Seminar on Digitalization and Safety of Maritime and Technology Industry

14.12.2024

BUSINESS TURKU

Co-funded by the European Union

MINISTRY OF EDUCATION AND CULTURE

Organizers

Applied Research Platform for Autonomous Systems (ARPA)

The ARPA project (Applied Research Platform for Autonomous Systems) focuses on building a novel research platform that provides consistent information to developers, researchers, and authorities alike. ARPA is joint project of Turku University of Applied Sciences and Novia University of Applied Sciences.

MINISTRY OF EDUCATION AND CULTURE

SafeSea

- The SafeSea Test Platform aims to activate potential export companies to utilize the synergies of the group of companies and the RDI know-how and infrastructures of universities in the development of internationalization capabilities. The test platform supports SME companies developing digital maritime safety solutions in global competition. SafeSea is a joint effort of Turku University of Applied Sciences, Novia University of Applied Sciences and Business Turku.

Co-funded by the European Union

Agenda

Session 1: Technical advancements 9.00-11.30

This session covers the latest developments for the digitalization of shipping and technology industry. Concepts such as situational awareness, digital twins and data spaces increase the efficiency and safety of maritime transport.

- **Test Environments for Autonomous and Remotely Operated Systems in Turku University of Applied Sciences (Jarkko Paavola, Turku UAS)**
- **Maritime Automatic Speech Recognition (Mikael Manngård, Novia)**
- **Maritime Data Space – value creation through data sharing (Olli Soininen, Fintraffic)**
- **Smart factory and digital twins (Diana Espinosa, Flanders Make)**
- **Implementing & orchestrating intelligent and distributed autonomous digital twins – from reality to idea (Nicolas Waern, Winniio)**

Lunch and demos until 12.30

Session 2: Regulatory landscape 12.30-15.30 (coffee break at 14.00)

This session discusses regulation environment and related standardization for the increased automation, remote and autonomous operations for maritime environment.

- **Legislator's Role in Maritime Digital Solutions (Matti Mämmi, Traficom)**
- **Upcoming legislation from IMO – Mass Code and autonomous ships (Reetta Timonen, Traficom)**
- **Regulation of autonomous and remote shipping from the national security point of view (Antti Lehmusjärvi, Head Legal Advisor, Navy Command Finland)**
- **Industry Standards in Maritime – Case Navigation and Radiocommunication (Antti Kukkonen, Member of IEC TC 80 follow-up group SESKO SR 80, Furuno Finland Oy)**
- **"Had coffee today? Thank maritime cyber. For that, thank standardization" (Matti Suominen, Director, Maritime Cyber Security, Wärtsilä)**

Cocktails and demos until 16.00

Applied Research Platform Autonomous Systems (ARPA)

Project data

- Joint project with Turku UAS & Novia UAS
  - Several research teams with complementary competences
- Funded by Ministry of Education and Culture – RDI profiling funding
- Budget 2,0 M€
- Duration Nov 2020 – Oct 2023
- Advisory board consists of companies and Traficom

BRIGHTHOUSE INTELLIGENCE

awake.ai

GROKE

KONGSBERG

VALMET AUTOMOTIVE

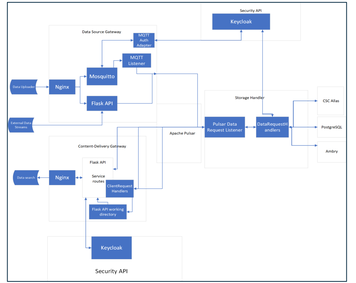
TRAFICOM
Finnish Transport and Communications Agency

