Giovanni De Vita, GIS and Data Management Coordinator

Orange is the new yellow: from legacy ROV inspection surveys to more efficient and cost-effective HUGIN AUV solution

Discussion Topics

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Introduction

Why AUV

AUV Pipeline Inspection

A Database Back On Deck

Conclusions

Introduction

Introduction

First controlled underwater vehicle - 1866

Kongsberg HUGIN 1 - 1993

Kongsberg HUGIN - Today

Introduction

DOF Subsea & AUVs

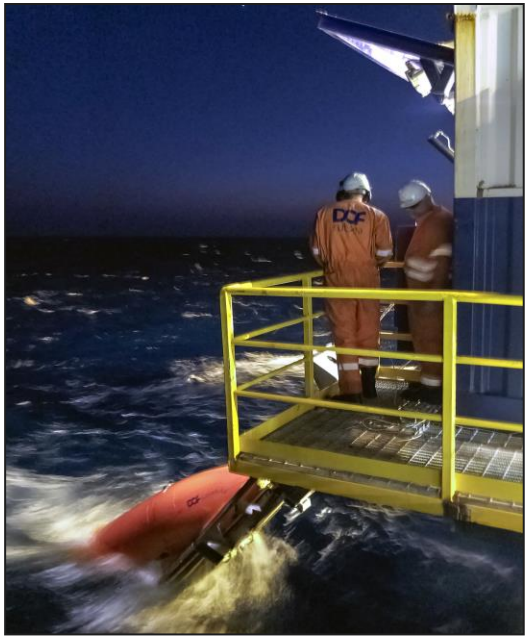
2001: **HUGIN 3000**

Longest AUV dive: 5 years, 1 month, 9 days (and counting…)

2012: **HUGIN 1000** (SV1)

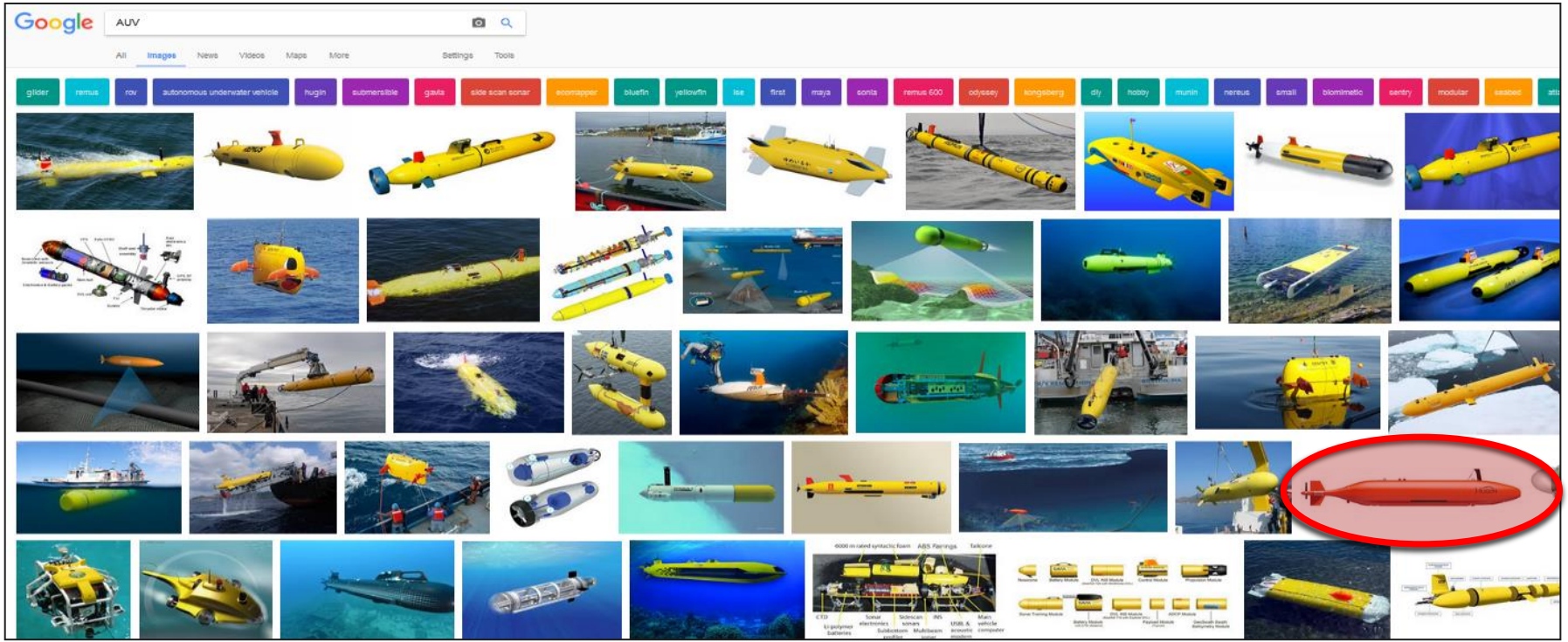
2016: **HUGIN 3000** (SV2)

