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2018

# Remote Survey and Inspection Developments for Unmanned Systems

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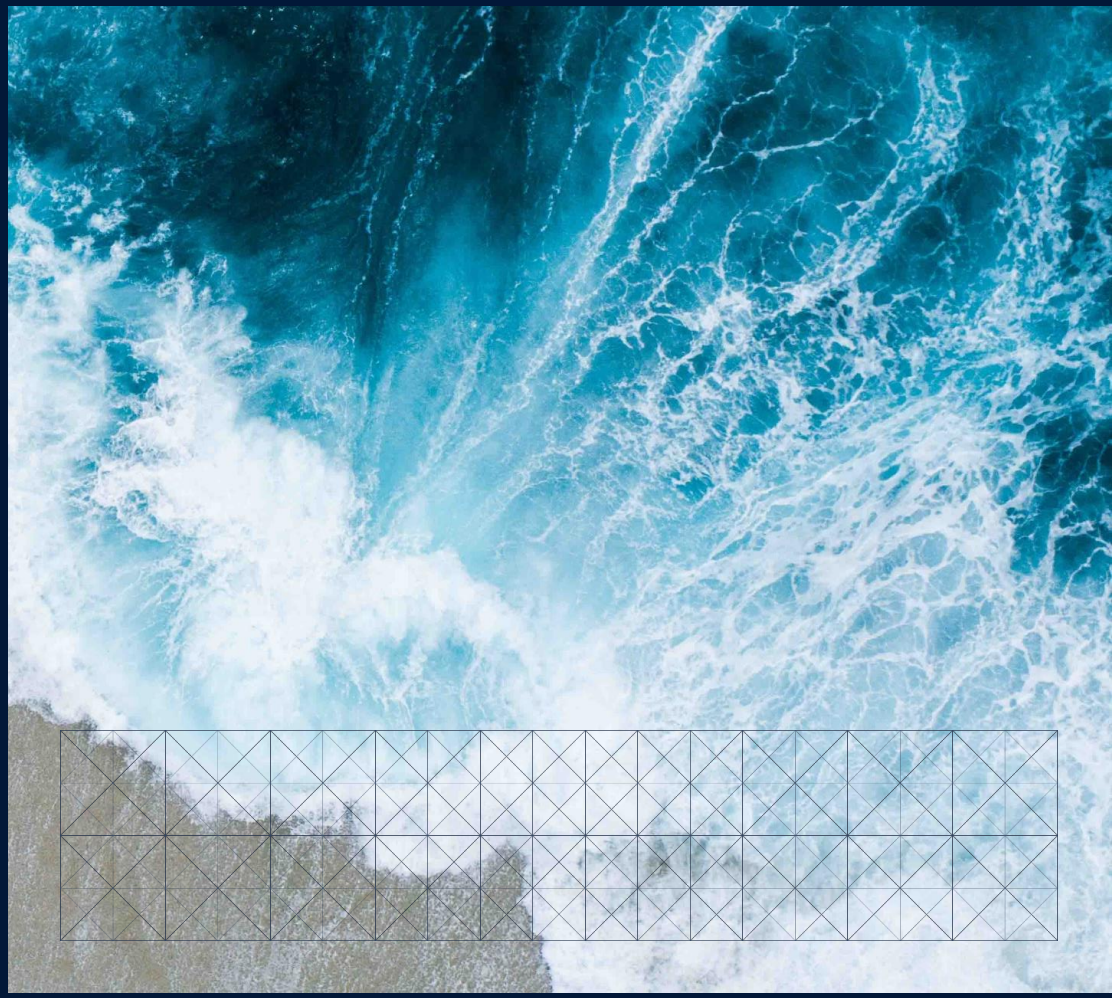


