

# Machine Vision Meets Blue Economy: *Enabling Sustainable Green Growth of Ocean Businesses*

Marius Leordeanu, Senior Scientist, 5<sup>th</sup> of October 2022



# NORCE is an independent research institute for both public and private sectors

NORCE is Norway's leading research institute with a presence along the entire Norwegian coast. Maintaining a strong local presence facilitates close collaboration with unique specialist communities, centres of expertise, the business community and government authorities.



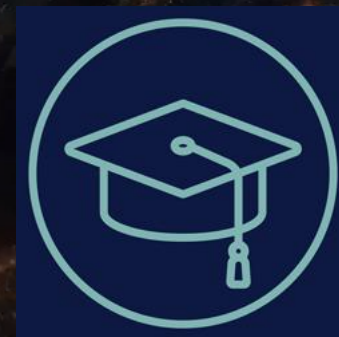
100  
mill. Euro



50  
nationalities



750  
employees



75%  
doctoral degrees

# Selected Markets: Strong focus on Ocean



**Oil and gas**



**Climate**



**Renewable energy**



**Maritime,  
transport, security**



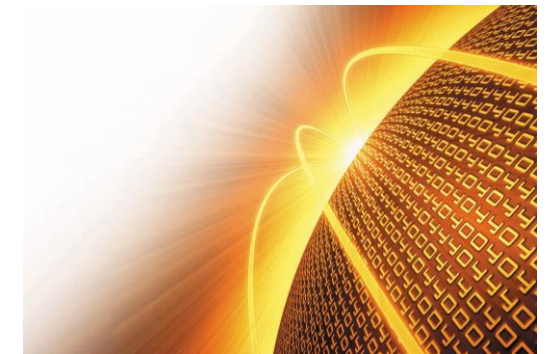
**Agriculture, farming  
and biotech.**



**Medicine and  
health**



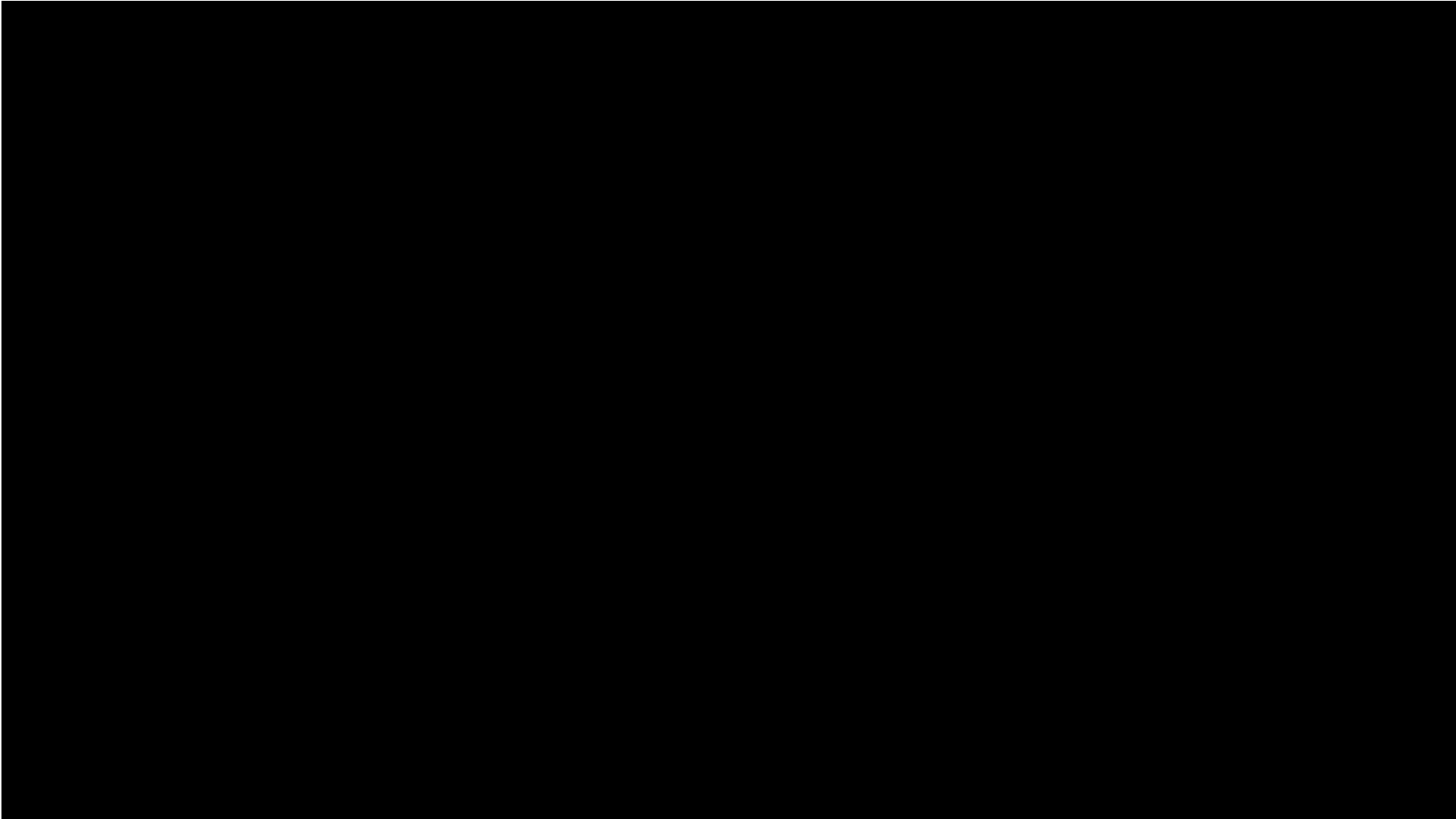
**Process, metallurgy,  
construction industries**



**Emerging, others**

# Selected Activities in Climate Research

# World Leading in Climate Research

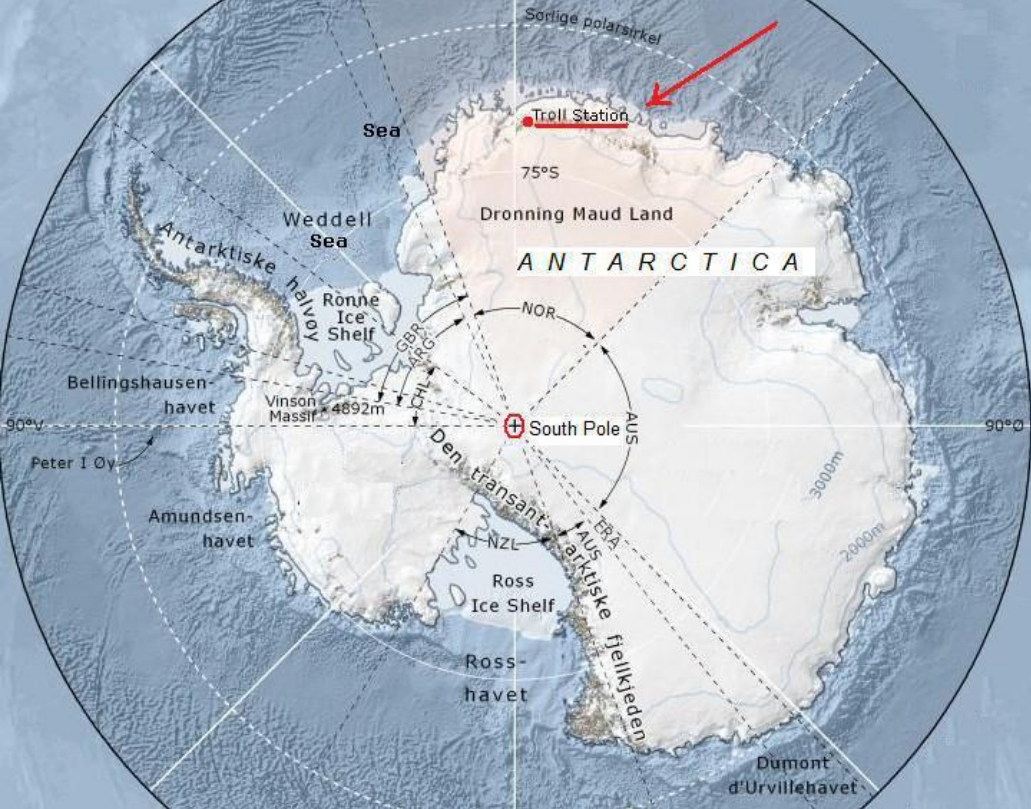


# Norways only research aircraft and worlds first passenger aircraft for remote sensing



Vulcan Air P68C





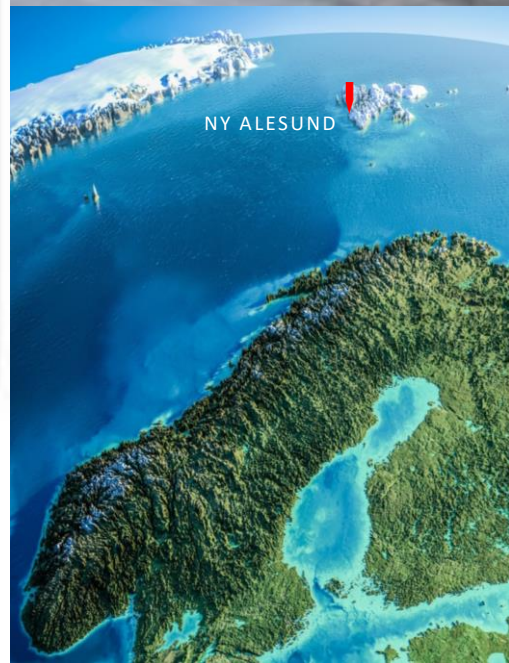
# Antarctic RPAS Infrastructure



- 2 Fixed wing aircraft (Long Range Drone) for long endurance data collection missions from Troll.



