Drone system for increased fire safety on open decks

Marvin Damschen, Ashfaq Farooqui, Rickard Häll, Per Landström, Anders Thorsén

LASH FIRE

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Dependable Transport Systems

- Safety and security for autonomous systems
  - Experimental V&V, Safety & Security Assurance, ODD, Automization, Safety for AI, …
  - Accredited functional safety & cybersecurity assessors
    - ISO 26262 (Road Vehicles – Functional safety)
    - ISO 21434 (Road vehicles – Cybersecurity Engineering)
  - Research, courses, development support
    - ISO 26262, ISO 21434
    - IEC 62443 (Industrial communication networks - Network and system security)

- Automotive, Railway, Maritime, Agriculture, Energy, …
- Demonstrator and tool development
- Fault/attack injection
- Dependable embedded systems

Å. Olsson
Director

P. Folkesson, PhD
Researcher

M. Skoglund, MSc
PhD student

M. Malik, MSc
PhD student

R. Avula, PhD
Researcher

M. Maleki, MSc
Researcher

A. Farooqui, PhD
Researcher

B. Sangchoolie, PhD
Researcher

A. Thorsén, PhD
Researcher

F. Warg, PhD
Researcher

P. Kleberger, PhD
Researcher

M. Damschen, PhD
Researcher

R. Häll, MSc
R&D Engineer

A. Mirzai, MSc
Researcher

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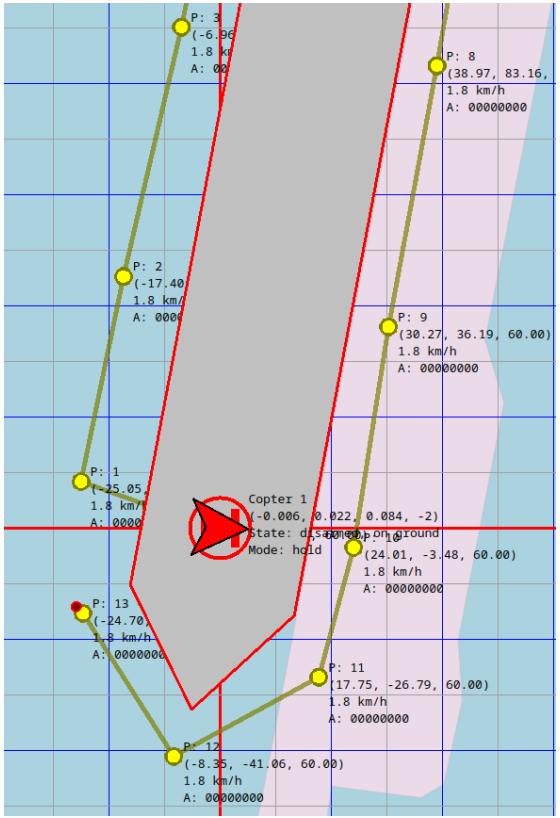
Use Cases – Weather Deck

1. **Fire Patrol** (main use case)
   - UAV flies autonomously (incl. takeoff and landing), warns bridge when critical temperatures / fires are detected
2. **Fire Resource Management**
   - Bird's-eye view in critical situations
3. **(Search and Rescue Missions)**
   - Search area using thermal camera

➢ **Assessment of**
- Technical Feasibility
- Legal Feasibility
- Usefulness

Support Fire Prevention & Fighting

- Periodic/triggered take off
- Flight of pre-defined paths (autonomous fire rounds)
- Thermal camera live stream
  - Autonomous fire threat detection
- Autonomous landing



Challenges – Rough Weather

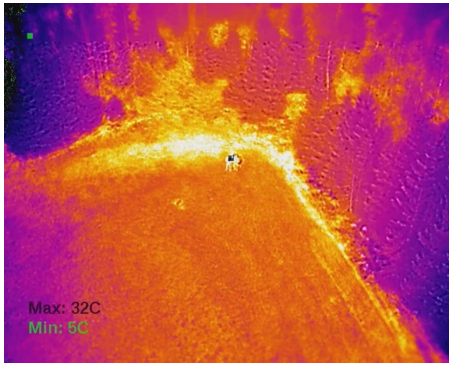
- Multicopter designs used in manned aircrafts