2017: SV1 **upgrade**



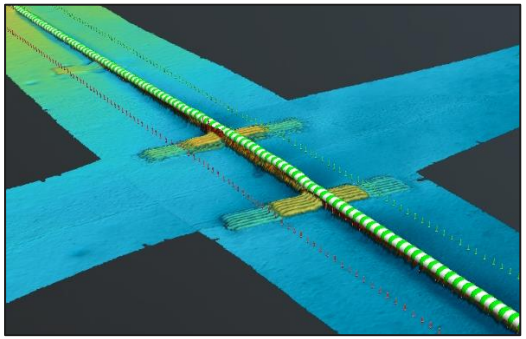
Introduction

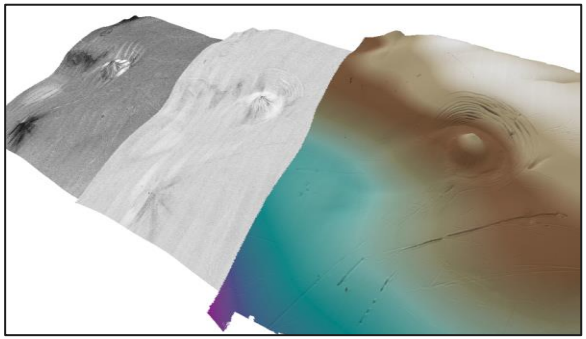
A swarm of AUVs, custom built, lots of different sensors, lots of data and promises…

