SFI AutoShip Christmas newsletter 2022

Season's greetings from the Centre Director

We have finally come to the end of 2022, and it has been an exciting year for SFI AutoShip! We welcomed two new partners, conducted the SFI days with great attendance and excellent contributions by our partners, arranged several workshops (our regular researcher workshops plus webinars), and increased our research capacity to a total of 14 PhDs and 3 postdocs. We also had a glimpse into the future through the world's first urban autonomous passenger ferry operation, involving milliAmpere 2 carrying more than 1500 passengers in three weeks.

The use cases are maturing, our researchers have published very interesting results on a wide range of topics, and our dissemination activities have continued. In total, more than 100 results were registered by the Centre in 2022, including scientific publications, popular science publications, dissemination activities and graduated MSc theses. We have been active in strengthening the ties between researchers and industry, a work that will be significantly enhanced next year via dedicated meetings and the utilization plan that is currently under development.

SFI AutoShip has come a long way in terms of laying the important groundwork for excellent research and innovation in the years to come, and is moving strong to its next phase. I wish you all Happy Holidays and a Happy New Year!

Anastasios Lekkas

Centre director SFI AutoShip

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MilliAmpere 2 trial run

From late September to mid October the self-propelled passenger ferry milliAmpere 2 had a successful trial run with passengers in the Trondheim canal, and thus became the world's first autonomous and electric urban ferry in operation. SFI partner Torghatten was a key part of the trial, as well as several researchers in the Centre.

1milliAmpere 2 ferrying passengers. Photo: Kai T. Dragland/NTNU.

During the three-week trial operation, Ole Andreas Alsos, SFI AutoShip's work package leader for Remote Operations Centre and Human Factors, led a survey along with researchers employed in and associated with the SFI, covering not only the robustness and safety of the technology, but also how the passengers themselves experienced safety and trust in the autonomous ferry.

To study the interaction between human passengers and autonomous ships, researchers charted the passengers' expectations before the journey as well as their experiences afterwards.

Transporting passengers between Ravnkloa and Fosenkaia in Trondheim, milliAmpere 2 was accompanied by a ferryman row boat which was in use until the 1960s, as a symbol of the changing times.

Although NTNU personnel travelled with the passengers to answer questions and make sure they felt safe, the passengers themselves pressed the button to start the crossing. Crossing the canal over 400 times, the ferry carried about 1500 people in total. Some brought their dogs and bicycles, while others came with prams and walkers, given the passenger age span of 5 months to 96 years old. Although most of the passengers tried the ferry out of curiosity, some made the crossing in their daily commute to work.

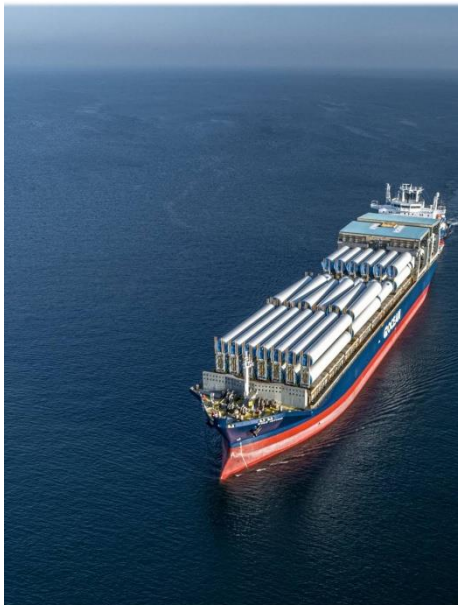
Researchers collected about 1000 questionnaires, and carried out 150 interviews with passengers as well as skippers on boats in the channel. The experience the passengers had of the ferry's response to boat traffic was also tested, by a researcher kayaking dramatically into the path of milliAmpere 2, making the ferry stop. No-one felt threatened by this, if anything they suggested the ferry responded too defensively.

Preliminary findings suggests that most passengers felt very safe and had high levels of trust before taking the ferry, and kept that feeling after making the crossing. Nevertheless, the passengers were initially skeptical of taking the ferry without safety personnel on board. After taking the ferry however, most were convinced of its safety even if personnel didn't stay on the boat. The safety host turned out to be an important part of passengers' experience of trust and safety, similar to the role of elevator operators until the 1970s, when people "got used to" the technology. Will passengers still use the ferry without personnel on board? This will be tried out next summer, when we are welcomed on board milliAmpere 2 again.