# Remote Survey and Inspection Developments for Unmanned Systems

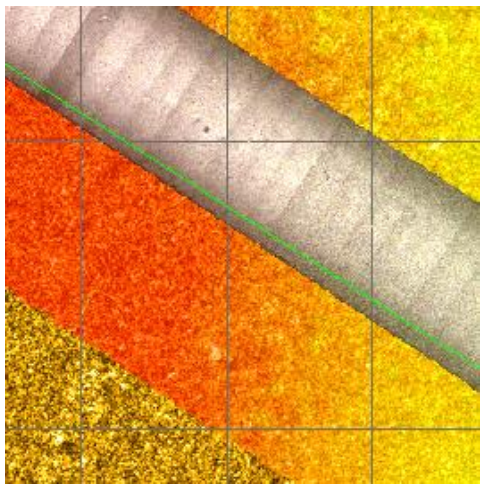
What will the future look like?

### CONNECTED NETWORK

Data collection, inspection and intervention will be conducted remotely, connected by a secure network to enable remote operation and supervision

### CENTRALISED CONTROL

Multiple assets controlled from a single location with qualified personnel making informed decisions based on real-time data



### DISTRIBUTED RESULTS

Global access to meaningful and detailed information to inform, support and feed future decision making

# What does unmanned really mean?

Operated, supervised and autonomous

**OPERATED**

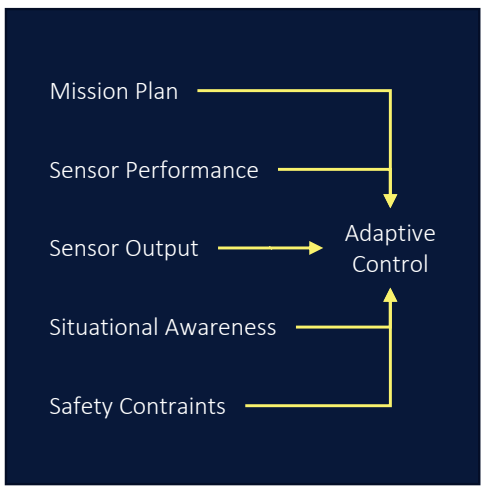
Tasks with greater risk or where complexity outweighs proven autonomous capability


**AUTOMATED/SUPERVISED**

Follow a plan with communications links providing real-time feedback and limited capability to change tasks

**AUTONOMOUS**

Existing autonomous systems can follow a plan and minimize deviations, good for survey and simple inspection tasks




**ADAPTIVE**

System determines the best way to achieve an outcome based on conditions and sensor feedback: the next step

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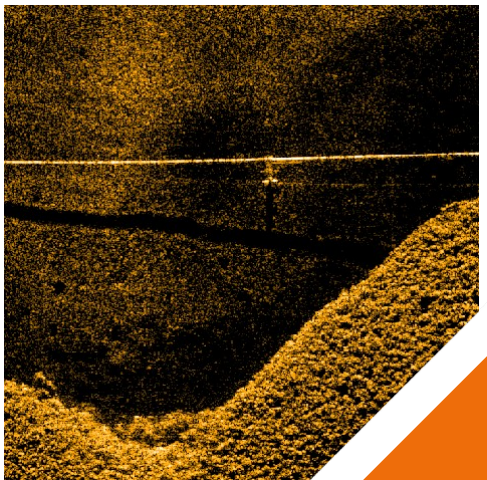
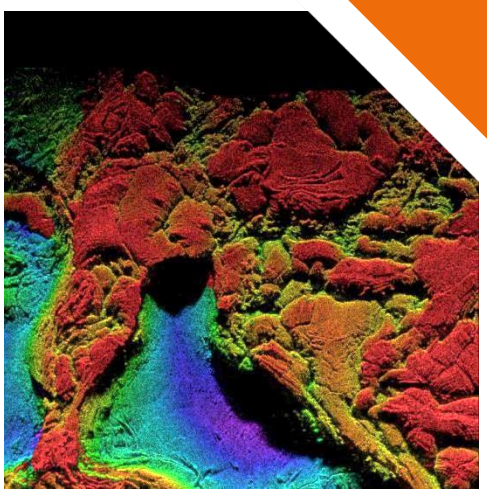
# Unmanned Survey



