**

Keskkonnaamet- Külmutamise ja sulatamise mõju kala pikkusele

**Uurimisrühma TA rakenduskompetentsid ettevõtluskoostööks**

Eesti on mereäärne riik, kuid meie oskused meres ja vees olevatest ressurssidest: kalast, vetikatest ja karpidest erinevate toodete tootmisel on veel lapsekingades. Meres ja vees kasvavad kalad, vetikad ja karbid on kõrge toiteväärtusega, kuid nende kasvatamise, kogumise ja töötlemise tehnoloogiad vajavad väljatöötamist. Mere- ja veeressursside tootmisvõimaluste väljatöötamine on äärmiselt oluline rannapiirkondade elanikele ja omavalitsustele, sest traditsiooniline kalapüük on hooajaline. Tänapäeva tarbijad teavad, et nende valikutel on tugev sotsiaalne ja keskkonnahoidlik mõju. Eelistades kohalikke ja kiiresti kasvavatest ressurssidest toodetud tooteid, aitavad tarbijad luua jätkusuutlikku maailma. Kala, vetikad ja karbid on just sellised kiiresti kasvavad toorained, kuid nende välimus ja maitse ei ole meie tarbijatele harjumuspärane. Uute toodete väljatöötamisel on oluline kaasata tarbijaid, et heast toorainest tehtud tooted vastaksid tarbijate ootustele. Uute tehnoloogiate ja uute toodete väljatöötamine annab võimaluse uute rannapiirkonna ettevõtete tekkimiseks või juba olemasolevate ettevõtete konkurentsivõime parandamiseks.

**Ettevõtluskoostöö eesmärk**

Estonia is a seaside country, but our skills having to do with resources found in sea and in freshwater, such as fish, seaweed, and mussels, are modest. Fish, seaweed, and mussels, that grow in sea and in freshwater, have high nutritional value, but technologies of growing, collecting and processing them need developing. The development of sea and water resources' production possibilities is extremely important for costal residents and municipalities because traditional fishing is seasonal. Today's consumers know that their choices have

a strong social and environmental impact. Favouring local products and products made of fast-growing resources helps to create a sustainable world. Fish, seaweed and mussels represent those fast-growing resources, but the consumers are not used to their appearance and taste. For the products to be able to meet the consumers' expectations it is important to involve the consumers in the process of developing new products. The development of new technologies and products provides an opportunity for the emergence of new costal enterprises or for the improvement of already existing enterprises' competitiveness.

## Täiendav info:

**Uurimisrühma seotus TalTech TA prioriteetse suunaga (kuni kaks olulisemat suunda):**

- 6. Nutikas merendussektor ja jätkusuutlik merekeskkond
- 3. Keskkonnaressursside vääristamine

**Uurimisrühma tegevusega seotud teadusvaldkond – kuni 2 alamvaldkonda Frascati Manuali klassifikaatori alusel ja kuni 3 teaduseriala CERCS klasifikaatori alusel.**

Frascati Manauali teadusvaldkonnad:

1.7 Teised loodusteadused

2.11 Teised tehnika- ja tehnoloogiateadused

CERCSi teaduserialad:

B260 Hüdrobioloogia, mere-bioloogia, veeökoloogia, limnoloogia

T270 Keskkonnatehnoloogia, reostuskontroll

T130 Tootmistehnoloogia

**Hinnang rühma kasutuses olevale TA taristule (sh kollektsioonid ja andmekogud), piisavus ja seisund**

Hinnang seisundile:

Seisundi selgitus:

TA taristu vajab uuendamist laboriseadmete näol, millele enam ei toodeta varuosi ja/või tarkvara.

**Uurimisrühma liikmete osalus oluliste TA&I-ga seotud välisorganisatsioonide töös lõppenud aastal**

-

**Kolm kõige olulisemat välis- ja kolm kõige olulisemat Eesti koostööpartnerit**
**Välispartnerid:**

- Matis Icelandic Food and Biotech R&D
- Sitef Ocean
- Aarhus University; University of Iceland Food Science and Nutrition; Fodurverksmidjan Laxa hf

**Eesti partnerid:**

- Keskkonnaamet
- Regionaalministeerium
- Eesti Maaülikool; Tartu Ülikool

**Rühma liikmete TA populariseerimisega seotud tegevused**
Erialased töötoad Eesti Mereakadeemias keskkooliõpilastele ja eriala ettevõtetele. Merenduse digikursus keskkooliõpilastele.