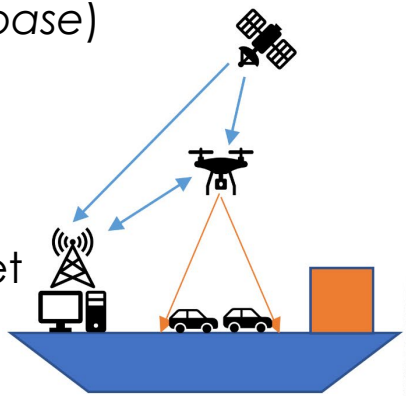
src: Volocopter

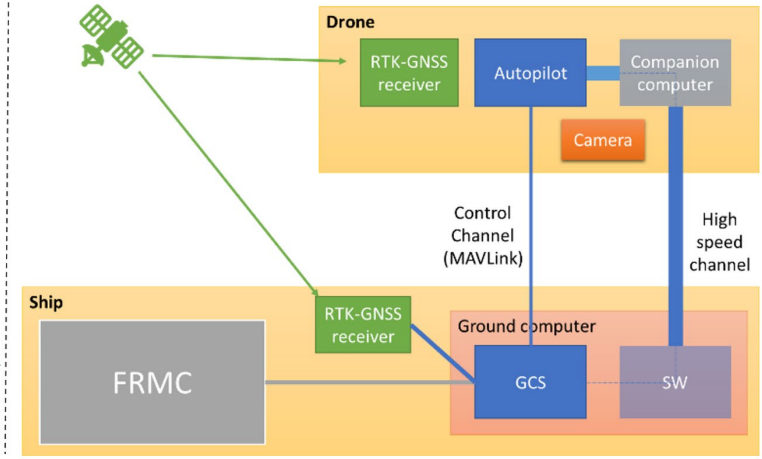
→ More cost concern than technical
(Resistance to 50 km/h wind constant, 10mm/h rain in ca. 10k € price range)