For the HUGIN AUV System, it’s all about the data

## What has been achieved so far?

Autonomous Underwater Vehicles (AUVs) like the HUGIN AUV System are reliable data collection platforms for survey pruposes

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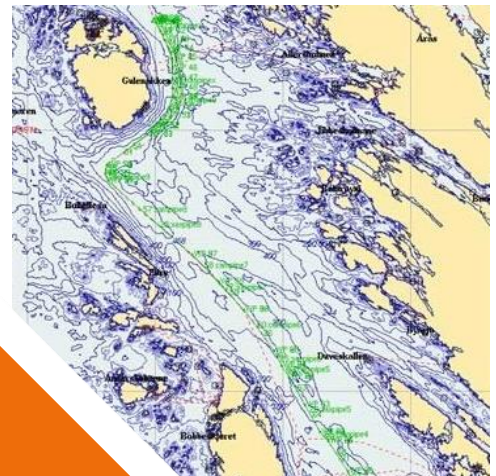
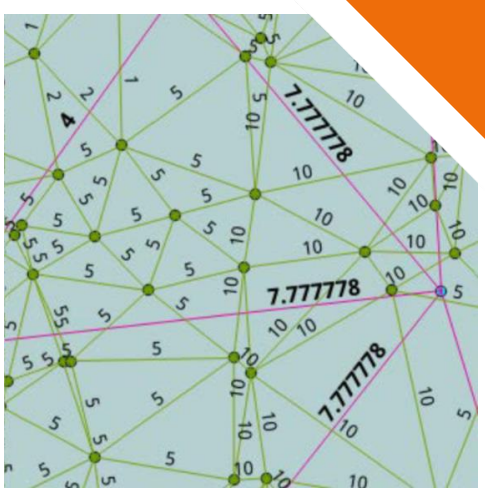
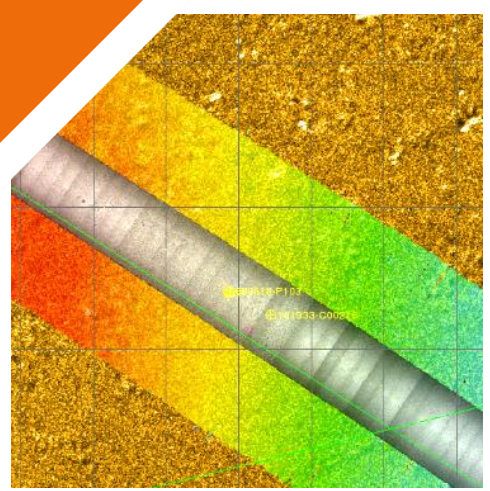
# From goal-based mission planning to in-mission adaptive control and data handling the Hybrid Autonomy Layer (HAL) works as mission controller for AUVs and USVs



## Hybrid Autonomy Layer

Developed in partnership with FFI

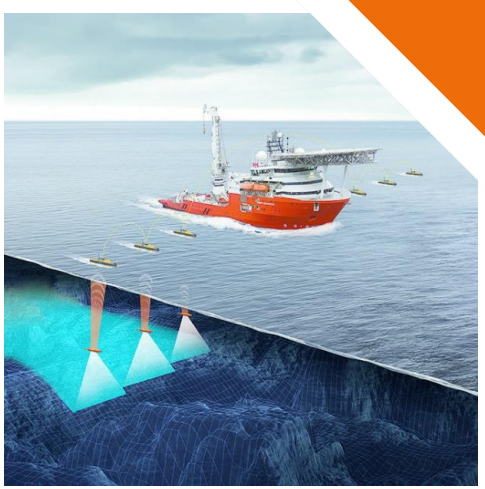


# Force Multipliers

The efficient application of multiple systems.