Feasibility study on unmanned cargo ships

Work Package 5 and 6 have collaborated this year on a feasibility study on unmanned cargo ships. The study is based on use case 1 (deep-sea break-bulk shipping) and use case 2 (short-sea container shipping). The overall conclusion from the study shows that there are still some challenges to be solved before large cargo ships can operated unmanned (under the given assumptions). However, for small and medium size vessels, unmanned operation with human support from a ROC can be feasible today or in near future within certain concept of operations (CONOPS), especially in national waters where there exist regulations for autonomous ships. To operate an unmanned ship internationally, regulatory challenges related to e.g. IMO, can be solved by bilateral agreements between the countries involved. Moreover, even for a large cargo ship, some of the individual tasks can be automated today or in the near future with economic, environmental, and/or social benefits. Some recommendations for further research have been discussed in the report:

- Sailing with periodically unmanned bridge in deep sea
- Energy efficient navigation by taking into account weather forecasts and ship sensor data
- Automatic docking for large cargo ships, these are often dependent on tugboats today
- What is the needed level of redundancy for power and propulsion to stay as safe as conventional ships?
- Investigate and take into use automatic mooring, should the ship or the terminals make the investments?
- There are steps to be taken to enable autonomous cargo handling, where remote control could be the first



G2 Ocean vessel applicable for the feasibility study.

- Transmission of data to remote operations center (ROC): Which data, how much, and when?
- Assessment of the coming MASS code and its implications.
- How can an unmanned ship interpret and follow the COLREGs?

Some of the recommendations above will be taken further in the SFI next year, such as periodically unmanned bridge and remote control of deck cranes.

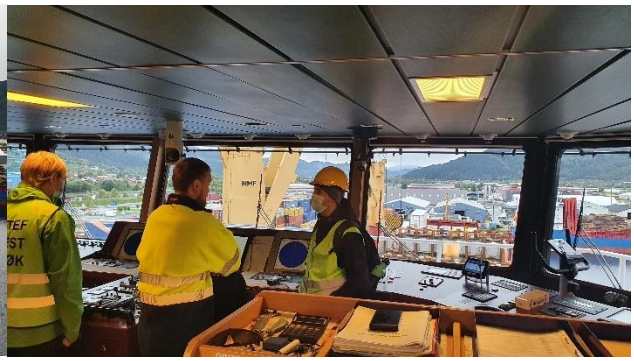
Meeting places

2022 was an eventful year, with researcher workshops as well as use case meetings and site visits, and the well-attended SFI Days in October, this year with a special focus on our industry partners. The following highlights show some of these activities, including photos from the events.

SFI Days 2022

During this year's SFI Days, we were introduced to many of our partners and use cases, as well as the most recently hired researchers in the Centre. Topics ranged from the technology, feasibility, experiences and regulatory framework of autonomous ships. We heard stimulating presentations and interactions with over 80 participants from our research sector, public sector and maritime industry partners. Welcome back next year!

Visit to NCL Svelgen in Orkanger



Researchers and PhD students visited NCL Svelgen at Trondheim Havn container terminal in Orkanger on September 21st. NCL crew gave a guided tour on the vessel and provided a lot of interesting information about operational experiences. The port personnel also guided around the terminal and answered questions about the port logistics. The information gathered will be important in the further research related to Use Case 2 - Short sea container shipping.

Fall researcher workshop

SFI AutoShip's Fall Workshop for researchers and research partners took place in September with interesting discussions and valuable contributions from participants. We were introduced to the talented new PhDs and postdoc that have joined the SFI and updated on recent developments as well as the Centre’s plan for dissemination and utilization. All work packages separately discussed communication, supervision and researcher alignment with our four industry use cases.

Visit from Minister for Trade and Industry

During a visit in May to Nyhavna by Minister of Trade and Industry Jan Christian Vestre, arranged by Ocean Autonomy Cluster, then Centre Director Mary Ann Lundteigen and Work Package 3 leader Ole Andreas Alsos presented the SFI to the Minister.