Drone System – Overview

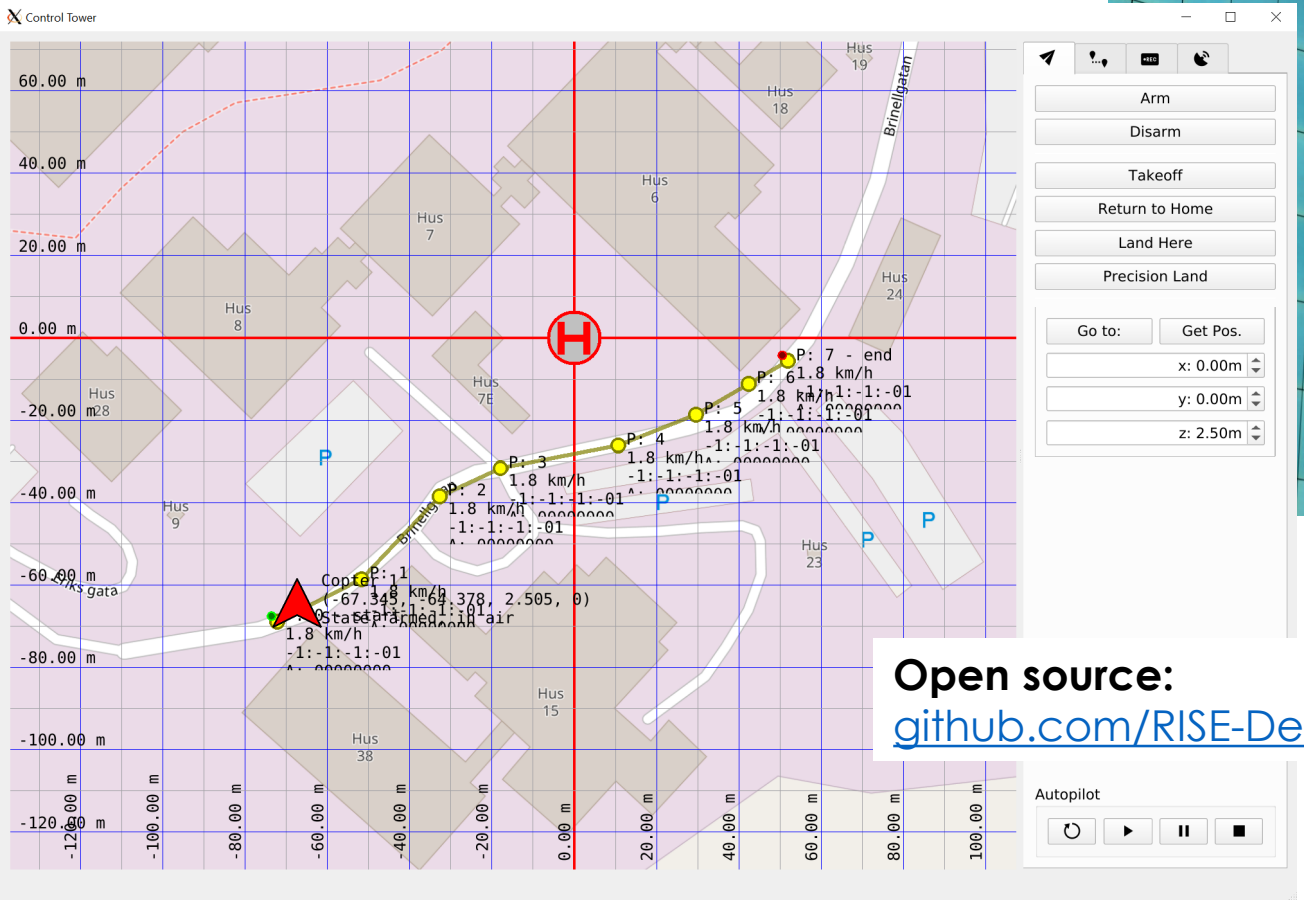
- **RGB & thermal** video live stream
- **Satellite-based positioning** (*RTK GNSS*)
- **Ground computer**
  - Implements control logic for realizing use cases
  - Position reference (*moving base*)
  - Video / sensor analysis
  - User interface
- **Out of scope: charging**
  - Solutions available on market (e.g., Skycharge Skyport)