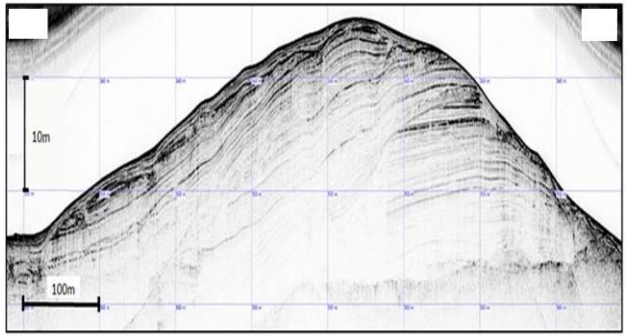


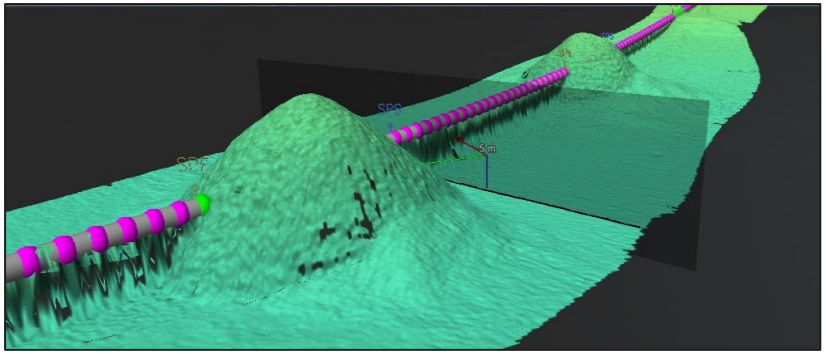
Why AUV

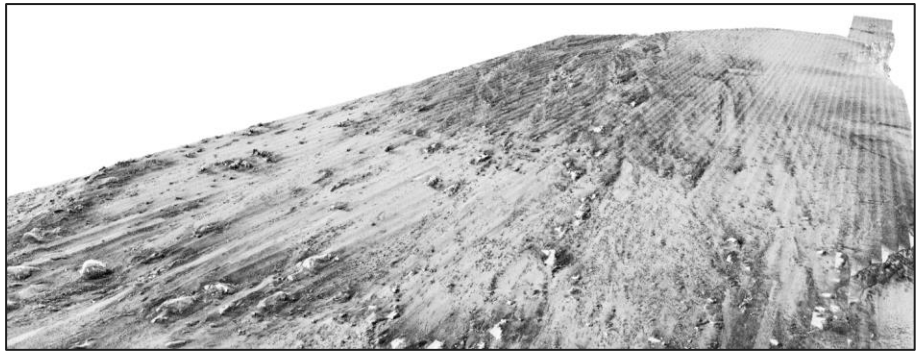
AUV = Quality and Repeatability











AUV = Fast

- Fast survey rate of up to 4 knots
- Mobilisation on 3rd party vessel < 3 days
- Demobilisation = 1.5 days
- Constant +100 km/day rate of data collection per AUV

AUV = Reliability and Portability

2 AUVs

5 Continents

12 different vessels

8 different Clients

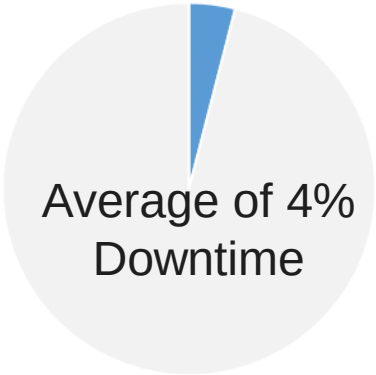
~350 dives

19m

Depth

2850 m

> 28000 km
Perth to Aberdeen
(return)



AUV Pipeline Inspection

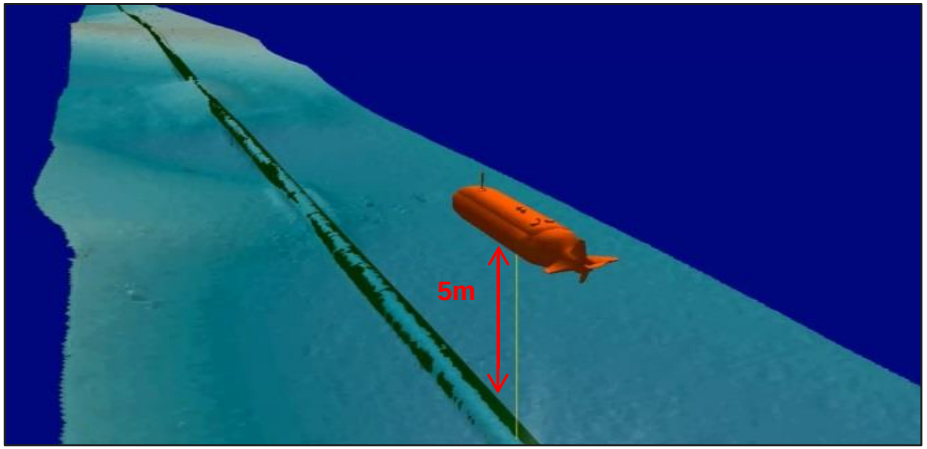
AUV Pipeline Inspection

- One pass to the side of pipeline and one pass directly over: detect, track and map pipe with SSS or MBES, use result in second pass (e.g. new pipelines)