Åbo Akademi

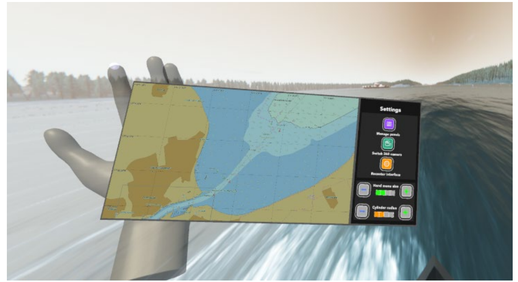
ARPA themes

Maritime Environment

Factory Environment



Data Platform



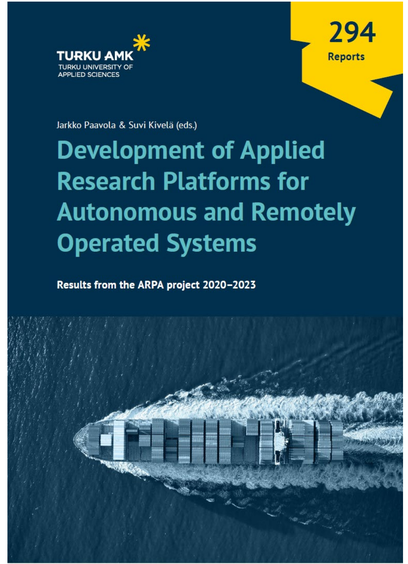
Digital Twins and Simulations

ARPA goals set in 2020

- Setup test platforms for automated, autonomous and remotely operated systems in maritime and factory environment
- Tools for testing
  - Create digital twins for virtual testing environment and situational awareness tools
  - Create high quality open data sets for R&D purposes
- Boosting knowhow and collaboration around autonomous systems in research and business

Main results

- Maritime RDI Environments
  - Physical platforms
  - Digital twins and Metaverse solutions
- The Data platform
  - Data governance
  - Cybersecurity
- Industrial RDI Environments
  - Physical platforms
  - Digital twins and Metaverse solutions



- https://urn.fi/URN:ISBN:978-952-216-862-7
- https://www.turkuamk.fi/fi/tutkimus-kehitys-ja-innovaatiot/julkaisuhaku/203/
- https://arpa-project.turkuamk.fi/blog/

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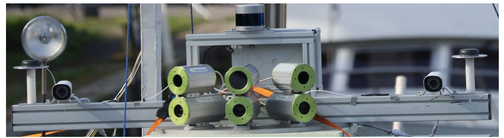
Test Environments for Autonomous and Remotely Operated Systems in Turku University of Applied Sciences

Maritime RDI Environments

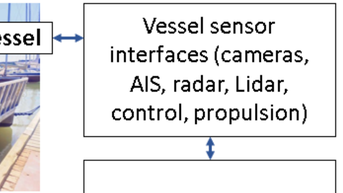
- TUAS Vessel eM/S Salama
- Sensor platform and Wireless connectivity
- Remote Operation Center and Metaverse implementation

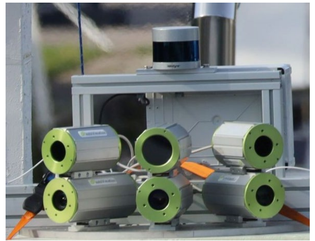


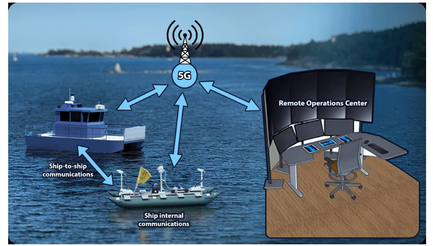
Test Vessel eM/S Salama

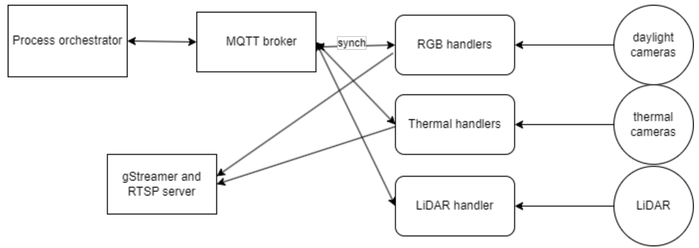
- TUAS autonomous test vessel can be used for example as a sensoring platform to collect data and test remote and autonomous operations in Turku archipelago area.
- 6.8 meters long and 3 meters wide aluminum body with a cabin.
- Two electric outboard pod motors.
- Manual, remote and autonomous operation modes.
- Batteries and a battery management system; capacity 34 kWh.
- ICT infrastructure