# Arctic Infrastructure

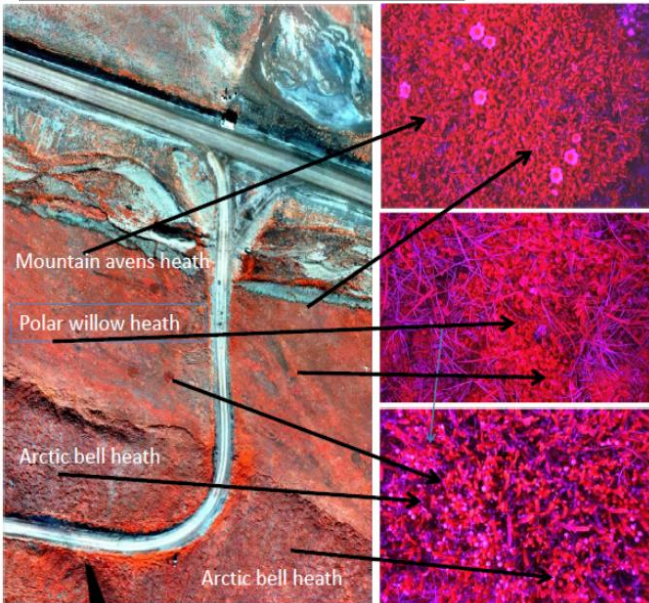
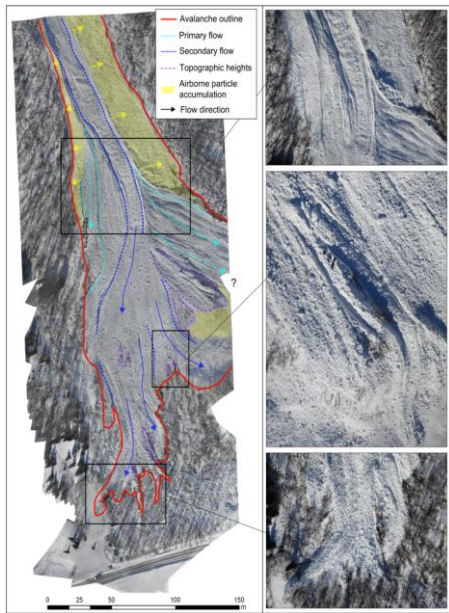
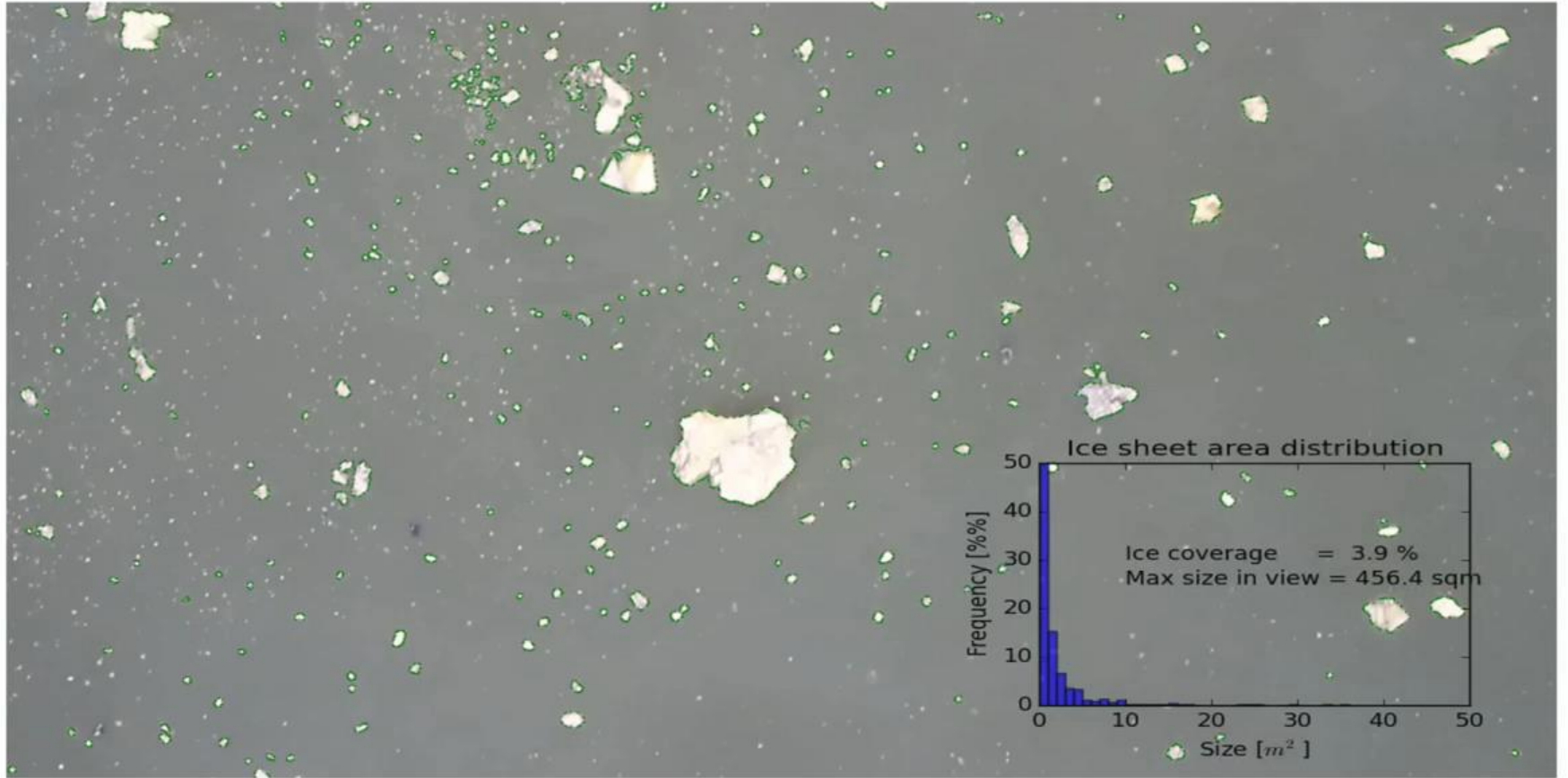