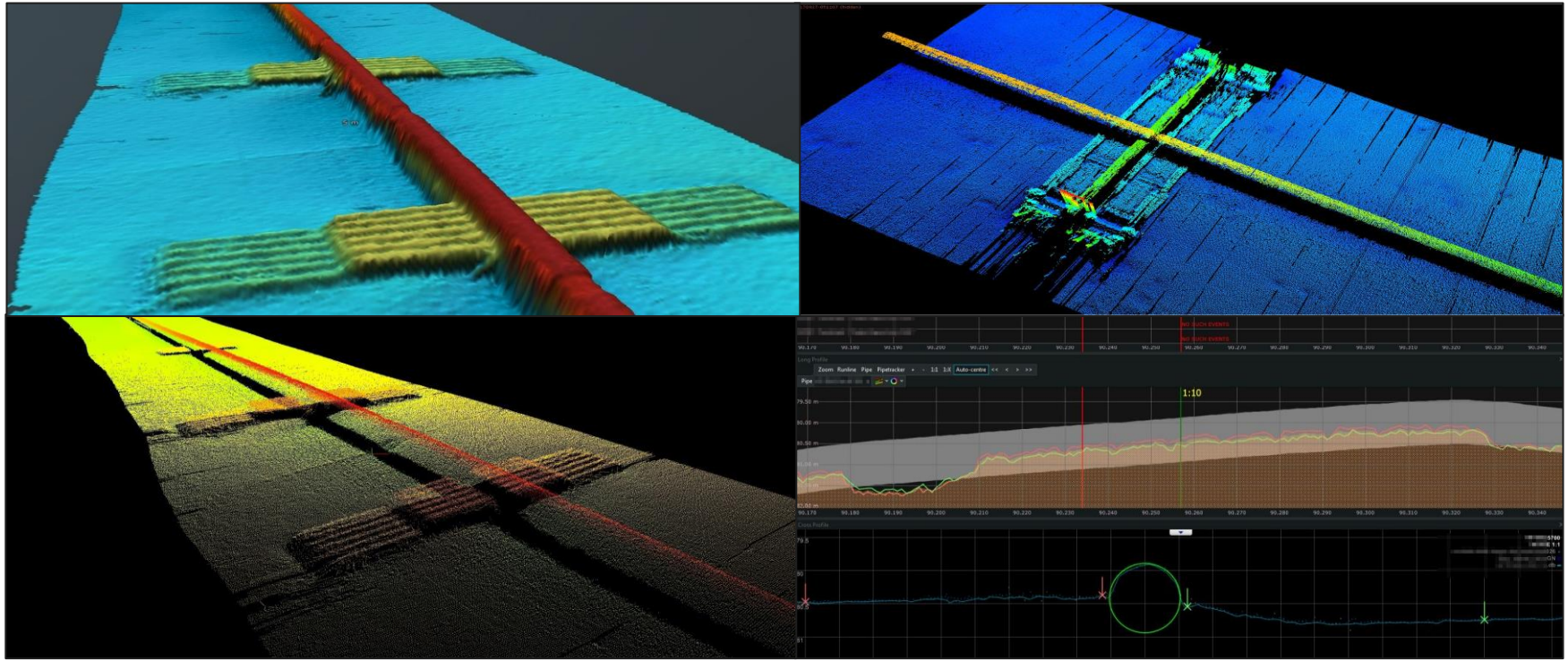
- One pass directly over the pipe, following the pipeline with the MBES (Pipe-tracking mode) running the TileCam, SSS, environmental sensors etc.

AUV Pipeline Inspection

- AUV follows pre-set survey lines (*mission plan*) in Supervised mode
- Operating altitude of 5 m for TileCam optimisation (MBES swath = 20 m) or 8 m altitude for 30 m MBES corridor (10 cm resolution) using Pipe-tracking mode / Waypoint mode
- Approximate 100 km per dive. ~20 hrs average dive time with a turn around on deck of 4 hrs.