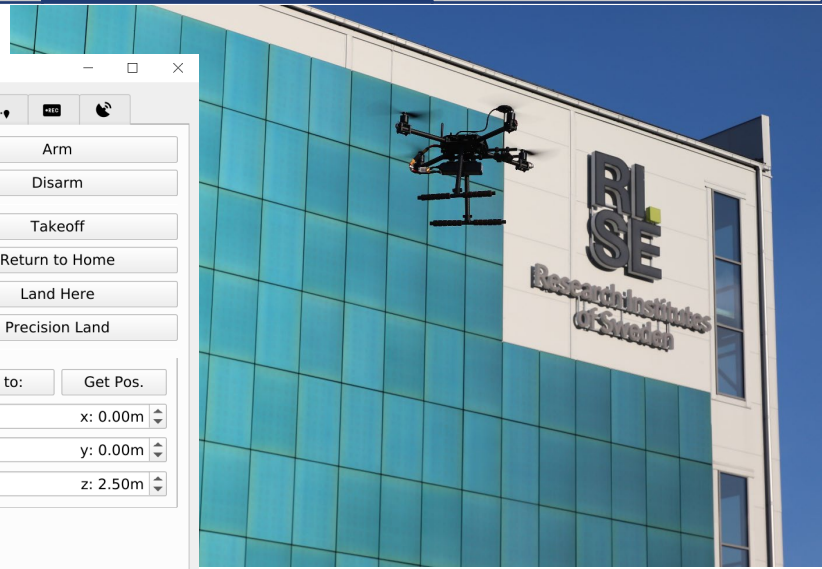






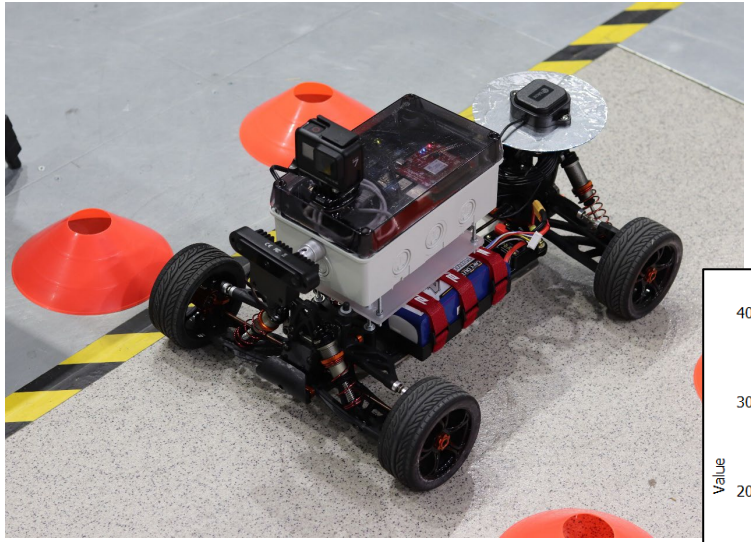
Prototyping (1) – Control Tower

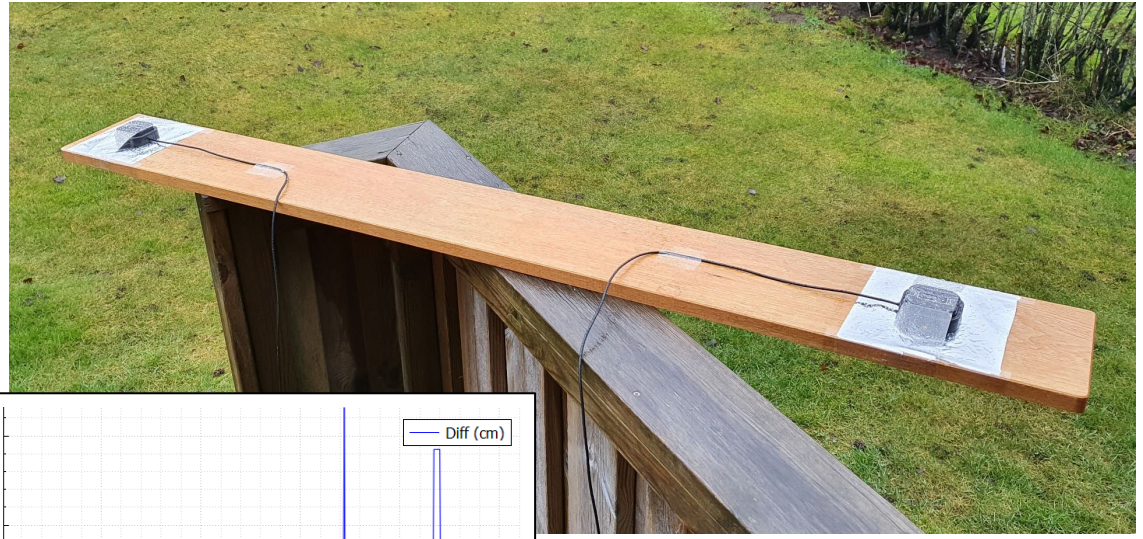