# Aerial monitoring

EaslyIce Realtime Board Processing

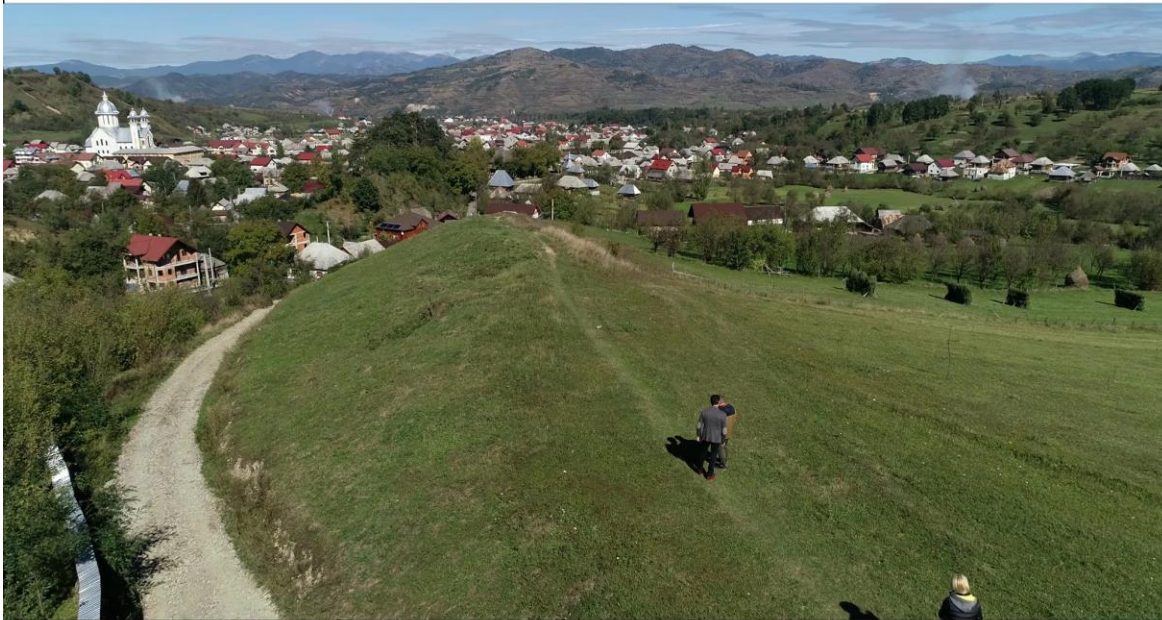
Courtesy of Agnar Sivertsen, NORCE



Vegetation and Ice Mapping

# Self-supervised Learning for Aerial Perception

Original input image



Automatic semantic scene segmentation



Person	Forest	Land	Hill	Sky	Residential	Church	Haystack	Road	Fence	Car	River

# Selected Activities in Offshore Energy Research

# Infrastructures in the west coast

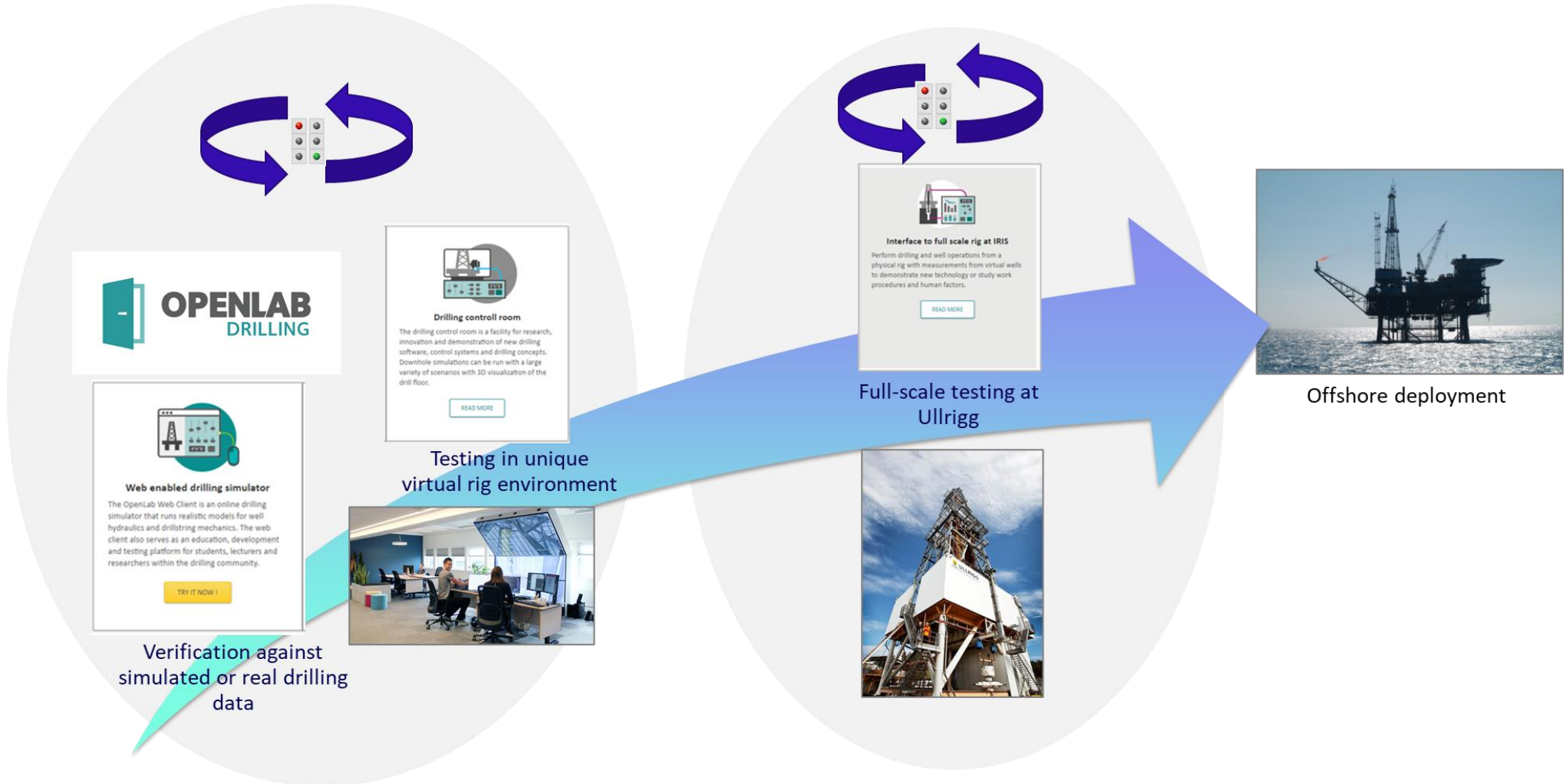


Ullrigg Test Centre (Stavanger)

**NORCE has the world's most advanced and realistic drilling simulator environment**

# OpenLab Drilling: AI and Digital Twin 1/2

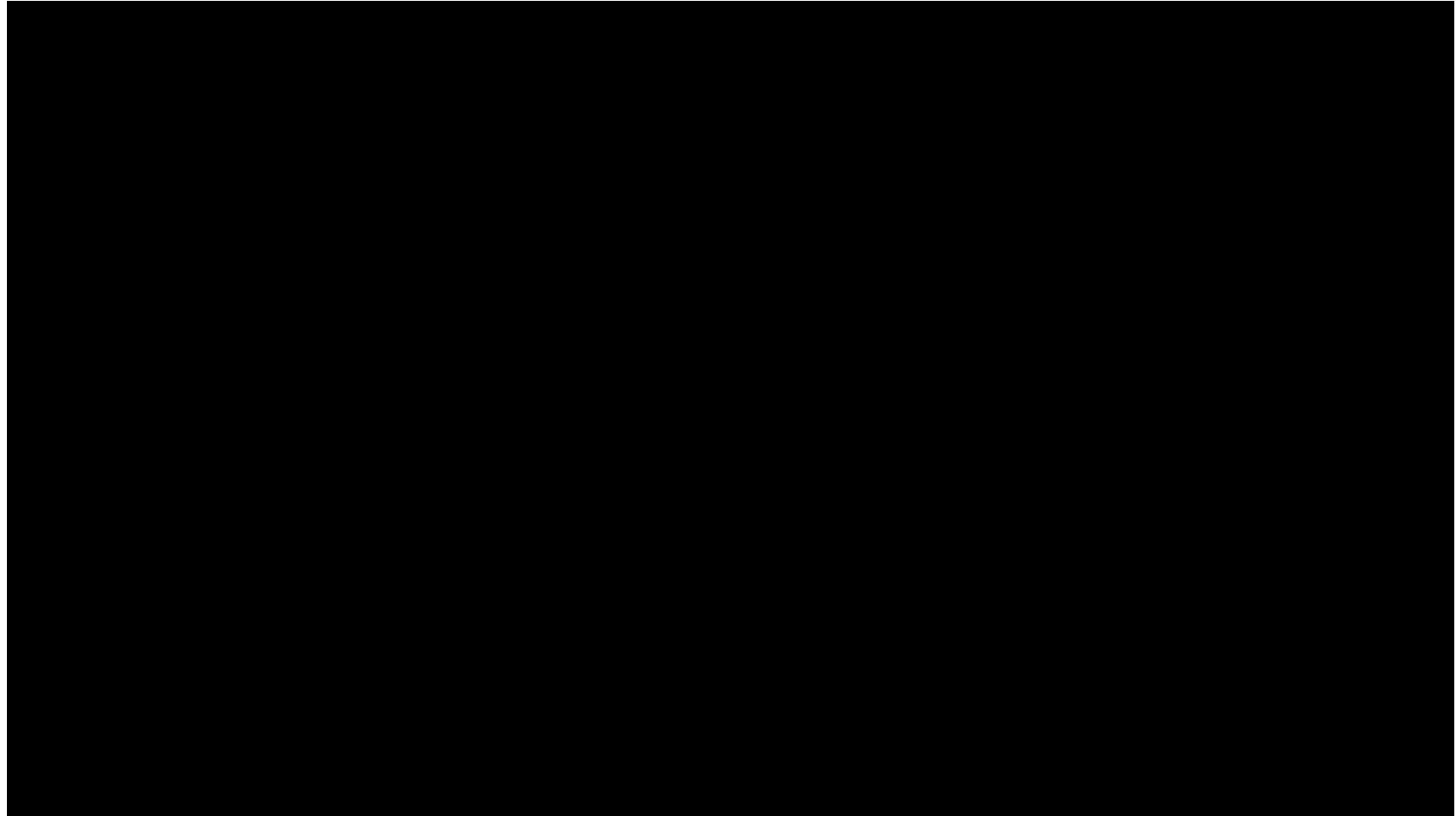
Fully accessible on the web → <https://openlab.app/>



## OpenLab Drilling: AI and Digital Twin 2/2

### **Autonomous Drilling**

- Autonomous decision-making while drilling
- Real-time optimization
- Protection functions
- Self-stabilizing safe modes management
- Early detection of weak signals
- Auto-calibrating models
- Self-learning system



Video Link:

[https://vimeo.com/640005862?embedded=true&source=vimeo\\_logo&owner=90135765](https://vimeo.com/640005862?embedded=true&source=vimeo_logo&owner=90135765)

## Condition Monitoring and Condition-Based Maintenance (O&G)

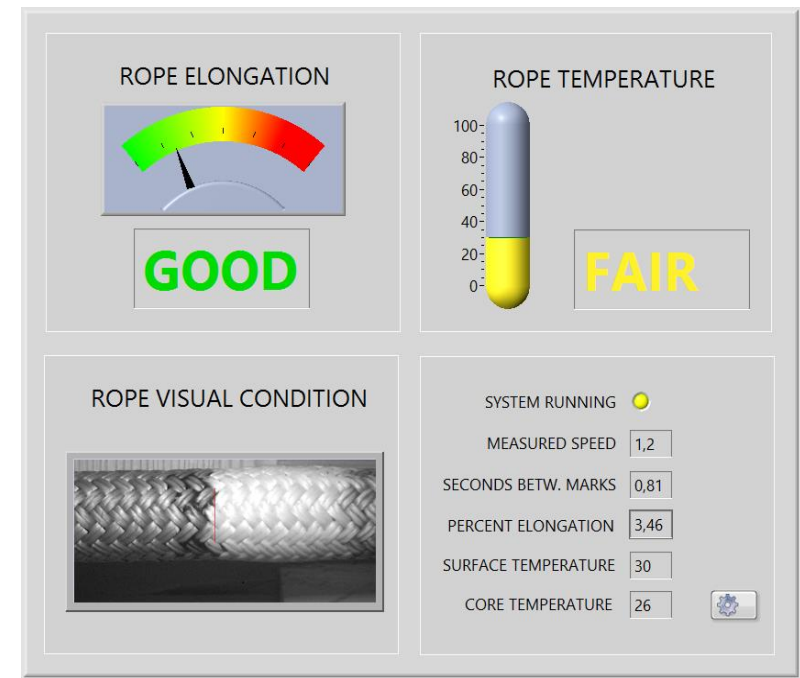
### Research-based Innovation Offshore Mechatronics (SFI)

Next generation of advanced offshore systems with a focus on automated operation and condition monitoring of topside drilling systems towards condition-based maintenance.