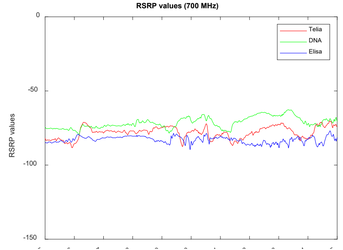
Sensor Platform and Wireless Connectivity

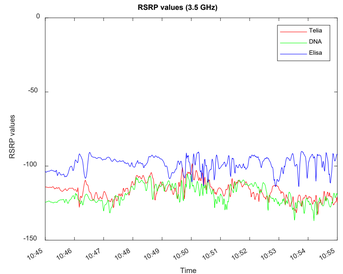






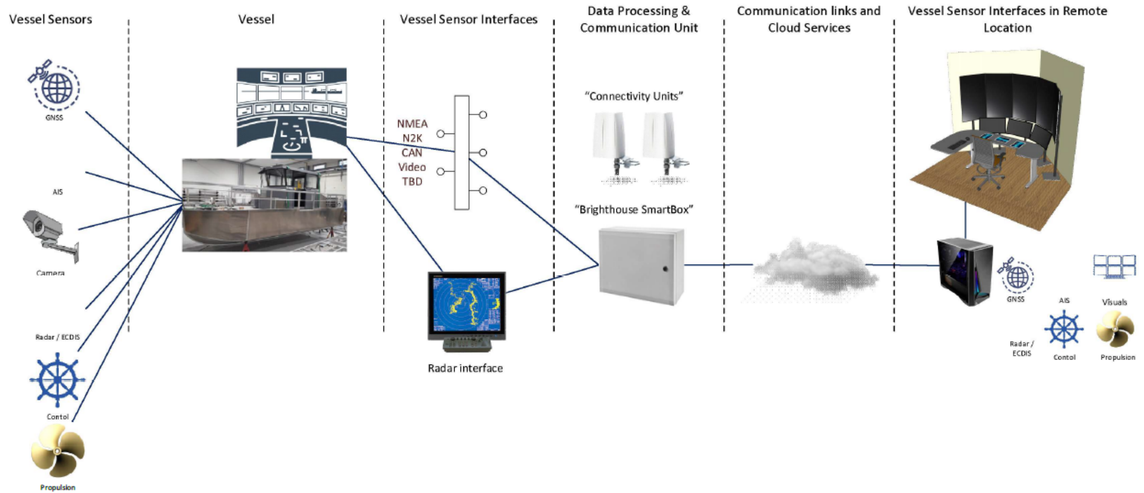






Remote Operations Center

- The vessel will be controlled with NMEA2000 messages, which will also be used to transfer the telemetry data from the vessel to the remote operations center.
- **Possibility to visit ROC at 12.00 & 15.45**.
- Forthcoming: Open doors event early spring



Next Generation ROC

Visualization of sensor fusion inside the industrial metaverse

Various visualizations utilizing neural networks Disruptive UI solutions needed for remote controlled systems e.g.

- identification of vessels from 360-degree video footage
- same video footage augmented with LiDAR and AIS data
- presented to users as video panels

Inside Metaverse, a model of a battleship,

- featuring a prototype view of the command center with multiple monitoring screens
- on the command bridge, the ability to view simulated AIS data on a map display
- feature for real-time situational awareness is a 360-degree view of the operating environment

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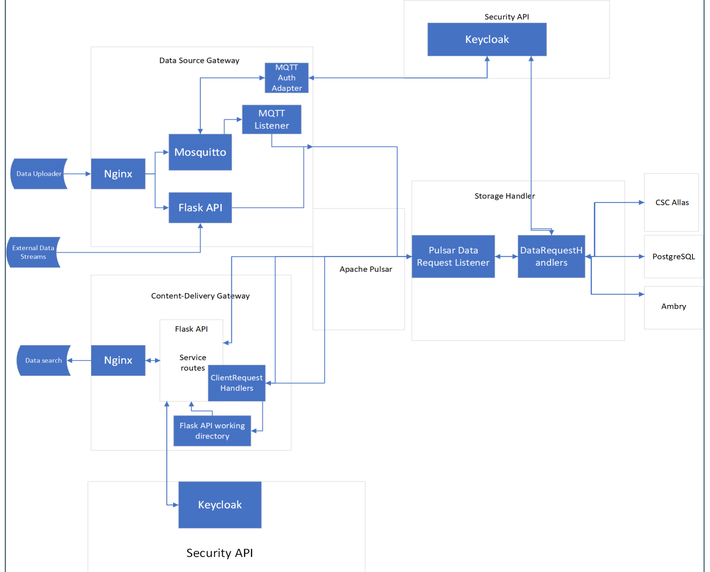
The Data Platform