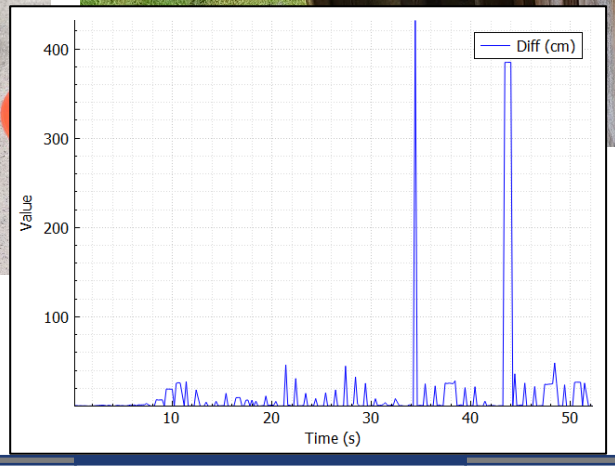


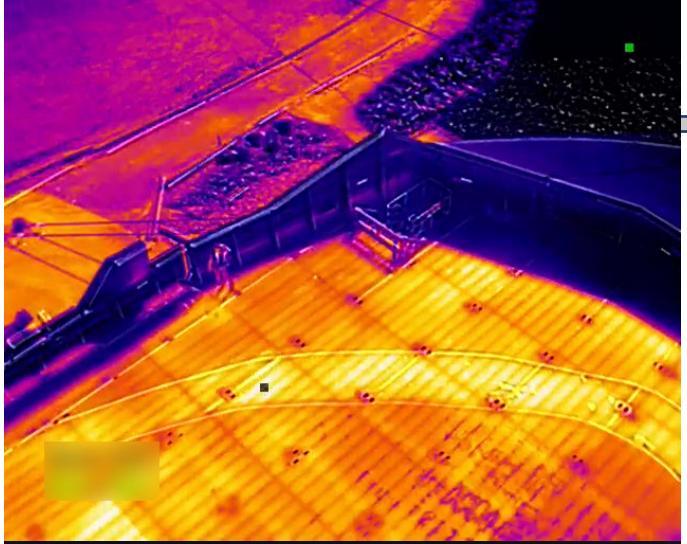
Open source:
github.com/RISE-Dependable-Transport-Systems

Prototyping (2) – Positioning (RTK GNSS)