## Covering greater area in less time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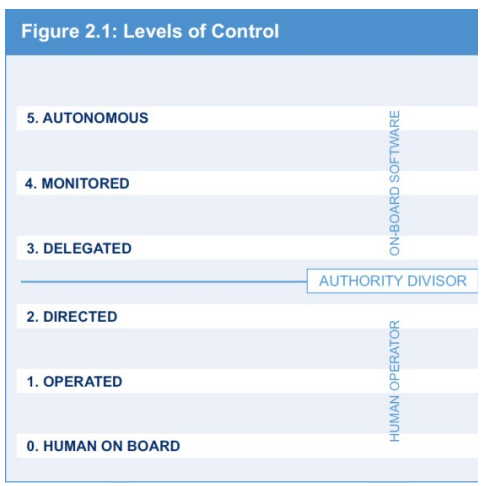
# Unmanned Surface Vehicle

## Deploying Kongsberg Autonomy on Unmanned Surface Vehicles

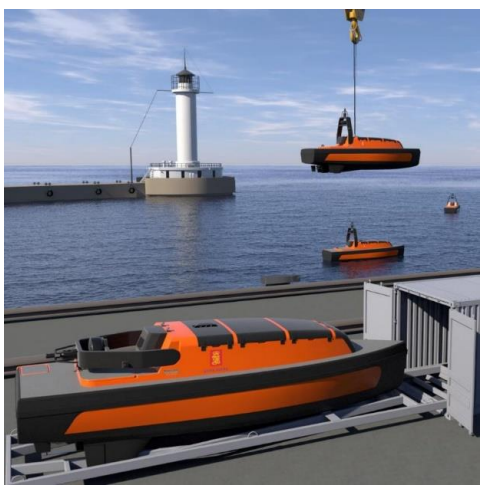



### K-MATE

K-MATE is the controlling software that enables the safe and efficient autonomous operation of USVs

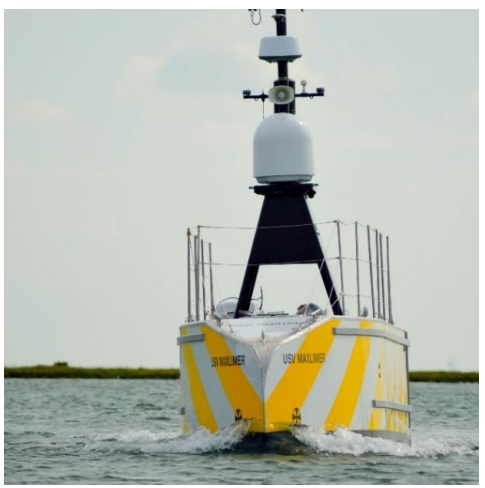

### DEVELOPMENT

Working in conjunction with FFI (The Norwegian Defence Research Establishment) we have devloped advanced autonomy for USV



### NEAR-SHORE

The Norsafe team have designed a USV for shallow water and near-shore use, controlled by K-MATE and equipped with KM sensor packages



### TRANS-OCEAN

SEA-KIT has been developed by Hushcraft Ltd, GEBCO and the Nippon Foundation. It is controlled by K-MATE and equipped with KM sensor packages

# Advanced Control for USVs

K-MATE includes waypoint and event based mission capabilities combined with advanced control for safe operation.

Scene analysis and collision avoidance

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# Combined Systems

USVs have been used to supervise AUV operations before, now we are working on a long range, over-the-horizon capability

Launch, recovery and supervision of HUGIN from a USV


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# Connectivity

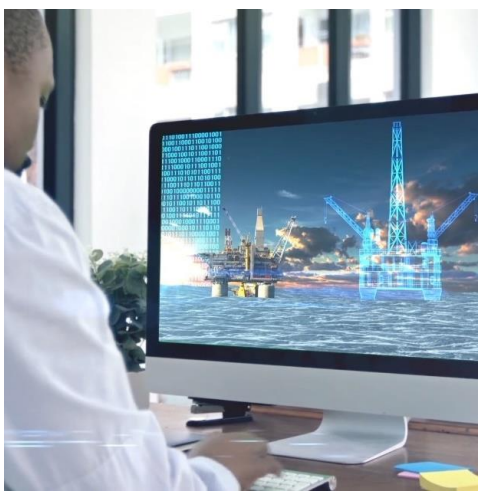
# Digital Development

Kongsberg Digital is developing smart applications to improve safety, efficiency and data quality

**OIL & GAS**

**RENEWABLES & UTILITIES**

**MARITIME SIMULATION**



**KOGNIFAI**

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# Connectivity Enabling Remote Operation

The implementation of digital connectivity through KongnifAI enables mission supervision and data processing from anywhere.