**Rühma liikmete rahvusvahelisel ja riiklikul tasemel olulised tunnustused lõppenud aastal**
**Riiklikud:**

**Rahvusvahelised:**

**Rühma liikmete osalemine TA tegevusega seonduvalt ettevõtete nõustamistes**
-

## Uurimisrühma veebilehe aadress

**Eesti keeles**
https://taltech.ee/et/mereakadeemia/uurimissuunad/sinimajandus-ja-veeressursid

**Inglise keeles**

https://taltech.ee/en/estonian-maritime-academy/areas-of-advance/blue-economy-and-water-resources

# 4 Roheline meretehnoloogia

## Uurimisrühma juht

Jakub Jerzy Montewka, kaasatud professor, jakub.montewka@taltech.ee

## Uurimisrühma liikmed

Rasul Niazmand Bilandi, Magister, doktorant-nooremteadur
Fatemeh Roshan, Magister, doktorant-nooremteadur
Ahmed Shehata, Magister, doktorant-nooremteadur
Jakub Jerzy Montewka, Doktor, kaasatud professor

## Võtmesõnad

**Eesti keeles**
roheline merendus; heitkoguste vähendamine; nutikad lahendused; hüdrodünaamika

**Inglise keeles**
marine hydrodynamics; fuel efficiency; safety; smartization

## Uurimisrühma kompetentside tutvustus

**Rühma ülevaade eesti keeles**

Nutika, ohutu ja rohelise hüdrodünaamika uurimisrühma tegevuse peaeesmärk on pakkuda sektorile regulatiivsete ning poliitiliste organite (IMO, HELCOM, ELi Läänemere piirkonna strateegia ja rahvusvahelised säästva arengu lepingud) poolt deklareeritud põhimõtete ja strateegiate teaduspõhist rakendamist juurutades keerukaid nutikaid, ohutuid ja keskkonnasäästlikke lahendusi ning suurendada meresõidukite jõudlust. Uurimisrühma peamised uuringusuunad jagunevad neljaks: Ohutus - põhirõhk on aluste dünaamika vähendamisel. Keskendume aluse dünaamika mõjule meeskonnaliikmetele ja pardasüsteemidele. Hetkel töötame kere dünaamilise ohutuse parendamisega kombinatsioonis aktiivtrimmiseadmete ja amortiseerivate istmetega. Heitmekoguste vähendamine - töös on mitu uurimisvaldkonda. Keskendutakse kütusesäästlikele kerekujudele ning käitursüsteemide optimeerimisele ja heitmevabadele käituritele. Käimasolev Interregi Läänemere piirkonna programmi toetatud projekt keskendub väikelaevade rohelisele ristlusviisile, milles töös laevakere uue vormid, elektrilised käiturid ja kiirekäiguliste väikelaevade kütusesäästlikud digitaalsed juhtsüsteemid. Nutikus - keskendutakse mitmesugustele uuringutele, sealhulgas laevakere nutikas disain, mehitamata kiirlaevad ja arvutuslik hüdrodünaamika (DCFD), rakendades selleks tehisintellekti, masinnägemist ja geneetilist algoritmi. Hetkel koostatakse ulatuslikku andmebaasi laevakerede projekteerimise hüdrodünaamikast, töötamaks välja nutikat arvutusmudelit kerekuju disainimiseks ja optimeerimiseks. Veesõidukite hüdrodünaamika - on osaks kõigist eelnimetatud uuringutest. Töötatakse erinevate veesõidukite meresõidu- ja käiguomaduste arendamisel, seades sihiks ohutuse, kütusesäästlikkuse ja nutikuse. Värskemalt keskendutakse redaankerede mereomadustele ja juhitavusele. Uurimisrühmas on arendamisel hulk matemaatilisi, arvutuslikke ja eksperimentaalseid meetodeid. Lisaks planeeritakse basseinikatsed uurimaks veesõidukite käitumist irregulaarses

lainespektris ja kütusesäästlikkuse mõju meresõiduomadustele.