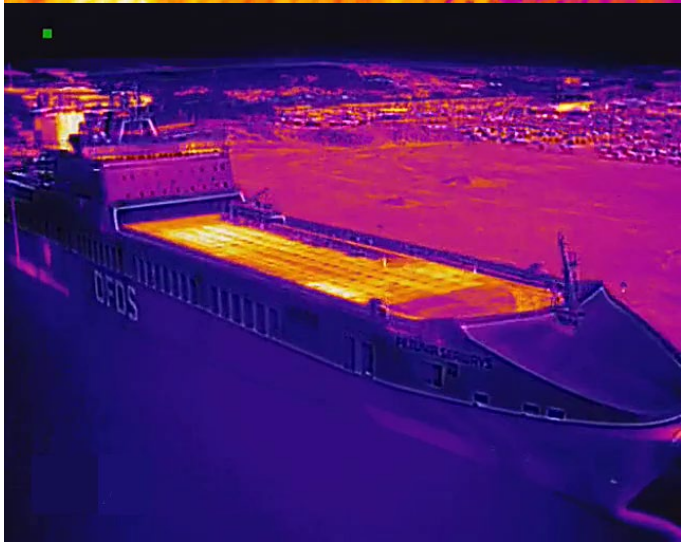


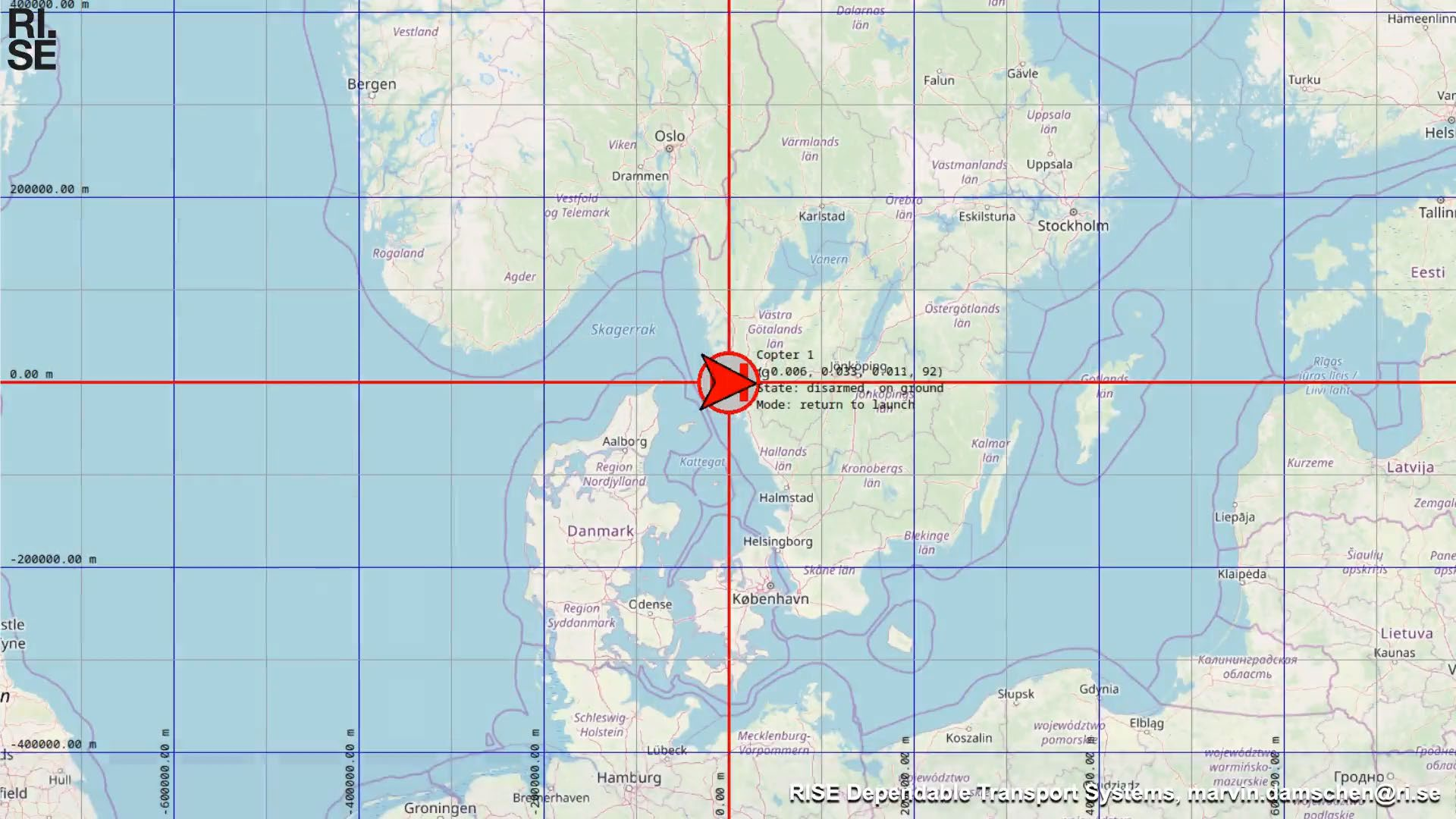






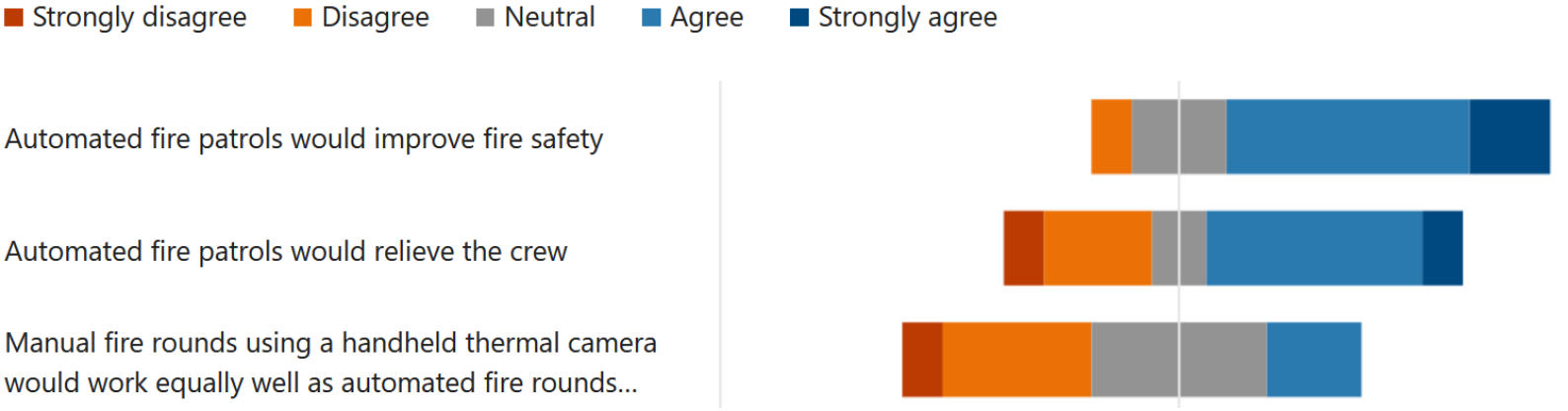

DFDS
PETUNIA SEAWAYS


DFDS

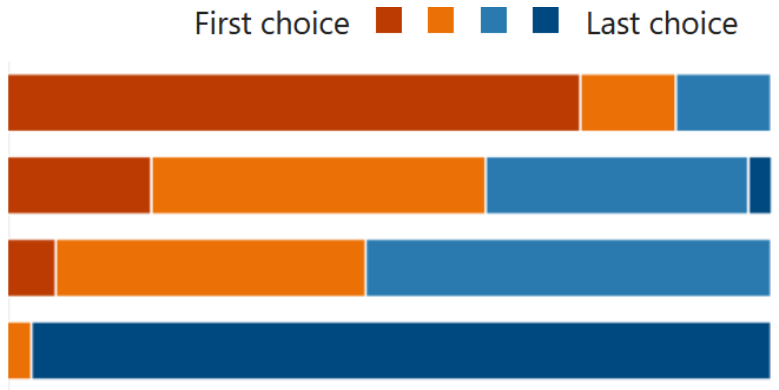


Online Questionnaire

- 34 maritime experts replied to ~60 questions. Excerpt:



Rank	Options
1	Search & rescue
2	Fire patrol
3	Fire resource management
4	Other (please specify in further ...



Results

- **Prototype drone system designed**, built on open standards and open-source software.
- **Technical feasibility evaluated positively** overall but further development is needed.
- **Legal feasibility was assessed:** operational authorization required, best pursued in collaboration with ship operator
- **Usefulness is assessed positively.** Challenges remain in achieving a reasonable selling price and trust in system.
- **SWOT analysis** provides a concise summary for strategic business planning.

Strengths	Weaknesses
• Provided bird's-eye view is a unique and powerful feature in various situations • Can speedup localising missing person, fire detection and situational understanding, thus, save lives and protect property • Helps avoid human error in existing procedures • Technically feasible with off-the-shelf components and open standards • Drone system maintenance could be combined with other scheduled maintenance • Once installed, other use cases can effectively be supported: evacuation situations, inspections, supporting ship's navigation in difficult situations, … • The offshore context is quite challenging. Once "conquered", the system can further support applications along or on shore	• Requires a considerable investment • Regulation and integration are challenging and time-consuming • Introduces safety risks itself (esp. take-off and landing operations as well as charging) • Subject to weather, weather resistance is a cost factor • Monitors open decks only • Flight times are a limiting factor • High usability includes training and getting the crew used to the system. Otherwise, might be seen as a toy or distraction • Required manual interaction needs to be kept low, as much automation as possible • False alarms need to be kept at a minimum
Opportunities	**Threats**
• Drone technology is a fast-growing market, leading to lower required investments and better products • Drone servicing and repair is a fast-growing market, helping to keep OPEX low • Airspace regulations and management are under development, clearly specifying the integration of drone-base services • Maritime industry is increasingly digitized and going towards automation in general	• Revised maritime regulations (e.g., SOLAS) can strongly influence the interest of ship operators • Trust in the system is crucial but can be harmed by external influence and single negative events (e.g., news about an autonomous drone crashing into people)


Thank you for
your attention!
RI.
SE
ACECORE
Marvin Damschen, marvin.damschen@ri.se

Full report

Online QNR

Marvin Damschen, marvin.damschen@ri.se

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SE