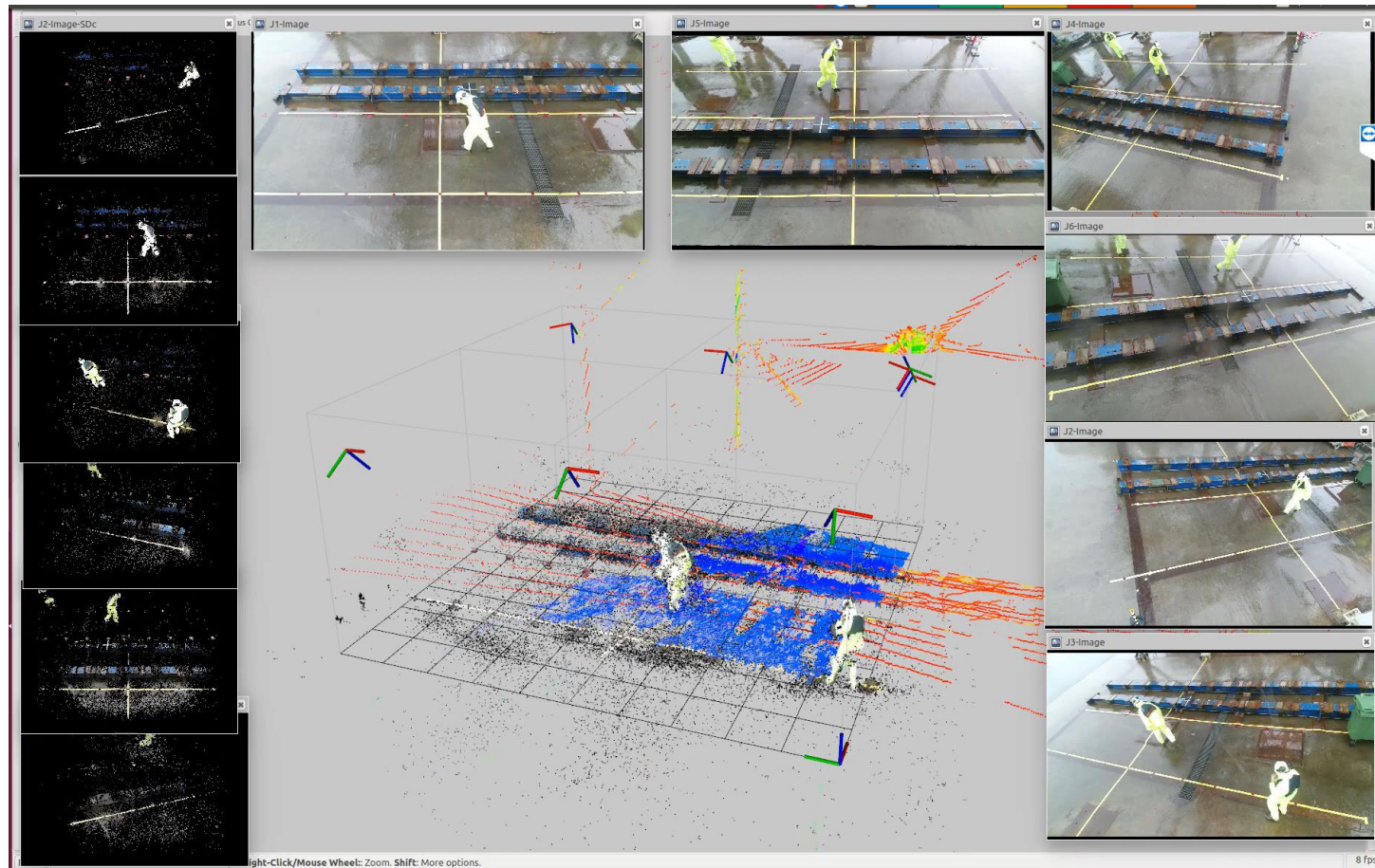


### Deep Learning Fiber Ropes

Condition based maintenance of equipment by on-board monitoring analysis and prevention of faults and failure

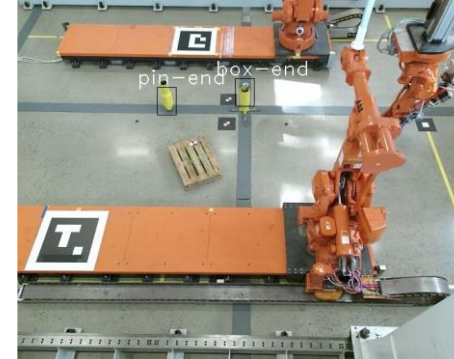
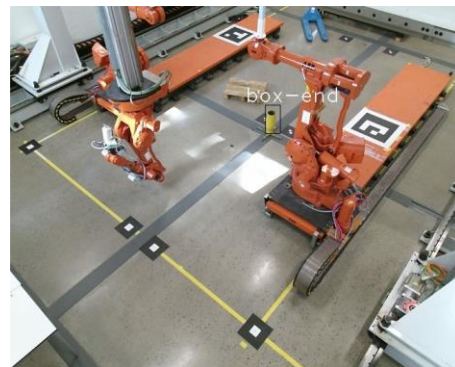
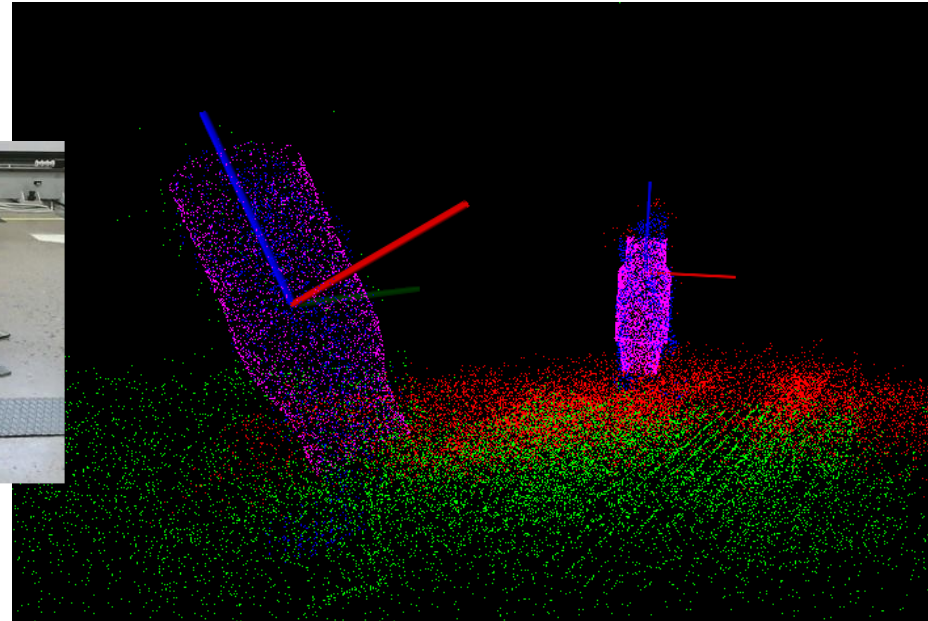