Meet our most recently hired PhDs and postdoc

We have been very fortunate in our researcher recruitment to SFI AutoShip, with 17 excellent PhDs and postdocs in total so far. Not all those previously hired have been introduced in newsletters yet, but more candidates will be presented during the coming year. This time we start with the three most recently hired; PhD researchers Lukas Herrmann and Simon Lexau, and postdoctoral researcher Trym Tengesdal.

Lukas Herrmann

Lukas Herrmann is a new PhD candidate at the department of Electronic Systems at the Norwegian University of Science and Technology. His project “Ship-Shore Radar Network” focuses on establishing a network of maritime radars to be utilized for both monitoring and guiding autonomous vessel. Specifically developing methods for radar detection even for small vessels in a large surveillance area as well as senor fusion in order to provide high quality tracks. Distributing the resulting target tracks will enhance the situational awareness of the whole area and his project is

therefore tied to Work Package 2. The whole development process will be based on real world data obtained from observations of the Trondheimsfjord.

Lukas received his master's degree in Electrical Engineering with a major in signal processing and RF-electronics from Trier University of Applied Sciences in 2020. After his graduation he has worked in the industry developing radar systems for industrial applications such as high precision positioning and human robot collaboration. Besides his intrinsic drive to fundamentally understand how things work, and his general interest in RF-systems, he has his enthusiasm for radar technology because of the wide field of applications.

When asked about where his interest for his project comes from, he answered: "After my first radar project it's always been clear to me that I want to do my PhD within this field since it is fascinating to me that starting from a basic principle a huge amount of information for a variety of applications can be gained by using advanced algorithms. I'm now looking forward to deal with maritime applications. Hence, I'm very excited about being part of a project in a country which is leading and a driving force in maritime technology and autonomous shipping."

Simon Lexau

Simon Lexau is a PhD candidate at the Department of Engineering Cybernetics at NTNU. He will work in Work Package 1, focusing on "Docking for Autonomous Surface Vessels". In particular, he will develop methods for trajectory planning in complex harbor environments, including obstacles and moving ships. In addition, he will perform full-scale experiments on the milliAmpere ferry in Trondheim harbor.

He has a master's degree in Cybernetics and Robotics from the Norwegian University of Science and Technology (NTNU), due to his enthusiasm for self-controlled robots, he focused on autonomous systems. In his master's thesis, he developed a hand-gesture-based control system for the shared control of a robotic manipulator.

When asked where his interest in this area comes from, he answered: "When I was a child I was fascinated with science fiction movies of self-driving cars and intelligent robots. It is exciting to see how these futuristic technologies are taking shape in front of our eyes. This position allows me to be a part of the development and research moving our society forwards, which I find inspiring."

Trym Tengesdal

Trym Tengesdal is a Postdoctoral fellow at the Department of Engineering Cybernetics at NTNU. He will be working in Work Package 1, focusing on machine learning methods for adapting collision avoidance algorithms online/offline. A lot of focus will be put on developing a simulator for collision avoidance, which can incorporate historic Automatic Identification System (AIS) data and Electronic Navigational Charts (ENCs), and be used together with a collision avoidance evaluation tool to benchmark and validate algorithms in the field, on mixtures of randomly created scenarios and real scenarios from AIS data. Afterwards, the goal is to leverage the simulator and historical (AIS) data to develop automatic adjustment methods for collision avoidance algorithms, based on varying situational conditions.

He has a MSc in Cybernetics and Robotics (2019) and PhD (2022) in Engineering Cybernetics from the Department on Engineering Cybernetics, NTNU. His expertise lies within automatic collision avoidance, sampling based estimation and optimization, and probabilistic inference.

When asked about where his interest in this area comes from, he answered: “I have always been interested in math and technology, and curious about how things work in practice. Collision avoidance and autonomous ship technology sounded cool, and also very relevant for Norway which has a lot of expertise in the maritime sector. I was therefore interested in learning more about it. This eventually lead to my current situation being part of the SFI AutoShip, which has been a pleasure so far!"

Contact

Don't hesitate to contact us if you have ideas for topics for the next newsletter or any other suggestions.

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Visit our website: https://www.ntnu.edu/sfi-autoship/