- ARPA data platform collects data from sensors, processes the data for visualizations and long-term data storage.
  - Data harmonization
  - Situational awareness from versatile measurement data
  - Accompanying data ownership and agreement process
- For collaborators
  - Access to sensor data
  - Open datasets with extensive metadata
  - Testbed for AI algorithm evaluation
  - AI-powered decision making based on measurement data

Data Platform implementation

- Data storage hybrid approach
  - Relational databases provide Atomicity, Consistency, Isolation, Durability (ACID) properties -> solution for data search queries
  - Object strorages are highly scalable and typically easily accessible by HTTP APIs -> solution for unstructured data (e.g. images, videos, audio, etc.)
- Distributed message queue system for communications between services, handling of data streams, and multi-tenancy
- Identity and access management
- Data Governance: regulatory environment, data access, data ownership, data use cases, and contribution measurements
  - Contract templates



Data Sets
- Stereo vision camera & Drone
- RGB, thermal camera, Lidar, IMU, & GPS

Our data includes:

120,216 RGB images

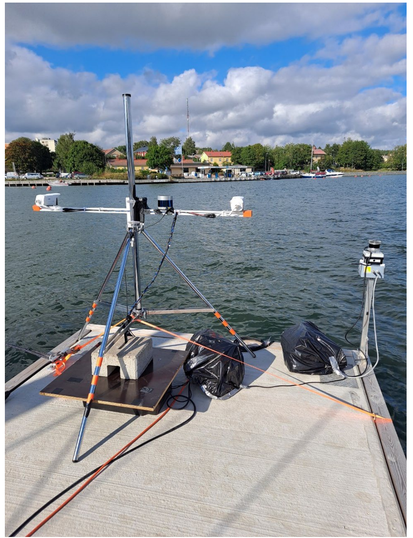
53,108 stereo images

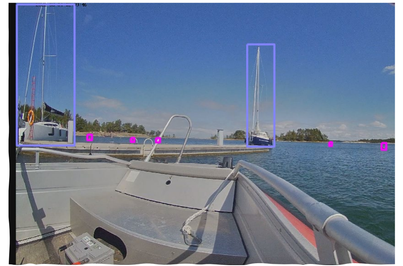
60,108 multi-frame view images

36 hours of LiDAR data

24,302 drone images

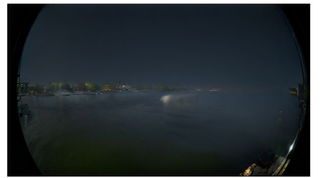
In addition: 1,322,726 synthetic and annotated images





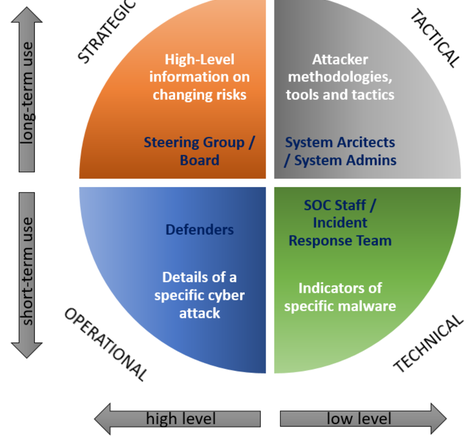
Synthetic data with generative adversial network (GAN)