# Depth Camera, Stereo Vision and scanning LiDAR in heavy rain.

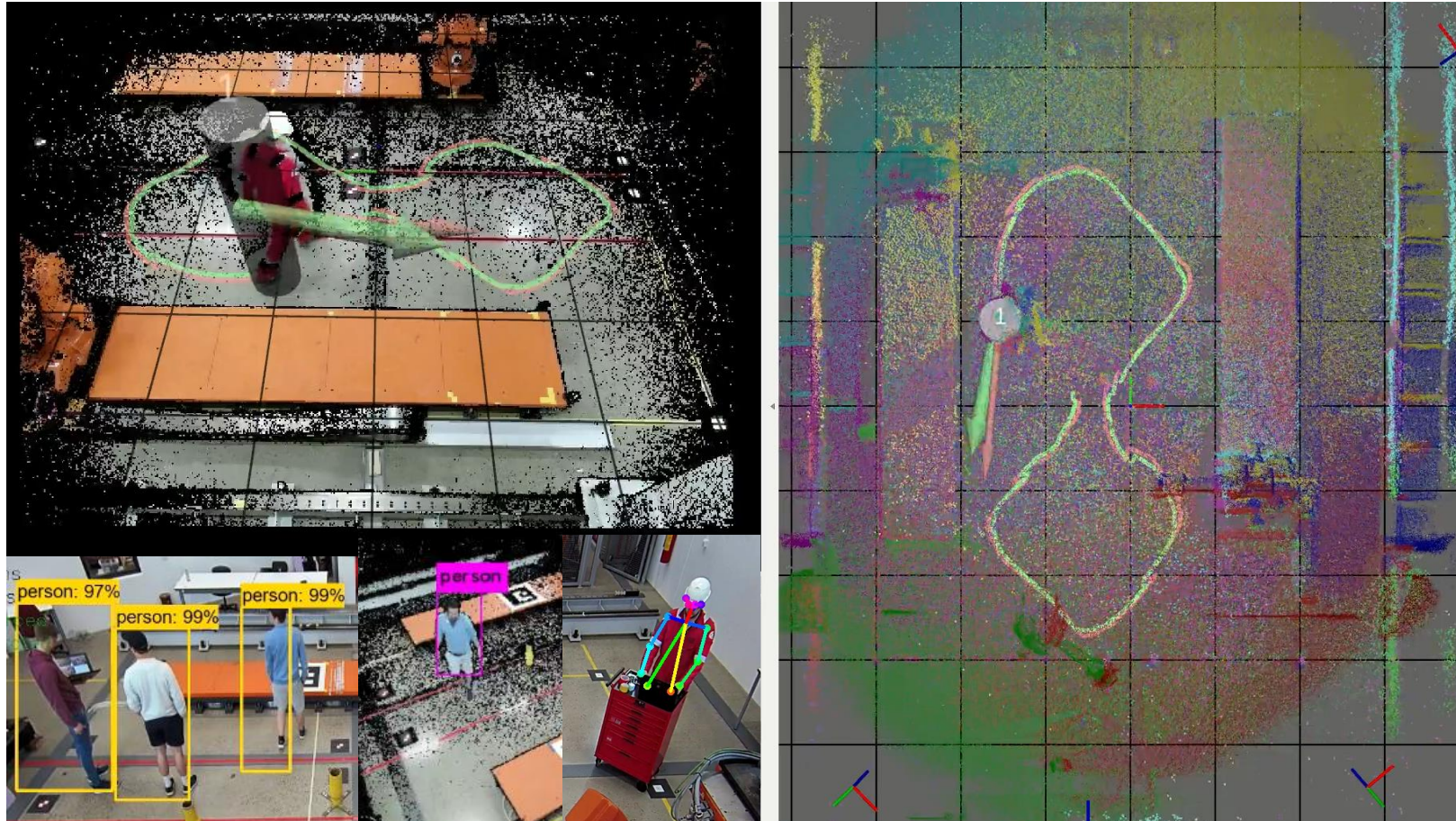




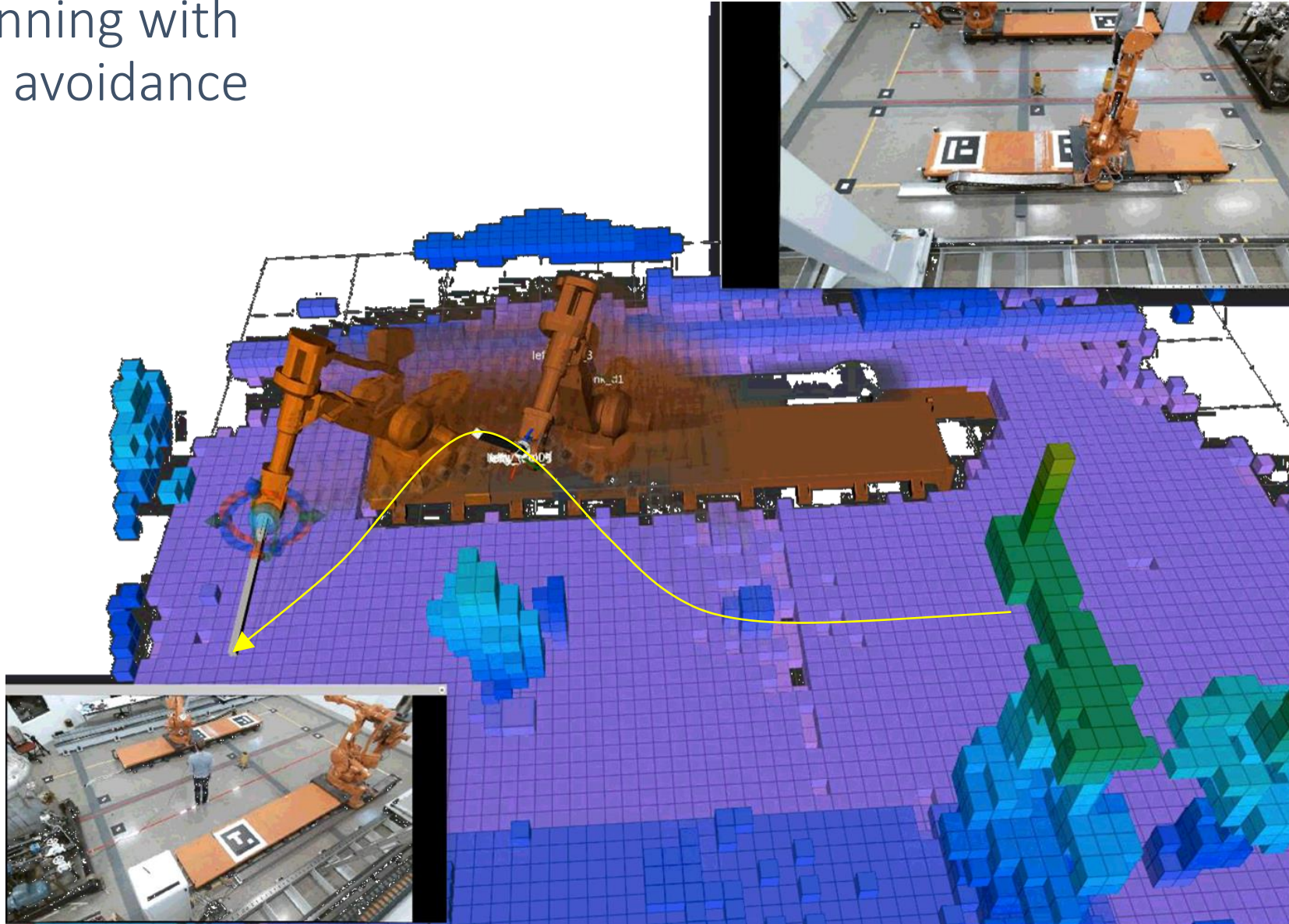
# Object Detection and Pose Estimation



# Personnel Detection and Tracking



# Path planning with obstacle avoidance



# High-resolution 3D mapping

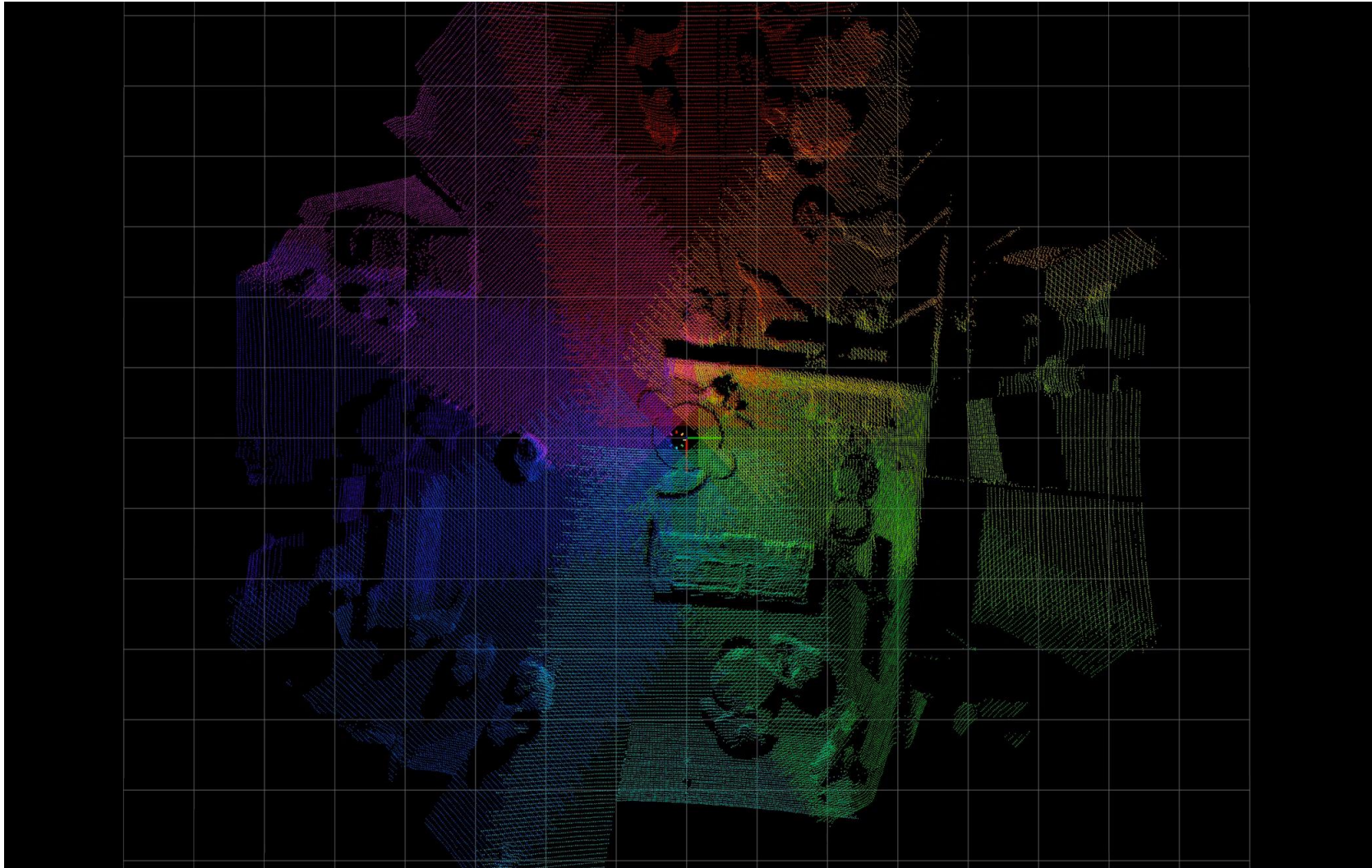
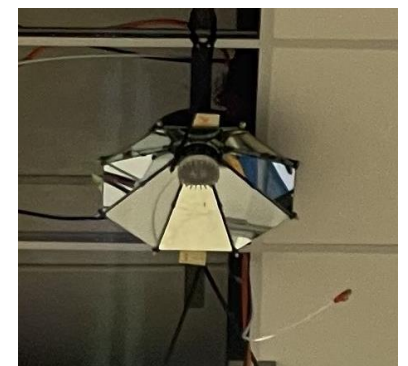
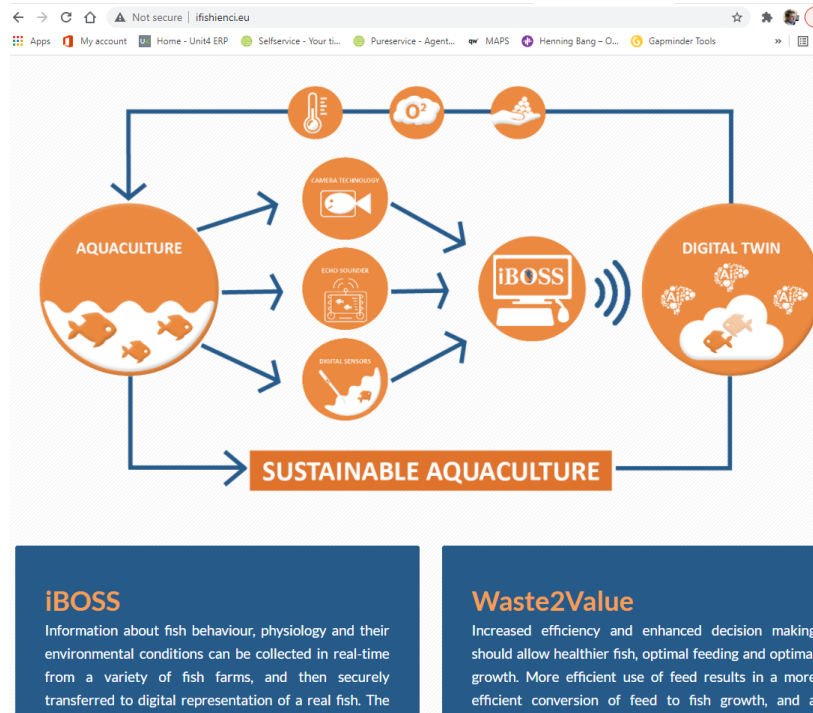