**Providing remote access to data**

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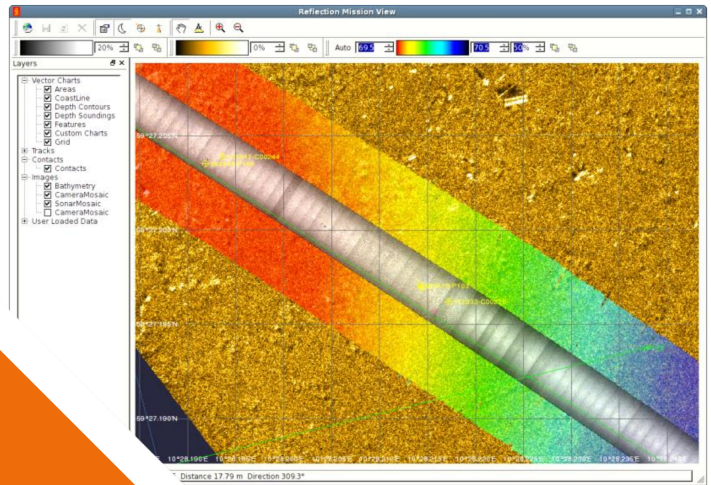
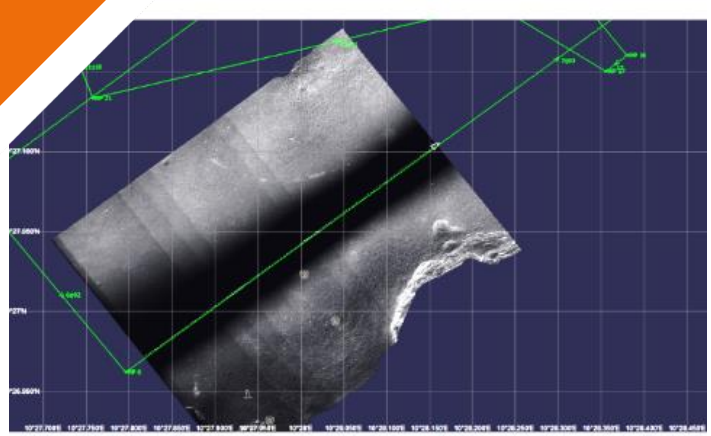
# Visualise and Process Data

Payload data can be viewed instantaneously through Reflection and processed along with navigation data to produce meaningful results fast.




Rapid Visualisation



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# Unmanned Inspection and Intervention

# The Eelume Story

Eelume was established in 2015 as a spin-off from the Norwegian University of Science and Technology (NTNU). After a decade of research on snake robots in collaboration with the research organization SINTEF, we decided to pursue industrial subsea applications of these amazing mechanisms.

The strategic partnership formed with Kongsberg Maritime and Statoil (LOOP product development program) in 2016 ensures that our unique vehicle concept is fused with leading subsea experience and technology. In addition, the support from the *Research Council of Norway* and *Innovation Norway* has been vital to our success.