**Rühma ülevaade inglise keeles**

The main motivation behind the activities of the research group is the implementation of the principles and strategies declared by regulatory and policy-making bodies (such as IMO, HELCOM, the EU Strategy for the Baltic Sea Region and international agreements on sustainable development) regarding various marine vehicles, especially focusing on high speed crafts. For this purpose, the main research studies of the research group are divided into four fields: Safety: The main focus is the development of methods for reducing the effect of HSC motion for the crew and on-board systems.. F. Roshan' thesis on "Safety improvement of high-speed planing craft development of a conceptual framework" addresses the health concern of HSC's operators when operated on high speed in rough conditions causing sleepiness, muscle and internal organ damage, and therefore reducing crew performance. Emission Reduction: This field focuses on fuel-efficient hull forms, optimization and zero-emission propulsion systems. R. Niazmad Bilandi thesis on "Fuel efficient high-speed small craft by considering seakeeping and manoeuvring motions" investigates the hydrodynamics of different stepped hulls to find out which step can lead to a fuel-efficient hull form by taking into account the seakeeping and manoeuvring motions. The focus is on improving the design and operation of future high-speed craft through mathematical modelling, numerical simulations and towing tank tests. Smartization: The focus is on smart ship design, unmanned high-speed craft and Digitalized Computational Fluid Dynamics (DCFD) by implementing artificial intelligence, machine learning and genetic algorithm. Hydrodynamics of Marine Vehicles: Enhancing hydrodynamic efficiency is in focus when working on solutions to enhance resistance and propulsion, seakeeping and manoeuvring characteristics of different marine vehicles by considering safety, fuel efficiency and smartization goals. The latest focus is on seakeeping and manoeuvring of stepped hulls. A large variety of mathematical, numerical and experimental methods are under development to address the existing knowledge gap in the sector.

**Viimaste aastate olulisemad projektid:**

**Viimaste aastate olulisemad artiklid:**

Bilandi, Rasul Niazmand; Tavakoli, Sasan; Mancini, Simone; Dashtimanesh, Abbas (2024). Dynamic motion analysis of stepless and stepped planing hulls in random waves: A CFD model perspective. Applied Ocean Research, 149, #104046. DOI: 10.1016/j.apor.2024.104046. https://www.etis.ee/Portal/Publications/Display/a79bd0b4-66a6-420c-af2e-004c5f6c08d0

Sulman, Muhammad; Mancini, Simone; Bilandi, Rasul Niazmand (2024). Numerical Investigation of Single and Double Steps in Planing Hulls. Journal of Marine Science and Engineering, 12 (4), #614.

DOI: 10.3390/jmse12040614. https://www.etis.ee/Portal/Publications/Display/d60caca7-8989-4ba7-b860-d9b3ffe03dcc

Niazmand Bilandi, Rasul; Mancini, Simone; Dashtimanesh, Abbas; Tavakoli, Sasan (2024). A revisited verification and validation analysis for URANS simulation of planing hulls in calm water. Ocean Engineering, 293, #116589. DOI: 10.1016/j.oceaneng.2023.116589. https://www.etis.ee/Portal/Publications/Display/9877f2a5-24d8-41ae-a40a-73b809ac320d

Roshan, Fatemeh; Tavakoli, Sasan; Mancini, Simone; Dashtimanesh, Abbas (2022). Dynamic of Tunneled Planing Hulls in Waves. Journal of Marine Science and Engineering, 10 (8), #1038. DOI: 10.3390/jmse10081038. https://www.etis.ee/Portal/Publications/Display/3d47b658-b6c7-4f66-9441-15c2094412f4

Niazmand Bilandi, Rasul; Mancini, Simone; Dashtimanesh, Abbas; Lakatos, Miklos (2023). How to Improve Full-Scale Self-Propulsion Simulations? A Case Study on a Semi-Displacement Hull. HSMV 2023 : Proceedings of the 13th Symposium on High Speed Marine Vehicles: 13th International Symposium on High Speed Marine Vehicles, Naples, Italy, 23-25 October, 2023. ISO Press, 265–274. (Progress in Marine Science and Technology; 7). DOI: 10.3233/PMST230034. https://www.etis.ee/Portal/Publications/Display/51fbf75a-c473-46fc-ae14-11368b3ea234

## Uurimisrühma lõppenud aasta rahvusvahelisel tasemel väljapaistvad teadustulemused

**Eesti keeles**

Uurimisrühma doktorandid on aktiivselt publitseerinud kõrgetasemelistes ajakirjades. Doktorant Rasul Niazmand Bilandi kaitses oma doktoritöö 20. detsembril 2024. Aastal 2024 täideti kaasprofessori ametikoht ning mas 2025 asub tööle professor Serkan Turkmen, kes on olnud juba aktiivselt kaasatud õppetöösse.