Image of 3D fix



# Selected Activities in Aquaculture and Maritime

# Examples of two On-Going Large Activities



## H2020 iFishIENCY

- Big data for digital twin from single fish to cage analysis.
- Machine learning fish behavior, physiology, and environmental data.

## Green Platform: Offshore Fish Farming

- Digital twin for efficient operation and maintenance with less manual efforts.
- Big data and AI for autonomous operations and control over production.

# Vision and AI: Farm Monitoring and Control

**Salmon farming in Norway**



**Seabass farming in Crete (Greece)**



**Biology: Knowledge about bioprocesses**

- Are you stressed?
- Are you hungry?
- Are you doing well?

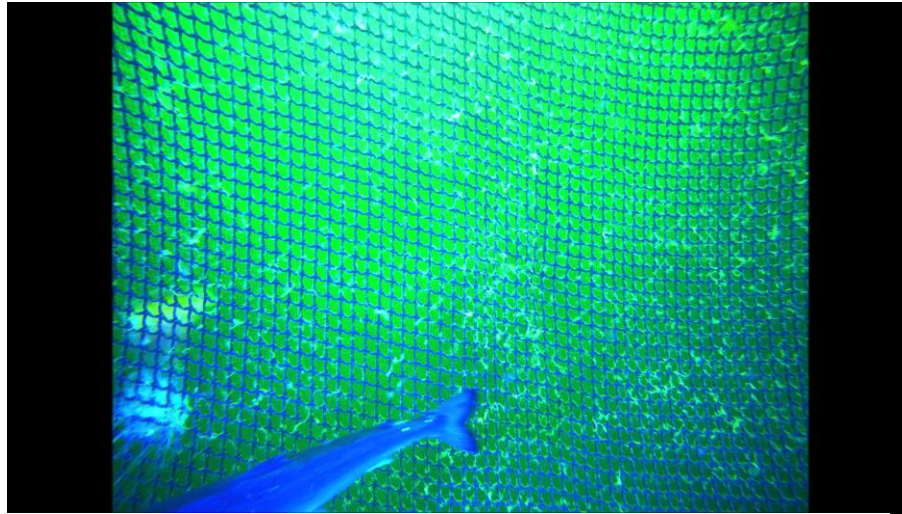
**Environment: monitoring and management**

- Ecological footprint monitoring
- Sea cage integrity and security
- Water quality monitoring

**Fish farm management: Data analysis**

- Real-time fish counting
- Real-time fish biomass estimation
- Real-time cage density analysis

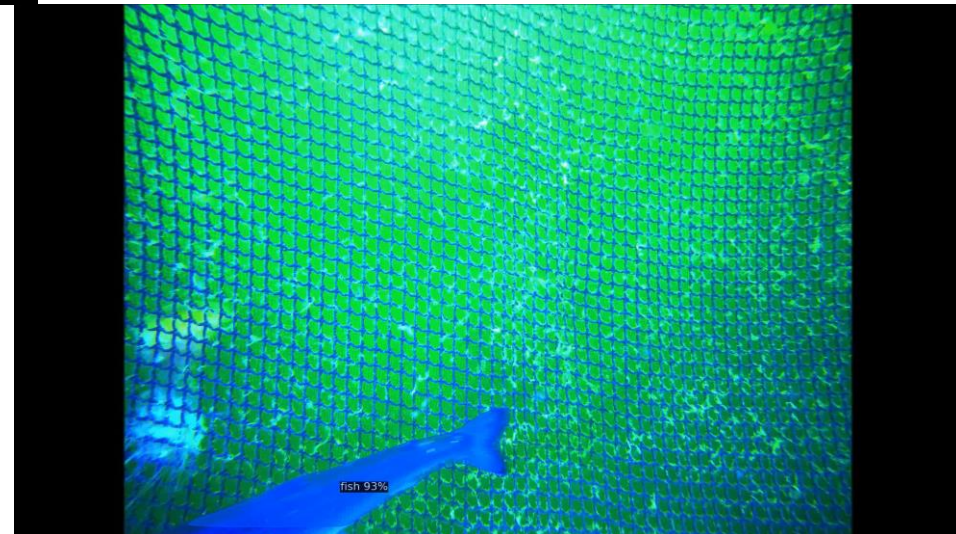
# Unsupervised Fish Segmentation and Analysis



**Original video recording**

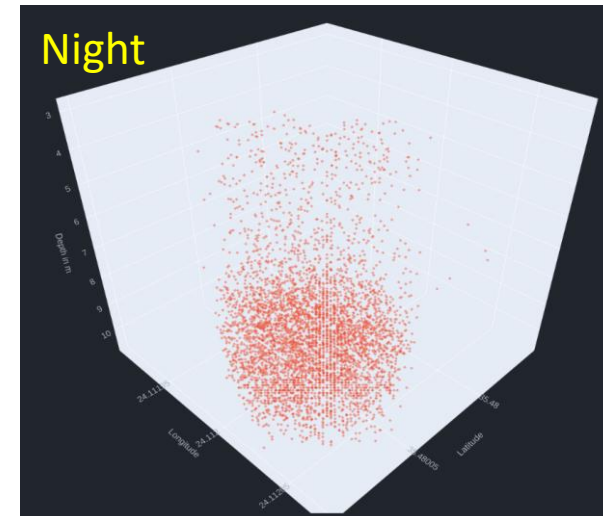
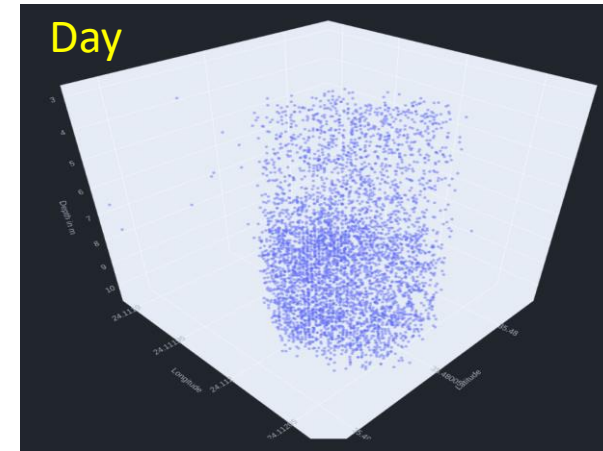
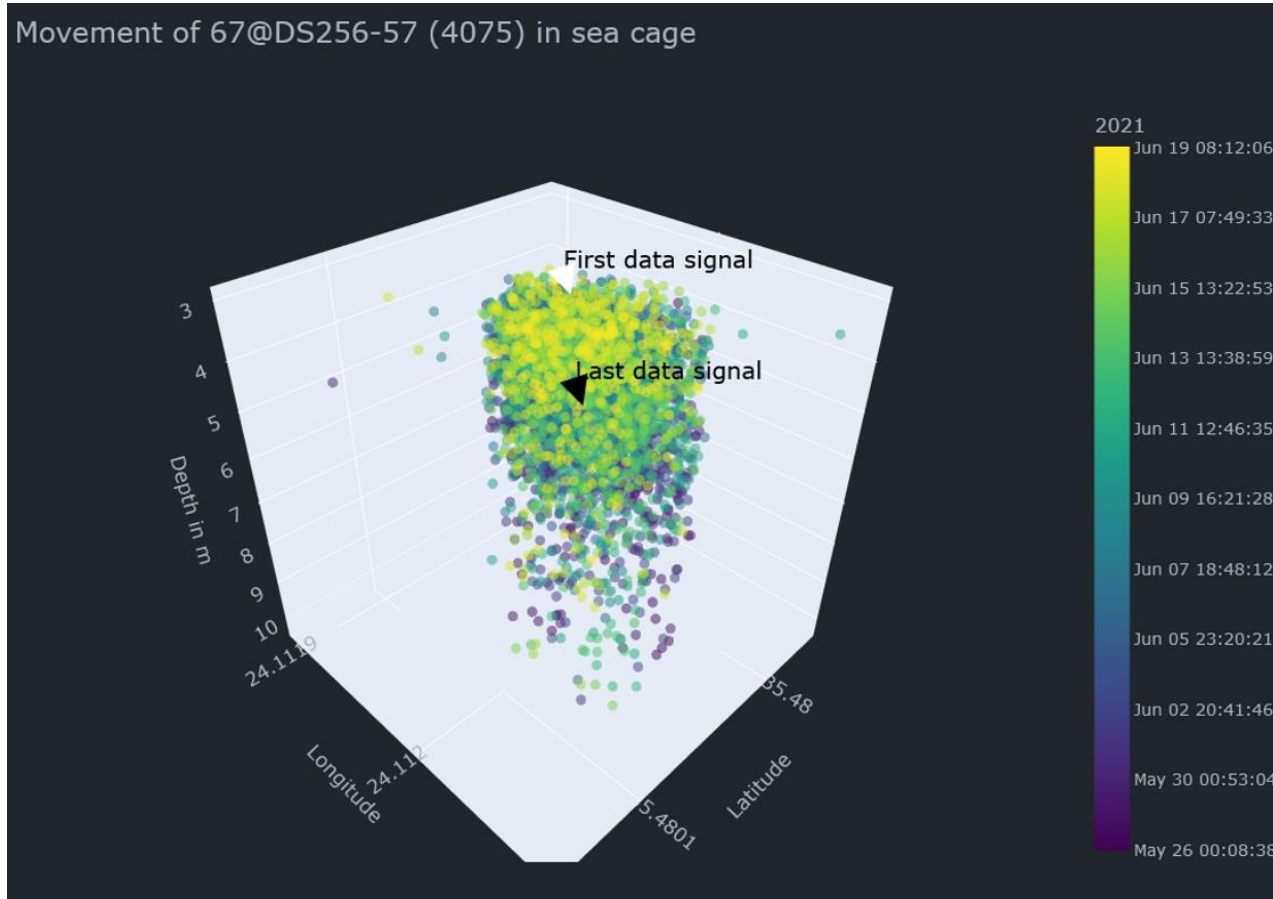