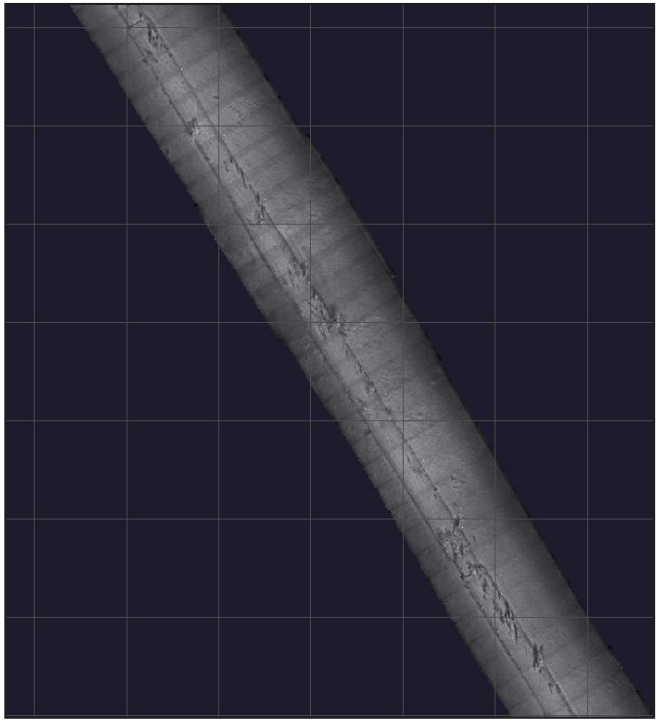


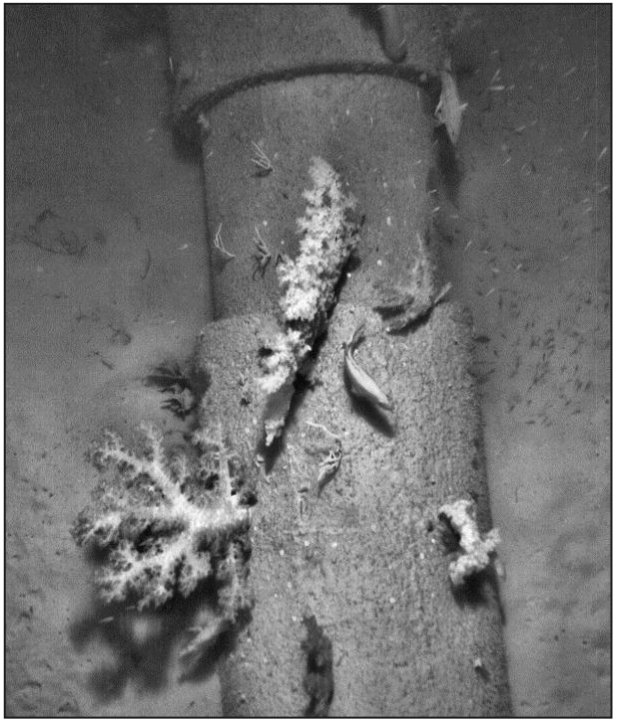
AUV Pipeline Inspection



MBES data (single pass) acquired at 5 m altitude (3.7 knots) with 20 m usable swath @ 10 cm resolution!

AUV Pipeline Inspection





TileCam data (single pass) acquired at 5 m altitude (3.7 knots) with a 5 m X 3 m footprint @ 3.5 cm resolution!

AUV Pipeline Inspection

ROV

- 0.5 knots or ~24 km/day
- **1 Pass**
- Acquisition = ~93 hrs (4 days)

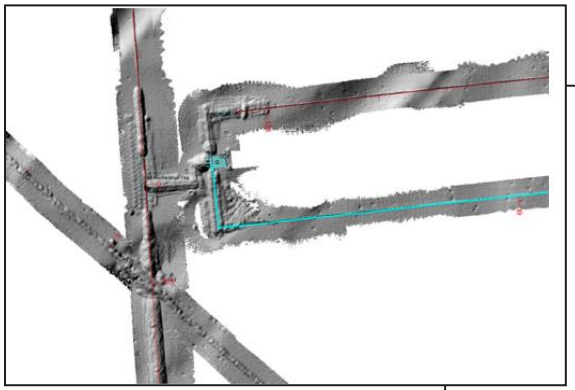
AUV

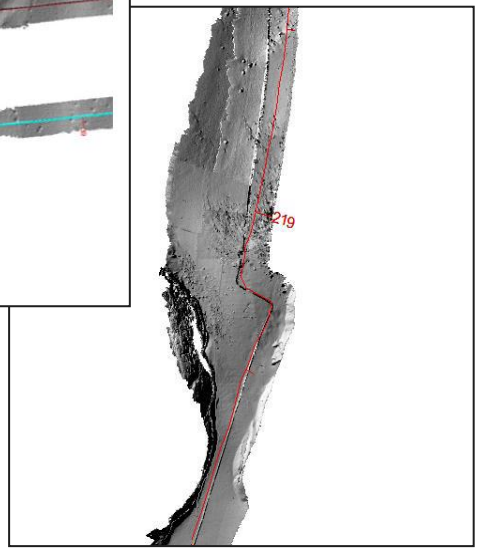
- 3.7 knots or ~100 km/day
- **1 Pass**
- Acquisition = ~20 hrs (1 day)