**Inglise keeles**

The doctoral students of the research group have been actively publishing in high-level journals. Doctoral student Rasul Niazmand Bilandi defended his dissertation on December 20, 2024. In 2024, the position of associate professor was filled, and in 2025, Professor Serkan Turkmen, who has already been actively involved in teaching, will start working.

## Rühma TA seotus ühiskonnas aktuaalsete probleemidega ning neile lahenduste pakkumisega

**Eesti keeles**

Doktoritööde raames arendatakse välja tehnoloogiaid, mis aitavad kaasa säästlikumatele lahendustele laevaehituses.

**Inglise keeles**
In the frame of doctoral theses, technologies are being developed that contribute to more sustainable solutions in shipbuilding.

## Info uurimisrühma rakendusliku väljundiga TA kohta

**Senised rakendused ettevõtluses, majanduses, ühiskonnas**

**Uurimisrühma TA rakenduskompetentsid ettevõtluskoostööks**
Väikelaevade hüdrodünaamika uuringud ja testimised.

**Ettevõtluskoostöö eesmärk**
Koostöö ettevõtetega toetab eesmärki liituda valdkondlike Horisondi konsortsiumitega.

## Täiendav info:

**Uurimisrühma seotus TalTech TA prioriteetse suunaga (kuni kaks olulisemat suunda):**

- 6. Nutikas merendussektor ja jätkusuutlik merekeskkond
- 1. Targad ja energiatõhusad keskkonnad

**Uurimisrühma tegevusega seotud teadusvaldkond – kuni 2 alamvaldkonda Frascati Manuali klassifikaatori alusel ja kuni 3 teaduseriala CERCS klasifikaatori alusel.**
Frascati Manauali teadusvaldkonnad:

2.11 Teised tehnika- ja tehnoloogiateadused
2.3 Mehaanika / masinaehitus

CERCSi teaduserialad:

T300 Veetransporditehnoloogia
T455 Mootorid ja ajamid
T210 Masinaehitus, hüdraulika, vaakumtehnoloogia, vibratsioonakustiline tehnoloogia

**Hinnang rühma kasutuses olevale TA taristule (sh kollektsioonid ja andmekogud), piisavus ja seisund**

Hinnang seisundile:

vajab uuendamist

Seisundi selgitus:

**Uurimisrühma liikmete osalus oluliste TA&I-ga seotud välisorganisatsioonide töös lõppenud aastal**

**Kolm kõige olulisemat välis- ja kolm kõige olulisemat Eesti koostööpartnerit**
**Välispartnerid:**

- KTH, Rootsi
- Newcastle University, UK
- University of Naples, Itaalia

**Eesti partnerid:**

-
-
-

**Rühma liikmete TA populariseerimisega seotud tegevused**
Rasul Niazmand Bilandi doktoritöö kohta ilmunud lühitutvustus Doktoritöö kaitsmine: Rasul Niazmand Bilandi, "Efficient High-Speed Small Craft: Performance in Calm Water and Waves" | TalTech [https://taltech.ee/sundmused/doktoritoo-kaitsmine-rasul-niazmand-bilandi]

**Rühma liikmete rahvusvahelisel ja riiklikul tasemel olulised tunnustused lõppenud aastal**
**Riiklikud:**

Doktorikraadi kaitsmine - Rasul Niazmand Bilandi (EMERA esimene kaitstud doktoritöö)