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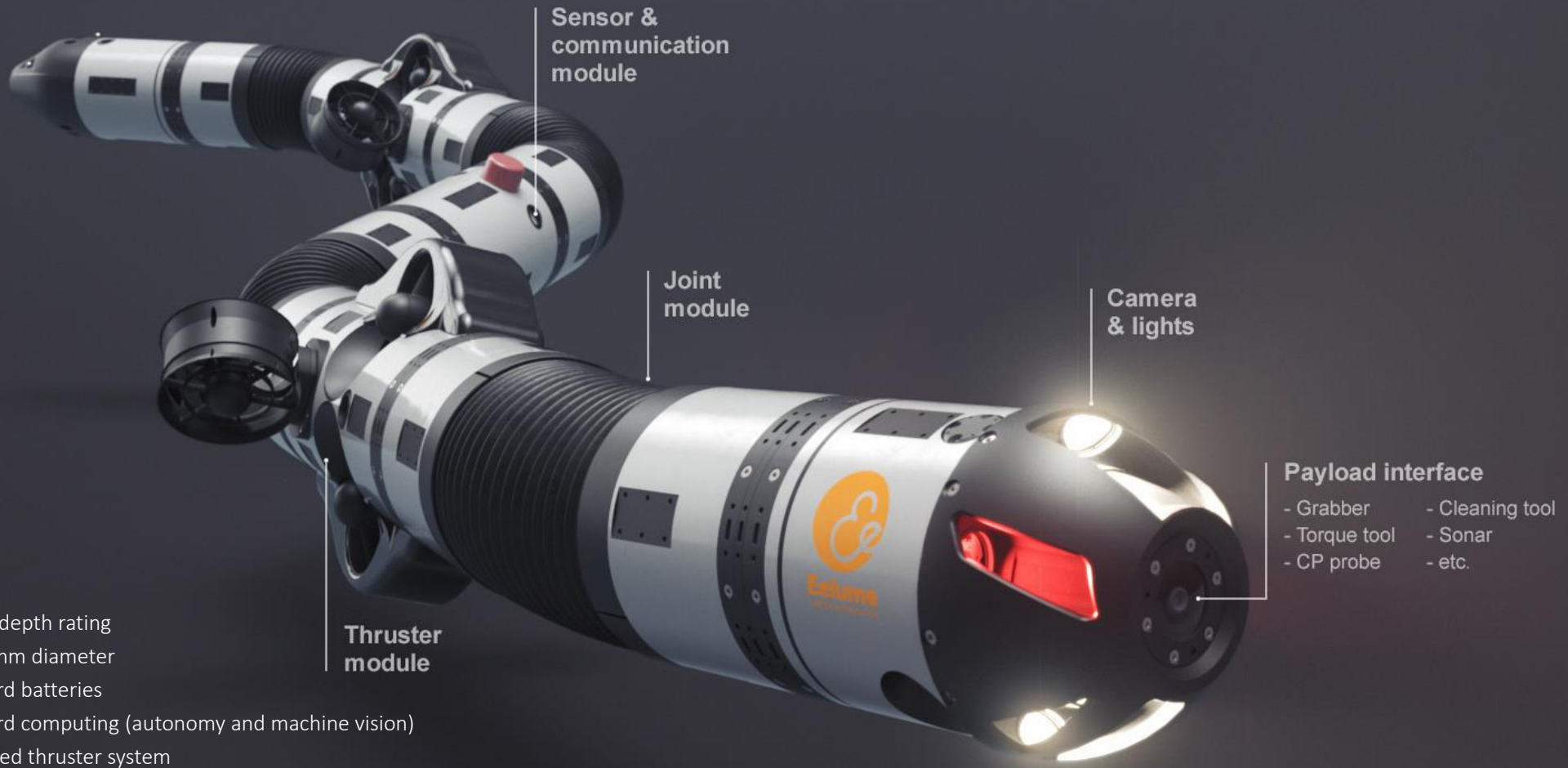
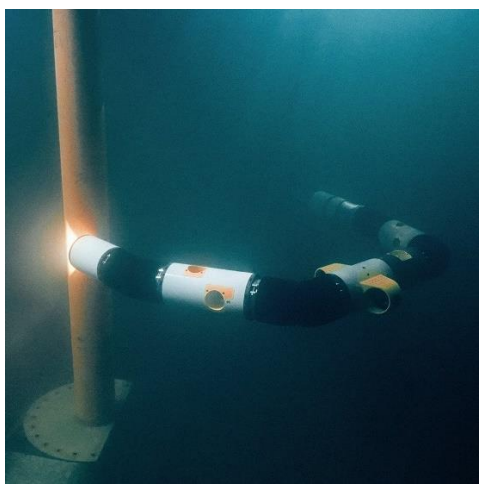