KP 0 *Pipeline* *KP 100*

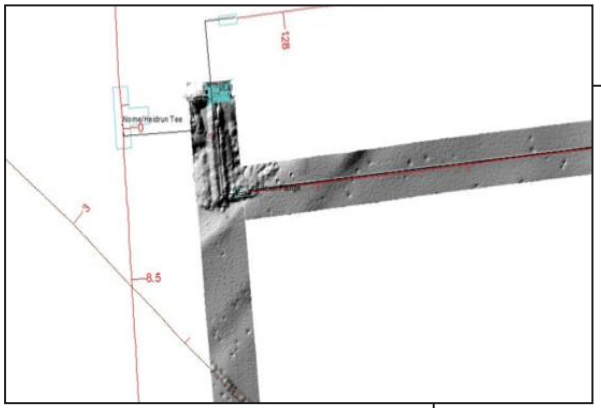
AUV Pipeline Inspection

- Using the pipeline as a reference, AUVs in pipe-tracker mode, can execute the exact same survey time after time

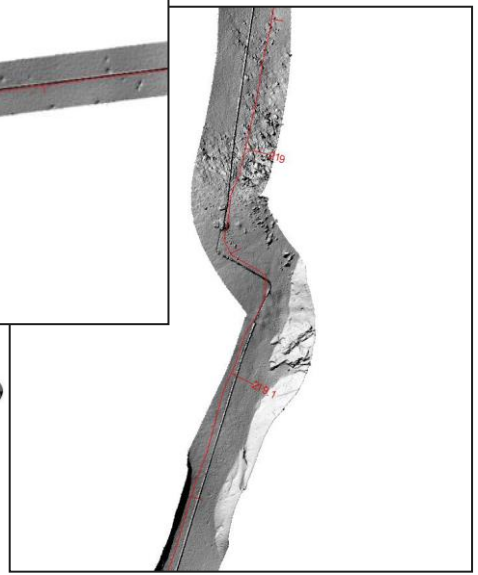




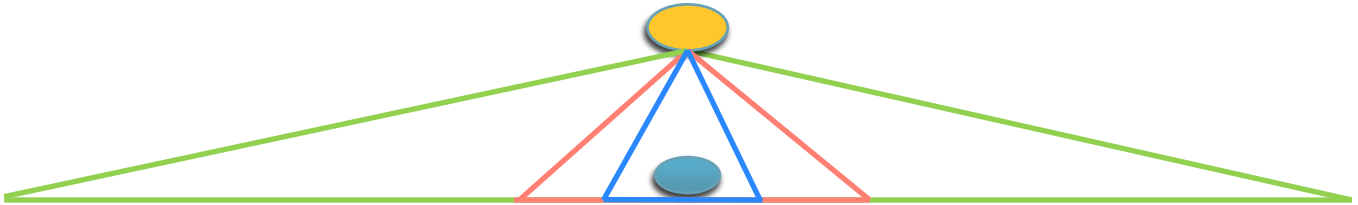
Analog



Digital



AUV Pipeline Inspection



HUGIN AUV SV1:

- 5m altitude @ 3.7knots
- MBES: 20 m swath, 400 kHz @ 35Hz, 10 cm resolution; backscatter
- SSS: 100 m scan range 100-400 kHz
- TileCam: 5 m x 3 m TileCam GeoTiff Imageries @ 2Hz with pseudo-video
- Environmental sensors: CTD, Salinity, Turbidity…
- SBP for Water Column Data

HUGIN AUV SV2:

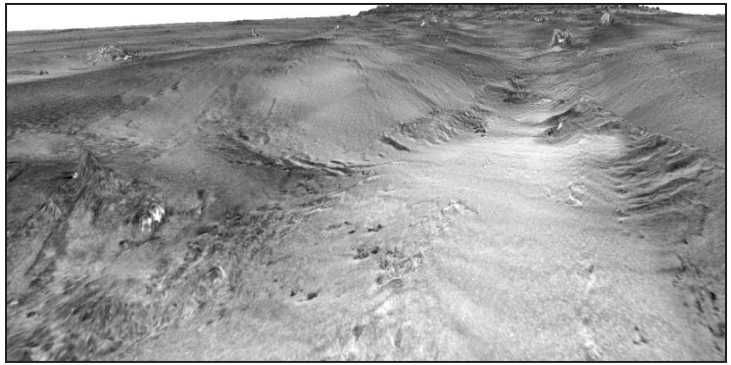
- 4 m altitude @ 3.7 knots
- MBES: 15 m swath, 400 kHz @ 40 Hz, 5cm resolution; backscatter + Mid Water Column Data
- SSS: 50 m scan range 100-400 kHz
- CathX Laser for micro bathymetry @ 40Hz 3.6 m swath, 2 cm resolution and Colour Images @ 4Hz – 5 m width
- Environmental sensors: Methane Sensor, CTD, Salinity, Turbidity…
- SBP for Water Column Data

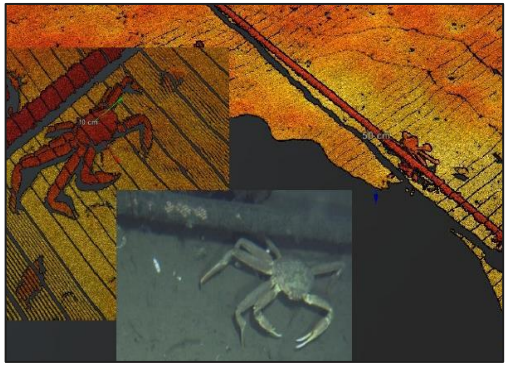
A Database Back On Deck

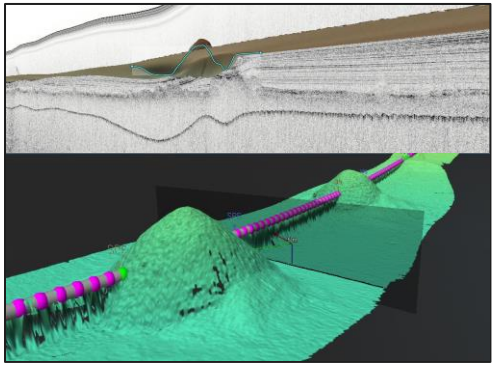
A Database Back On Deck

- MBES: DTM, backscatter, span analysis/asset integrity, events listing and anomalies
- Cathx Laser and Colour Camera: microbathymetry (e.g. defects)
- MBES, SSS, SBP: acoustic leakage detection (e.g. Water Column Data)
- TileCam: geotiff images, mosaic, GIS Raster Catalog, pseudo-video
- Environmental sensors: CTD, salinity, turbidity, CH4 sniffer
- FiGS – Field Gradient Sensor: precise non-contact CP data

All in ONE database (e.g. SSDM, PODS, APDM)







A Database Back On Deck

100 km a day, per sensor → MBES bathy, MBES backscatter, MBES water column, SSL, SSH or HISAS, SBP, CH4 sniffer, Laser, Camera, FiGS …

=

> 1000 Km a DAY of Data

Conclusions

Conclusions

- AUVs:
  - **Cheaper & faster** (7x) - reducing costs up to *70%* (market source)
  - Data **quality**, **accurate**, **consistent** and **repeatable** with solid reliability
  - **Innovative**, with advanced sensors