**Automatically segmented fish**





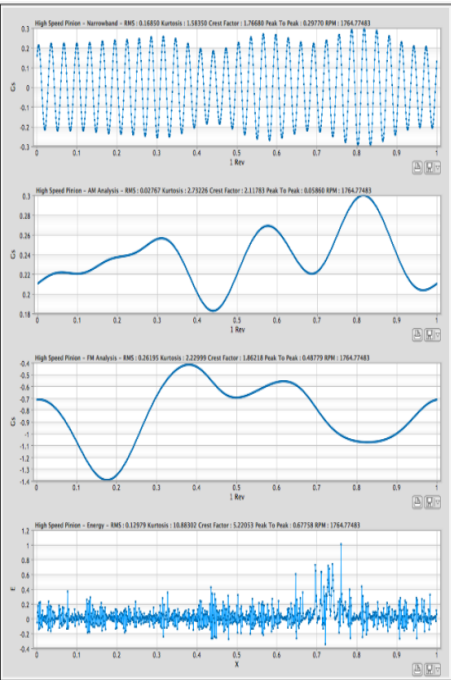
# AI for behaviour analysis (5000 tagged over 200k+)



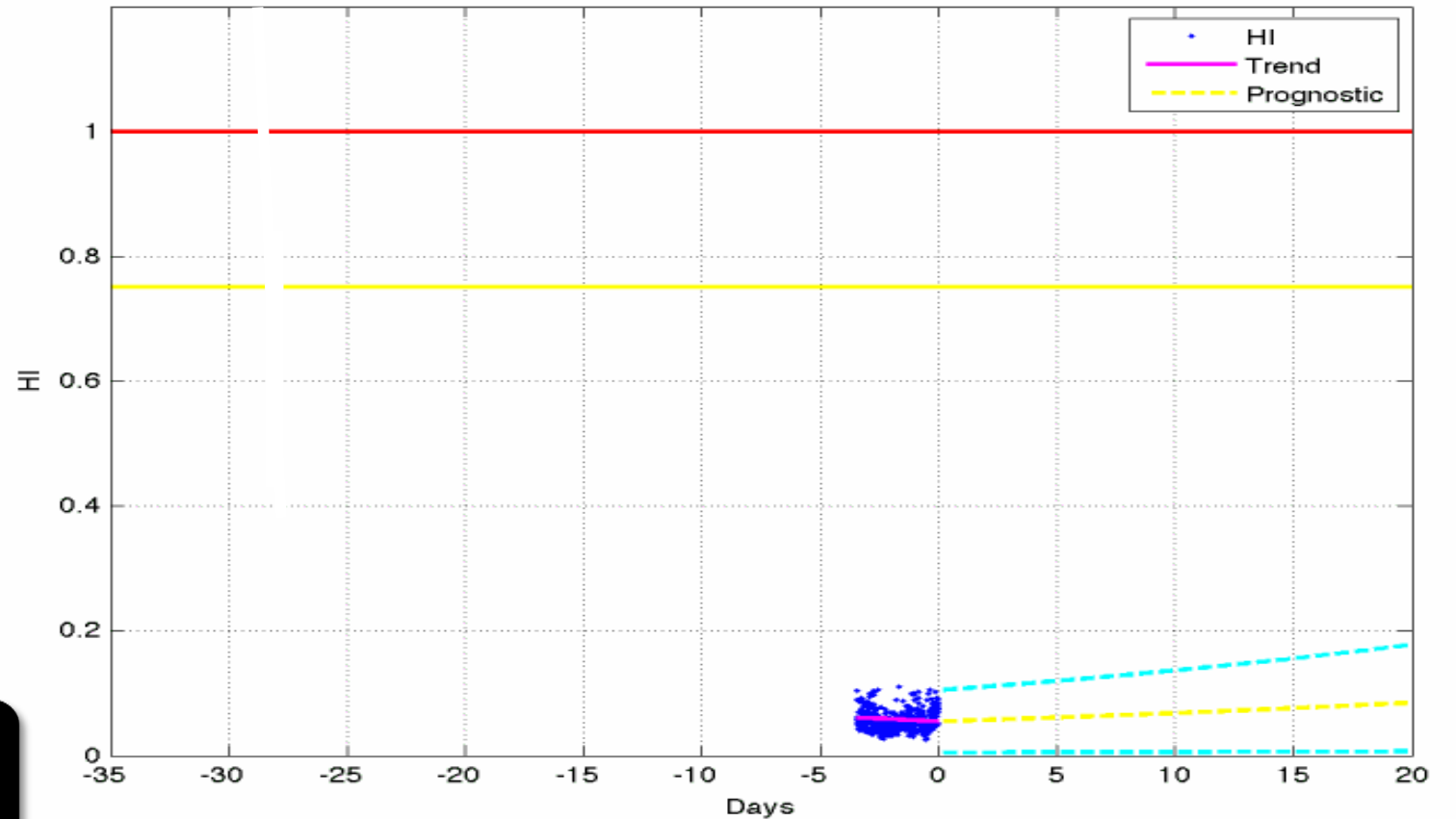
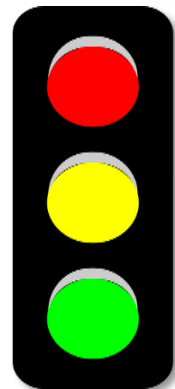
Link (Action recognition): <https://github.com/colincsl/LCTM>

Emerging, Others

# Big data and AI for diagnosis, prognosis and optimization



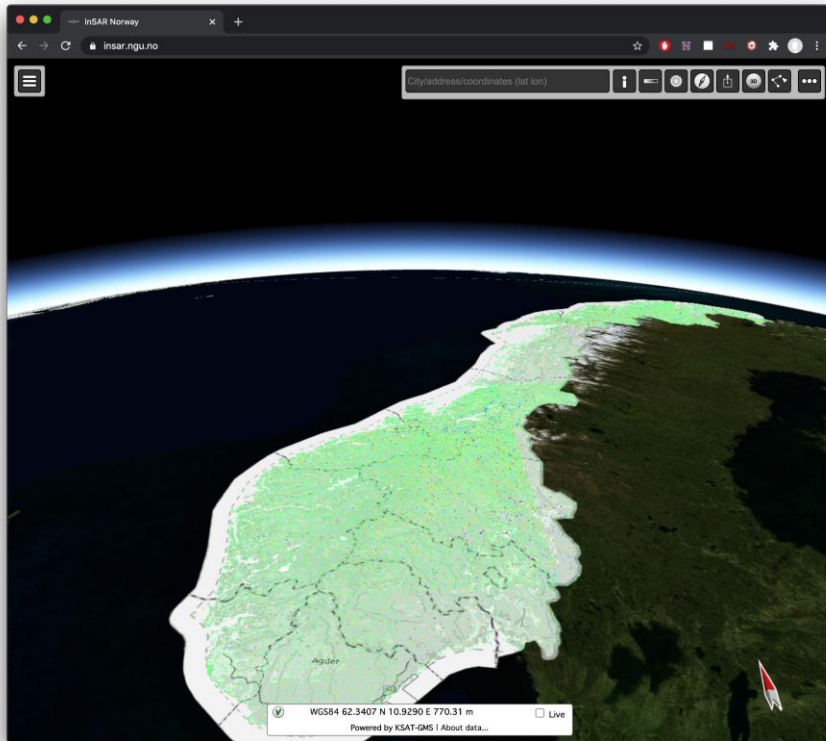
Creating stoplight simplicity out of complex data