- 500 m depth rating
- Ø200 mm diameter
- Onboard batteries
- Onboard computing (autonomy and machine vision)
- Improved thruster system
- Improved camera and light system
- Acoustic positioning (Kongsberg cNode)
- Subsea garage with TMS

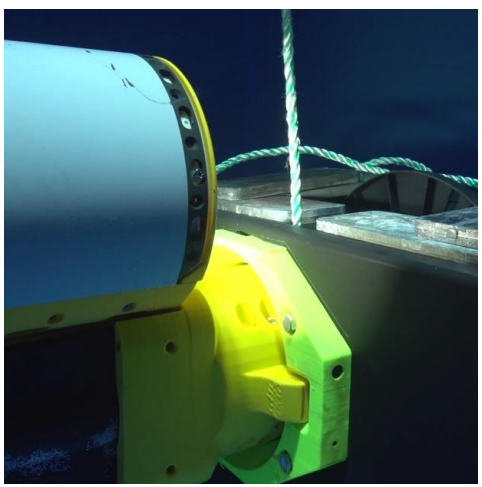
# Proving the Concept

Trials, demonstrations and qualification



**2016**

Prototype vehicle, tethered inspection capability in 150 m water depth proving confined space access



**2017**

EELY 500, tethered inspection and Class 4 torque tool operation in 500 m depths

**2018**

EELY 500, TRL4 qualification

One month subsea residency, battery powered for inspection and intervention (Class 4 torque tool)

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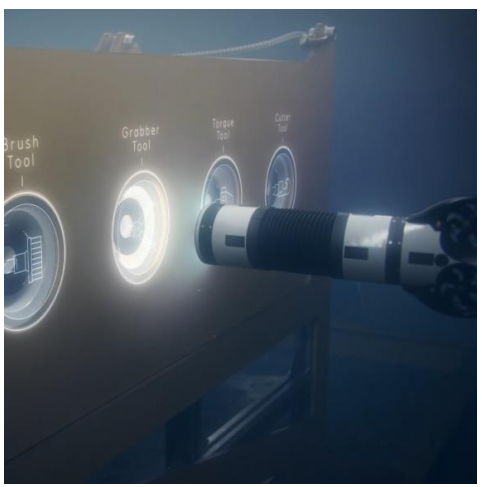
# The Future of Eelume

Rapid development and qualification of unique capabilities for Inspection, Maintenance and Repair

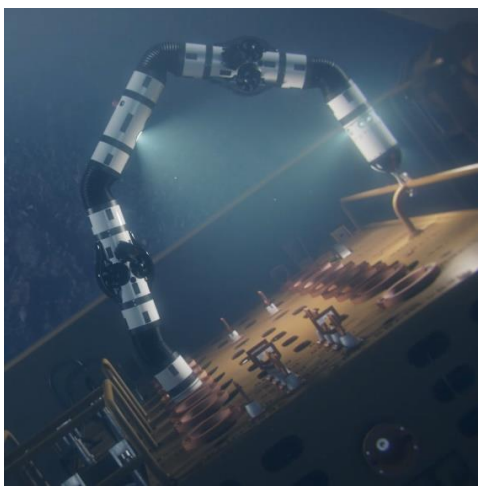
**Q1 2019**

Åsgard pilot, tethered from subsea garage, with shore control centre




**2019**

Autonomy, machine vision, mapping, subsea charging and tool exchange, acoustic communications



**2019/2020**

Live qualification of tetherless robot


**2020**

Pilot installation, tetherless autonomous robots. Pipeline inspection, near-template inspection and intervention

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