**Rahvusvahelised:**

**Rühma liikmete osalemine TA tegevusega seonduvalt ettevõtete nõustamistes**

## Uurimisrühma veebilehe aadress

**Eesti keeles**
https://taltech.ee/mereakadeemia/uurimissuunad/roheline-meretehnoloogia

**Inglise keeles**
https://taltech.ee/en/estonian-maritime-academy/areas-of-advance/green-maritime-technology

# 5 Veeteede ohutus

## Uurimisrühma juht

Pentti Jouko Sakari Kujala, professor, pentti.kujala@taltech.ee

## Uurimisrühma liikmed

Pentti Jouko Sakari Kujala, Doktor, professor
Inga Zaitseva-Pärnaste, Doktor, dotsent
Mihhail Fetissov, Doktor, peaspetsialist
Jarmo Kõster, Magister, vanemlektor
Roomet Leiger, Magister, direktor
Ahmed Nasr, Magister, doktorant-nooremteadur
Jim Henry Chen, Magister, tööstusdoktorant
Kirill Šustov, Magister, doktorant-nooremteadur
Kadi Kasepõld, Magister, projektijuht
Valentin Bratkov, , programmijuht

## Võtmesõnad

**Eesti keeles**
hüdrograafia; veeteede ohutus; navigatsiooniriskide hindamine; nutikas navigatsioonimärgistus

**Inglise keeles**
hydrography; safe waterways; navigational risk assessment; smart navigational marks

## Uurimisrühma kompetentside tutvustus

**Rühma ülevaade eesti keeles**
Loodud uurimisrühma eesmärgiks on olla tugev koostööpartner nii Eesti merendussektorile kui ka töötada koos rahvusvaheliste konsortsiumitega, panustades konkurentsivõimelise meremajanduse arengusse läbi teadustöö hüdrograafia, veeteede planeerimise, nutika navigatsioonimärgistuse, merekartograafia ning navigatsiooniohutuse valdkonnas. Uurimisrühma fookuses on teaduspõhise õppe arendamine ning pakkumine kõikidel kõrghariduse astmetel, nii bakalaureuse-, magistri- kui doktoriõppes, võttes arvesse merendussektori arengud ja praegusel ning tuleviku tööturul vajalikud kompetentsid.

**Rühma ülevaade inglise keeles**
The new research group aims to be a strong partner for Estonian maritime sector and work with international consortiums, contributing to the development of competitive maritime economy through research in the areas of hydrography, waterways planning, smart solutions for aids to navigation, marine cartography, and safety of navigation. Strong focus will additionally be directed on science-based higher education on all levels – Bachelor, Master, and Doctoral studies – taking into account the developments in the industry and relevant emerging competences required in the labour market.

**Viimaste aastate olulisemad projektid:**
LVEE22106 Saare-Liivi meretuulepargi navigatsiooniriski analüüs 2022 - 2024 https://www.etis.ee/Portal/Projects/Display/eb7aeb3d-146c-47c2-9b26-ee9d9ad6cbe5

VFP20050 ERA Chair in Maritime Cyber Security at Tallinn University of Technology - MariCybERA 2021 - 2025 https://www.etis.ee/Portal/Projects/Display/820aea14-b251-47bf-b3e6-ffd1e1e48c62

VEU23016 Praktiline küberturvalisuse koolitusprogramm Euroopa tööstusharude professionaalidele 2022 - 2025 https://www.etis.ee/Portal/Projects/Display/75295390-139d-4995-a7a4-b730cbe6bd96

**Viimaste aastate olulisemad artiklid:**
Hirdaris, S., Zhang, M., Tsoulakos, N., Kujala, P. (2024). A Ship Digital Twin for Safe and Sustainable Ship Operations. In: Karakostas, B.; Katsoulakos, T. (Eds.) (Ed.). State-of-the-Art Digital Twin Applications for Shipping Sector Decarbonization. (192−220). IGI Global. (Advances in Logistics, Operations, and Management Science (ALOMS)). DOI: 10.4018/978-1-6684-9848-4.ch009. https://www.etis.ee/Portal/Publications/Display/f4b7c258-d923-4cd6-8a6d-92e10ed420c2

Huang, Jiayu; Diao, Feng; Ding, Shifeng; Han, Sen; Kujala, Pentti; Zhou, Li (2024). A Study on the Ice Resistance Characteristics of Ships in Rafted Ice Based on the Circumferential Crack Method. Water, 16, 6, #854. DOI: 10.3390/w16060854. https://www.etis.ee/Portal/Publications/Display/eded9ad0-e22f-4b27-9da6-9c0cf5207ed1