GAN



Cybersecurity Situational Awareness and Threat Intelligence

- Situational awareness:
  - Perception: Understanding the current state of the protected environment, including assets on the networks, existing protective controls, records of previous security events, and more.
  - Comprehension: Analyzing data and log sources from both ICT and OT assets, collected from network sensors, host and network intrusion detection systems, and control systems. This stage also assesses the significance of the protected assets and how an attack on them could impact the ship's operations.
  - Projection: Anticipating and assessing the future state of the environment, enabling proactive decision-making and action selection based on threat information.
- Cyber threat intelligence (CTI) plays a crucial role in bolstering proactive cybersecurity and cyber resilience.
  - This information's value is determined by its relevance, accuracy, timeliness, specificity, and completeness for the company's business operations.
  - To a company, this means being able to analyze the threat potential against the company's business processes as well as to prepare for being targeted by certain threat actors and threat actor groups.
  - CTI can provide detailed knowledge of real targeted cyber-attack techniques, tactics, and procedures that can be used proactively to plan and prepare for, sustain, mitigate, or avoid a cyber-attack that has been successful elsewhere.

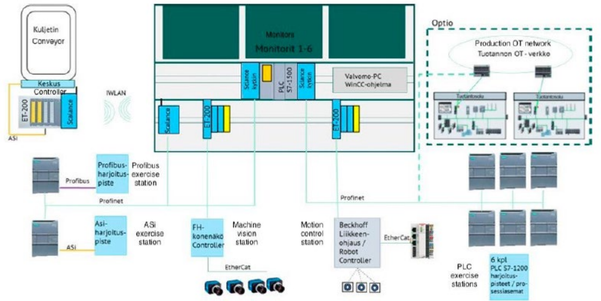


Industrial RDI Environments: #Factory and industrial Metaverse

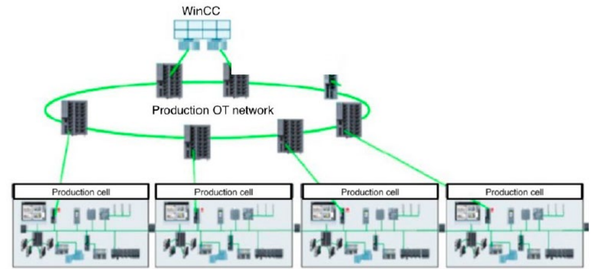
The #Factory is a modern development and learning environment for mechanical engineering at Turku University of Applied Sciences. It includes facilities such as a workshop, automation laboratory, and other spaces. The factory is also used for real workshop production.

#Factory Environment Development

- Control Room SCADA System
  - Siemens Control Logic
  - Profinet network
- Machine vision
- Mobile robots



Distributed automation system



Automation network

Industrial Metaverse

XiaoR Geek tank robot, an example of unmanned ground vehicles which could be replaced with drones, unmanned forklifts or vessels

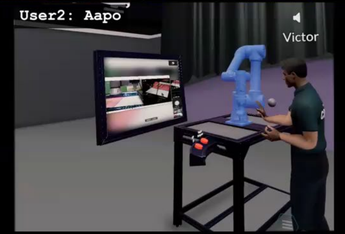
Tank robot introduced in European Robotics Forum 2023

Disruptive UI solutions needed for remote controlled systems

Universal UR5 cobot widely used in industry alongside with humans and thus illustrates potential on production lines and could be replaced with industrial robots

Cobot introduced in MatchXR (side event for Slush 2023)

Collaboration needed for remote maintenance and training



These robots now available in our multiuser metaverse environment

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Introduction to demos

- eM/S Salama sensor fusion and data visualization
- Remote Operations Center (video, visit opportunity)
- Utilizing virtual reality to remotely control a mobile robot over MQTT protocol
- Enhancing GDPR compliance by dynamically blurring faces or entire individuals in live video streams
- Object Detection for Thermal and RGB cameras

Spin-off projects coordinated by Turku UAS

- TEHOTEKO and related investment projects (ERDF, partner: AÅ)
- SafeSea (ERDF, partners: Novia, BusinessTurku)
- RoboSea (ERDF)
- 5G-Advanced for Digital Maritime Operations (ADMO), (BusinessFinland, partner: ÅA)
- Maritime Data Methods for Safe Shipping (MaDaMe), (Baltic Sea Region, partners: Väylä, Fintraffic, Novia, SMA, DMA, DMC, Sternula, DFDS, NIT, NavSim)
- …

Thank you! Questions?

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