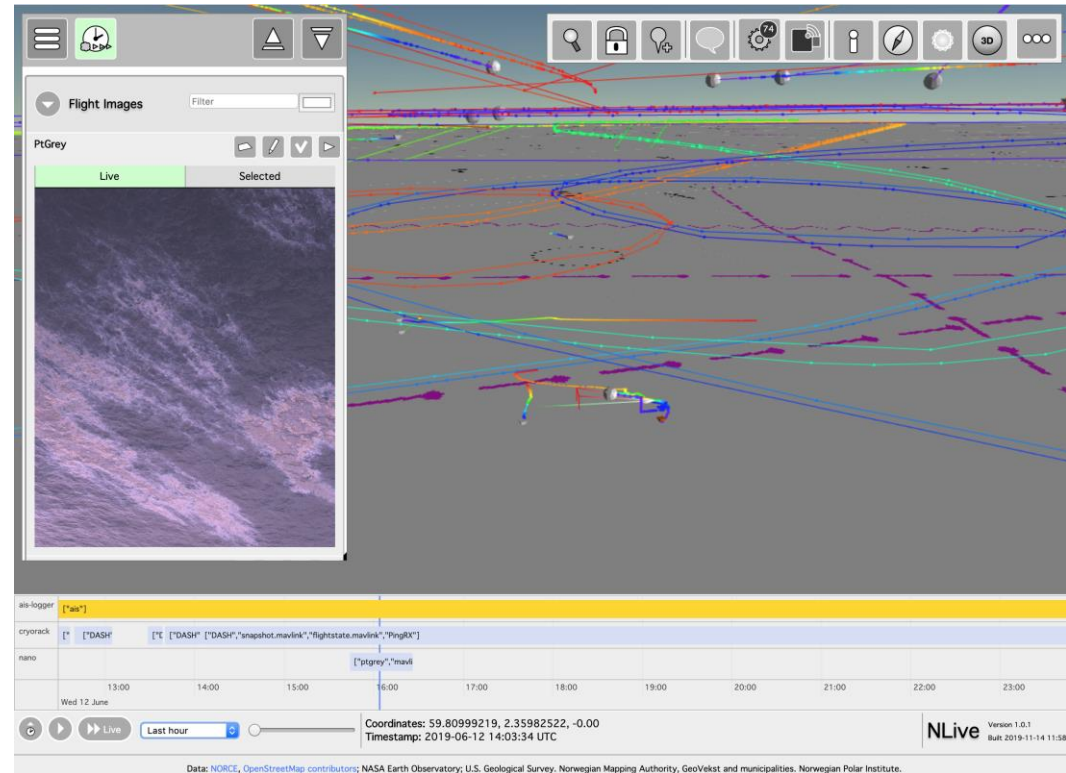
We compute the time to maintenance.

Emerging, Others

## NLIVE: NORCE Visualization Tool «[nlive.no](http://nlive.no)» for AI Adds-on



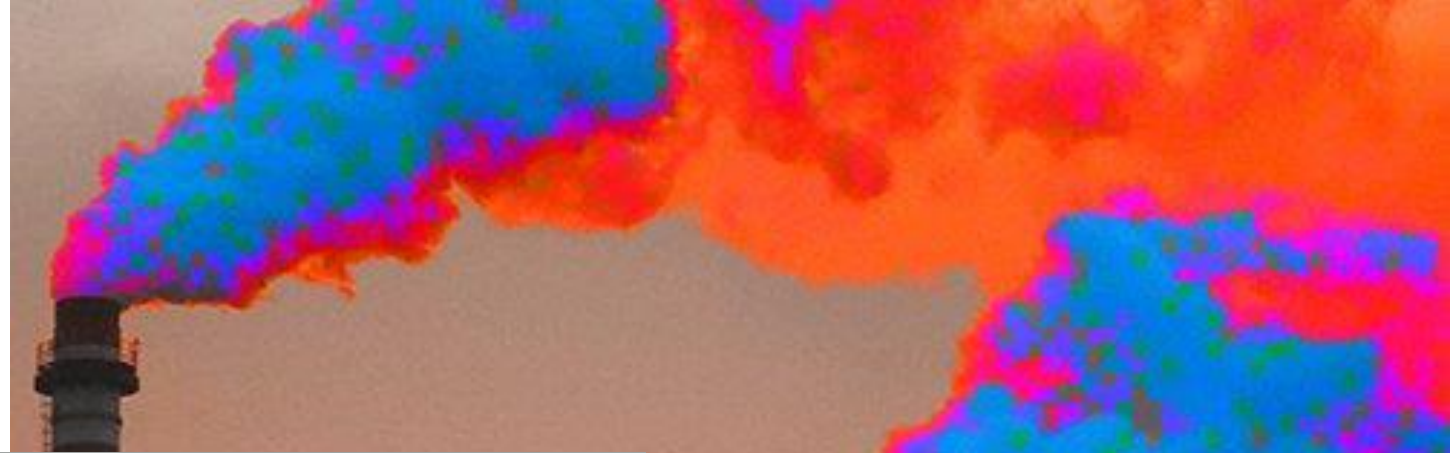
InSAR Norway - national service for ground deformation monitoring



OPV 2019: Olje på Vann 2019  
Oil spill monitoring and tracking By  
graph neural networks learning

Emerging, Others

# Digital twin and AI for Green shift of Process Industries



NLive

Not secure | nlive.norut.no/#llh=6.34791604,59.63060091,1100.47181733&look=0.12817776,0.10480556,-0.98619788&right=0.9848679,-0.13...

Apps NLive Trello ScienceDirect.com |... mPort Admincontrol - Sim... Meny - Unit4 Busin... Startside for Micros... Air Monitors Other bookma

Custom (43200 s) 1 s : 1 s System ID

Coordinates: 59.64465, 6.36152, 0.72  
Timestamp: 2020-04-20 02:30:03 UTC

Current active: 59.65244, 6.37659, 66.00

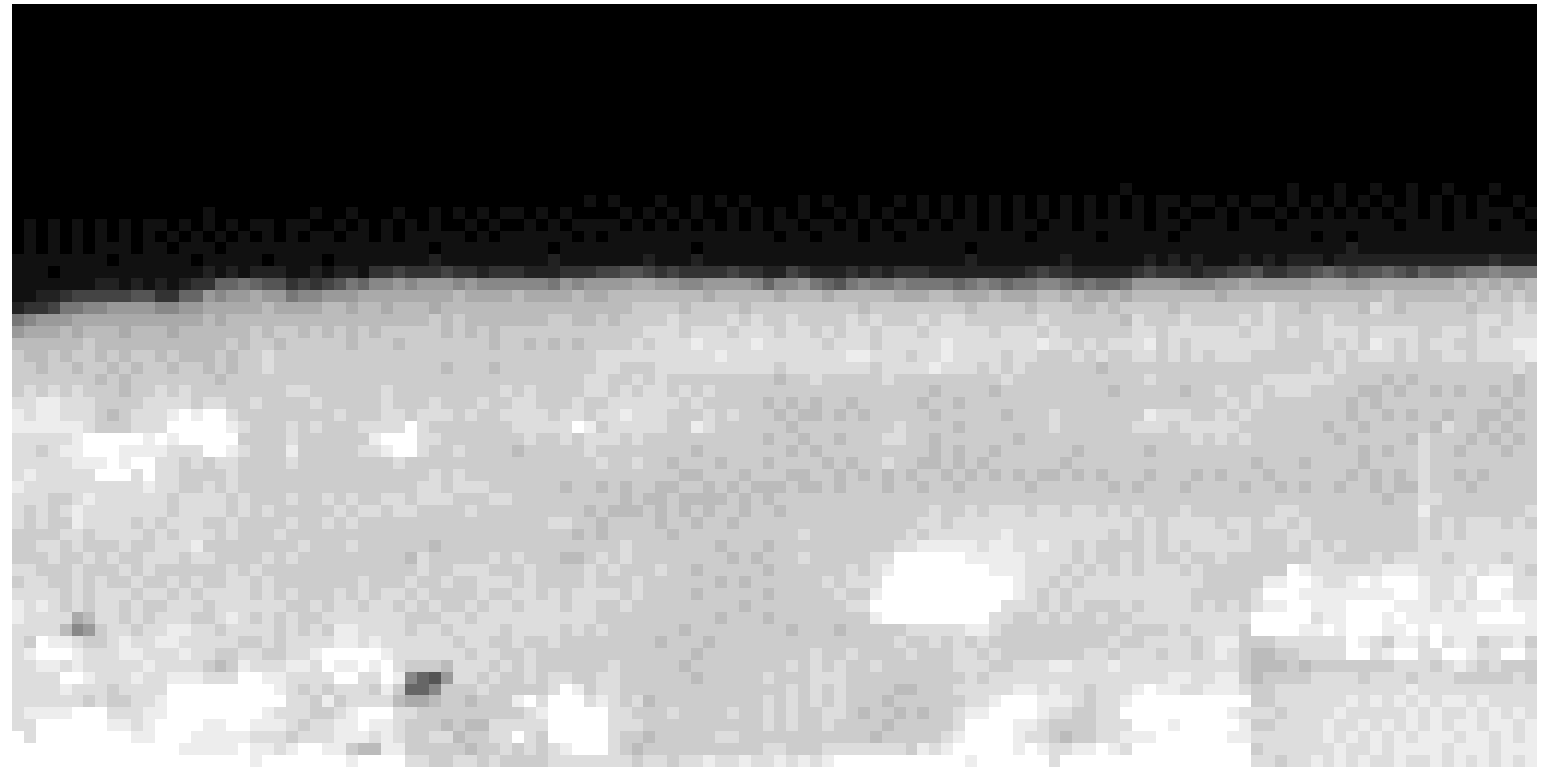
NLive Version 1.0.1 Built 2020-06-22

Data: NORCE, Norkart, OpenStreetMap contributors; NASA Earth Observatory; U.S. Geological Survey. Norwegian Mapping Authority, GeoVekst and municipalities. Norwegian Polar Institute.



Emerging, Others

## Hyperspectral vision & AI for Green shift of Maritime Industries



Thank you. Takk. Kiitos.  
Merci. Danke. Obrigado.  
Mulțumesc. 謝謝你. شُكْرًا

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