Zhang, Mingyang; Tsoulakos, Nikolaos; Kujala, Pentti; Hirdaris, Spyros (2024). AI-Based Surrogate Model for the Prediction of Ship Fuel Consumption Reflecting Hydrometeorological Conditions. Proceedings of the International Conference on Offshore Mechanics and Arctic Engineering - OMAE: ASME 2024 : 43rd International Conference on Ocean, Offshore and Arctic Engineering (OMAE2024), Singapore, June 9-14, 2024. American Society of Mechanical Engineers (ASME), #v009t13a016. DOI: 10.1115/OMAE2024-121992. https://www.etis.ee/Portal/Publications/Display/959d3b36-0990-4d48-b34d-8d0c02607a22

Pentti, K.; Ketki, K.; Aleksandr, K.; Liangliang, L.; Casper, W.; Fang, L.; Mashrura, M. (2024). System level simulation of the winter navigation in the Baltic Sea. Proceedings of 15th International Marine Design Conference (IMDC-2024): 15th International Marine Design Conference (IMDC 2024), Amsterdam, The Netherlands, June 2-6, 2024. TU Delft, 1−13. DOI: 10.59490/imdc.2024.902. https://www.etis.ee/Portal/Publications/Display/5aafbe67-53cb-4b43-a655-3eb4fb3e2e8d

Lu, Liangliang; Kondratenko, Aleksandr; Kulkarni, Ketki; Li, Fang; Kujala, Pentti; Musharraf, Mashrura (2024). An Investigation of Winter Navigation and Icebreaker Needs in the Ice-Infested Water: The Gulf of Finland and the Gulf of Riga. Proceedings of the International Conference on Offshore Mechanics and Arctic Engineering - OMAE, 6: ASME 2024 : 43rd International Conference on Ocean, Offshore and Arctic Engineering (OMAE2024), Singapore, June 9-14, 2024. American Society of Mechanical Engineers (ASME), #v006t07a006. DOI: 10.1115/OMAE2024-127955. https://www.etis.ee/Portal/Publications/Display/5e3536ad-5d03-4ba9-aa4e-f165dde09dbd

## Uurimisrühma lõppenud aasta rahvusvahelisel tasemel väljapaistvad teadustulemused

**Eesti keeles**
Uurimisgrupiga on aasta jooksul liitunud kolm doktoranti (2 doktorant-nooremteadurit ja üks tööstusdoktorant). Oluliselt on tugevdatud koostööd ettevõtete ja organisatsioonidega - ABB, Xamk, Aalto Ülikool, NTNU.

**Inglise keeles**
Three doctoral students (2 doctoral junior researchers and one industrial doctoral student) have joined the research group over the year. Collaboration with companies and organizations such as ABB, Xamk, Aalto University, and NTNU has been significantly strengthened.

## Rühma TA seotus ühiskonnas aktuaalsete probleemidega ning neile lahenduste pakkumisega

**Eesti keeles**
Suurt tähelepanu pööratakse teaduspõhisele kõrgharidusele kõikidel tasanditel, tagades hüdrograafia, veeteede planeerimise, navigatsiooniabi arukate lahenduste, merekartograafia ja sellega seotud valdkondade ekspertide järjepidevuse, mis kõik aitavad kaasa meresõiduohutusele.

**Inglise keeles**
Strong focus is directed towards science-based higher education on all levels, ensuring the continuity of experts in the field of hydrography, waterways planning, smart solutions for aids to navigation, marine cartography and related fields all contributing to the safety of navigation.

The research group work started in autumn 2023, so the results from 2023 are also limited. Most effort has been done to look for potential new doctoral candidates and during autumn and early 2024, now we have 3 doctoral students starting in the research group. The topics are related to design of ship propulsion systems for ice conditions, maritime cyber security and simulation of the marine traffic during winter time.

Group leader prof Kujala has achieved the top 2% level on the number of publications and citations on his area wordlwide.

## Info uurimisrühma rakendusliku väljundiga TA kohta

**Senised rakendused ettevõtluses, majanduses, ühiskonnas**
* Research group strong focus was on assessing the navigational safety risks in the planned offshore windparks. Cooperation with Utilitas Wind OÜ continued.