- Need to learn how to acquire, manage, deliver and **accept** large datasets

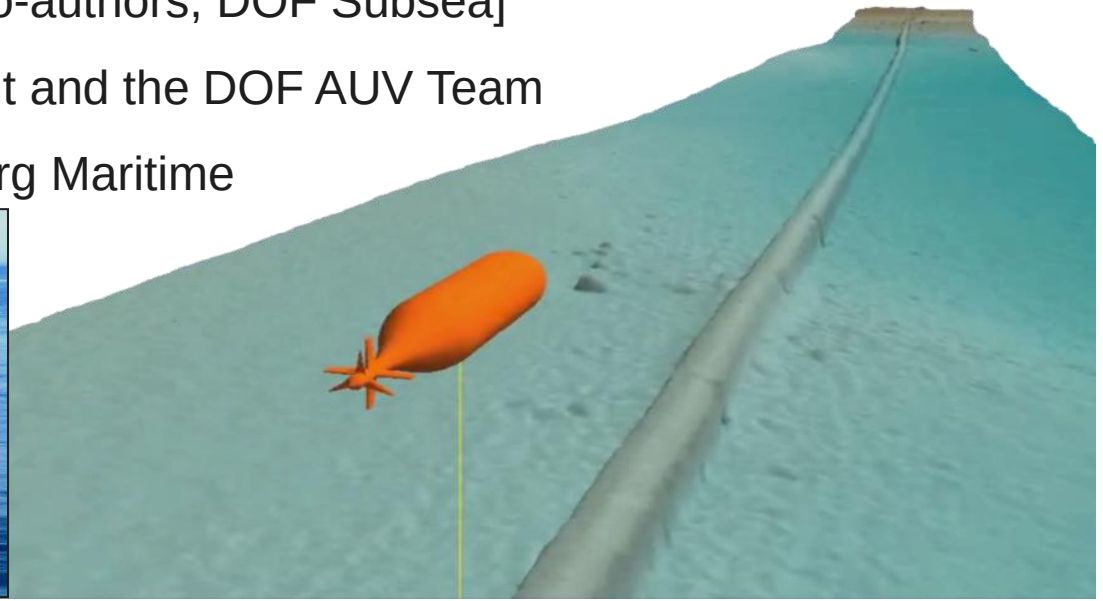
- Need to define deliverables that utilise the unique advantages of an AUV survey and **NOT** try to replace data from an ROV survey

Acknowledgements

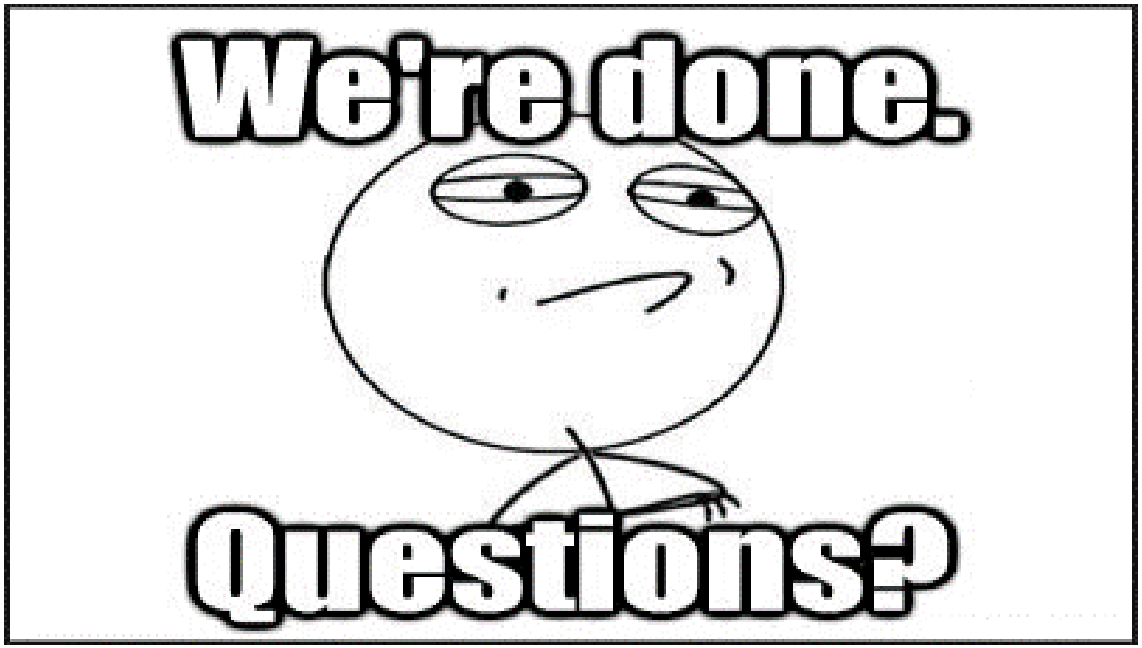
Taylor Brown and Len Rickett [co-authors, DOF Subsea]

DOF Subsea Survey Department and the DOF AUV Team

Richard Mills [KM] and Kongsberg Maritime



Questions



Thank you!

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SUT Society for Underwater Technology

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