LVEE22106 "Navigational risk assessment for Saare-Liivi offshore windpark" (31.10.2022–31.08.2024)

* In 2023 an industrial PhD position filled enabling even stronger cooperation with ABB on digital solutions that have the potential to make data in the maritime industry more widely available and visualized for comprehensive analysis. ABB Marine and Ports will important co-operation partner in future to develop future propulsion systems for ice-going ships

**Uurimisrühma TA rakenduskompetentsid ettevõtluskoostööks**

Pentti Kujala coordinated the action to prepare an application for the EU call: Marie Skłodowska-Curie Actions - Doctoral Networks (DN). HOLMASAC proposal aims to bring collaboration between the fields of Holistic Maritime Safety, Automation and Cybersecurity to address all these topics holistically in terms of both safety, automation and cyber security functions and pillars. The integration is planned to be achieved by combining world-class expertise on marine safety and computer science.

This proposal is focusing strongly in collaboration witn industry having several key partners from all the participating countries.

**Ettevõtluskoostöö eesmärk**

The Waterways Safety Management research group aims to be a strong partner for Estonian maritime sector, but also internationally.

In 2023 an industrial PhD position filled enabling even stronger cooperation with ABB on digital solutions that have the potential to make data in the maritime industry more widely available and visualized for comprehensive analysis. ABB Marine and Ports will important co-operation partner in future to

develop future propulsion systems for ice-going ships

The current main university partners have been Gdansk U/Montewka, Szłapczyńska, AALTO/Banda, Musharraf, CHALMERS/Almgren, TUAS/Paavola, ABO Academy/Porres,

In Estonia, the main industrial partner has been Riigilaevastik as we have similar aims to develop digital twin applications on the maritime sector.

## Täiendav info:

**Uurimisrühma seotus TalTech TA prioriteetse suunaga (kuni kaks olulisemat suunda):**

- 6. Nutikas merendussektor ja jätkusuutlik merekeskkond
- 1. Targad ja energiatõhusad keskkonnad

**Uurimisrühma tegevusega seotud teadusvaldkond – kuni 2 alamvaldkonda Frascati Manuali klassifikaatori alusel ja kuni 3 teaduseriala CERCS klasifikaatori alusel.**

Frascati Manauali teadusvaldkonnad:

2.11 Teised tehnika- ja tehnoloogiateadused

CERCSi teaduserialad:

T300 Veetransporditehnoloogia

T210 Masinaehitus, hüdraulika, vaakumtehnoloogia, vibratsioonakustiline tehnoloogia

**Hinnang rühma kasutuses olevale TA taristule (sh kollektsioonid ja andmekogud), piisavus ja seisund**

Hinnang seisundile:

vajab uuendamist

Seisundi selgitus:

TalTech Estonian Maritime Academy owns a 16m motor boat SINILIND that is a pivotal asset for a wide range of maritime research endeavors, including maritime cybersecurity and hydrography. In 2023, SINILIND underwent a significant upgrade, enhancing its navigational capabilities with the integration of the Electronic Chart Display and Information System (ECDIS). This state-of-the-art technology provides advanced charting and navigation information, making it an invaluable tool for both educational and research purposes.

**Uurimisrühma liikmete osalus oluliste TA&I-ga seotud välisorganisatsioonide töös lõppenud aastal**

**Kolm kõige olulisemat välis- ja kolm kõige olulisemat Eesti koostööpartnerit**
**Välispartnerid:**

- ABB
- Xamk
- Aalto University

**Eesti partnerid:**

- Estonian Transport Board
- Merendusklaster
- ABB Eesti

**Rühma liikmete TA populariseerimisega seotud tegevused**
Participation in the work of international organisations – Inga Zaitseva-Pärnaste (member of the research group, associate professor) is a member of the board of PIANC Estonia.

PIANC (The World Association for Waterborne Transport Infrastructure) is a non-political and non-profit organization with a mission to bring together international experts issuing high-ranking and leading-edge technical reports related to sustainable waterborne transport infrastructure and a strong focus on climate change.

**Rühma liikmete rahvusvahelisel ja riiklikul tasemel olulised tunnustused lõppenud aastal**
**Riiklikud:**

**Rahvusvahelised:**

**Rühma liikmete osalemine TA tegevusega seonduvalt ettevõtete nõustamistes**

## Uurimisrühma veebilehe aadress

**Eesti keeles**
https://taltech.ee/mereakadeemia/uurimissuunad/meresoiduohutus-ja-turvalisus

**Inglise keeles**
https://taltech.ee/en/estonian-maritime-academy/areas-of-advance/maritime-safety-and-security