The Littoral Challenge – A SONAR Perspective
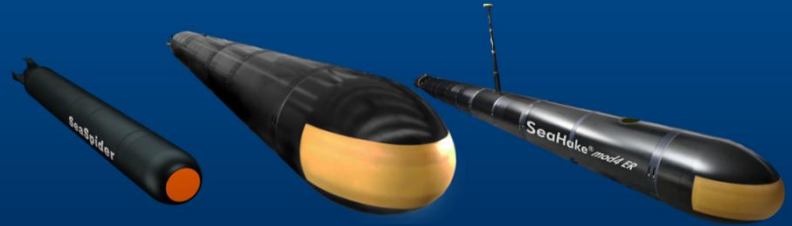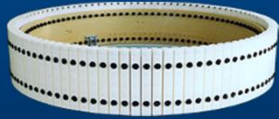
Dr. Kevin Brinkmann, ATLAS ELEKTRONIK GmbH

Littoral OpTech West, September 23rd and 24th

… a sound decision

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ATLAS ELEKTRONIK at a glance

Submarine Systems and Naval Weapons

Surface Combatant Systems

Naval Communication

Mine Warfare Systems


Maritime Security Systems

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Outline

- The Littoral Challenge

- Expanded Flank Array

- New Signal Processing Methods

- Advanced Data Management (SOTRAM)

- Forward Looking Active Sonar (FLAS)

- AUVs for Remote Sensing

- Conclusion

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The littorals are a „bad" combination of environmental conditions and operational demands
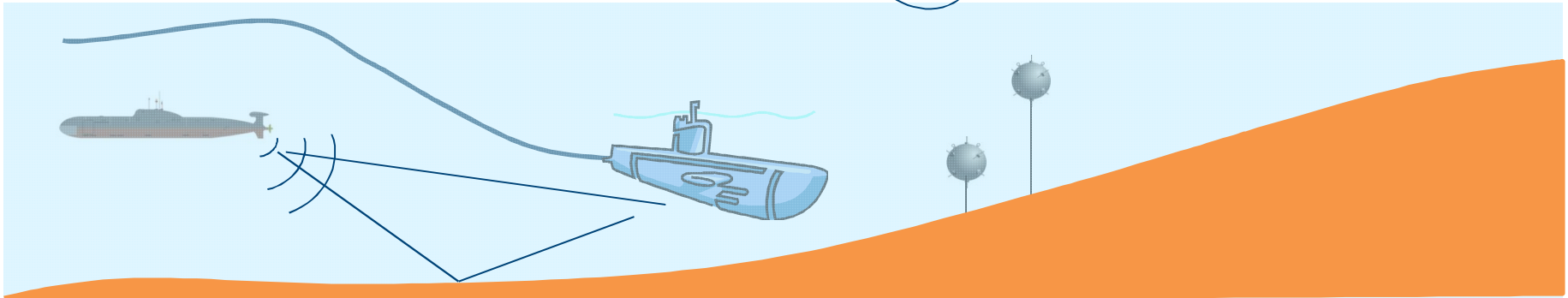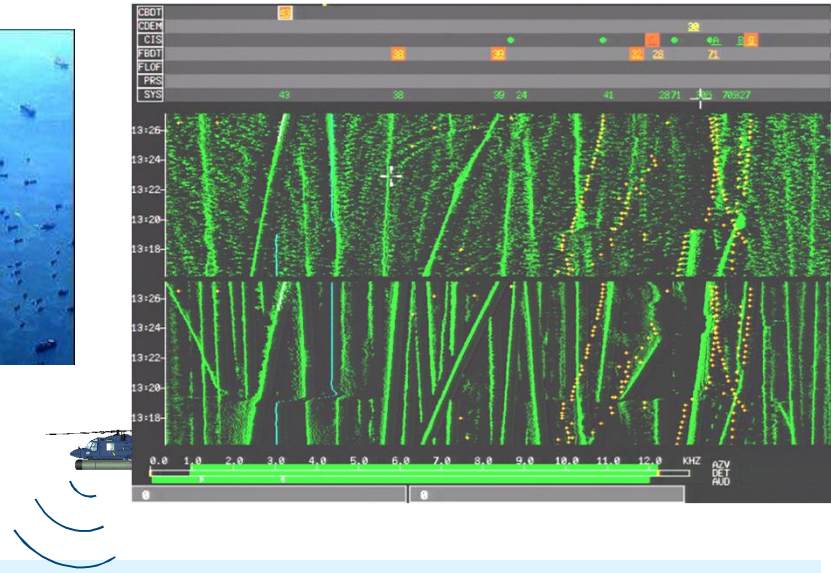
The Littoral Challenge

What are we talking about?

- shallow water depth
- difficult acoustical conditions
- high density of sonar contacts
- military platforms particularly silent
- danger of collisions with obstacles and sea floor impacts

What is required?

- improved sonar detection performance
- improved target separation
- high level of automation for target tracking
- sophisticated navigation sonar for shallow waters

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Expanded Flank Array

Features of the Expanded Flank Array Sonar (EFAS)

- Extension of the Frequency Range up to 4800 Hz
- Improved Directivity Index due to higher frequency
- Improved Target Separation Performance due to higher frequency
- Vertical extension of the dimension of the array
- Suppression of own noise by use of damping and shielding materials
- Provision of sufficient distance to the pressure hull
- Improved decoupling of the hydrophones
- Digitisation of the signals in the array
- Digital data transmission to achieve immunity against ship borne electrical interferences
- Easy integration on-board of the submarine

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Adaptive Beamforming for Passive Sonar
Improving Passive Sonar Detection Performance

Adaptive Beamforming Algorithms

- Estimation of beamformer parameters in real time from the stave data of the array ('adaptive')
- Computationally demanding compared to Delay-Sum beamformer

Features of Adaptive Beamforming

- High target separation capabilities due to very low side lobe levels
- Capability to detect very weak targets
- Cylindrical Array
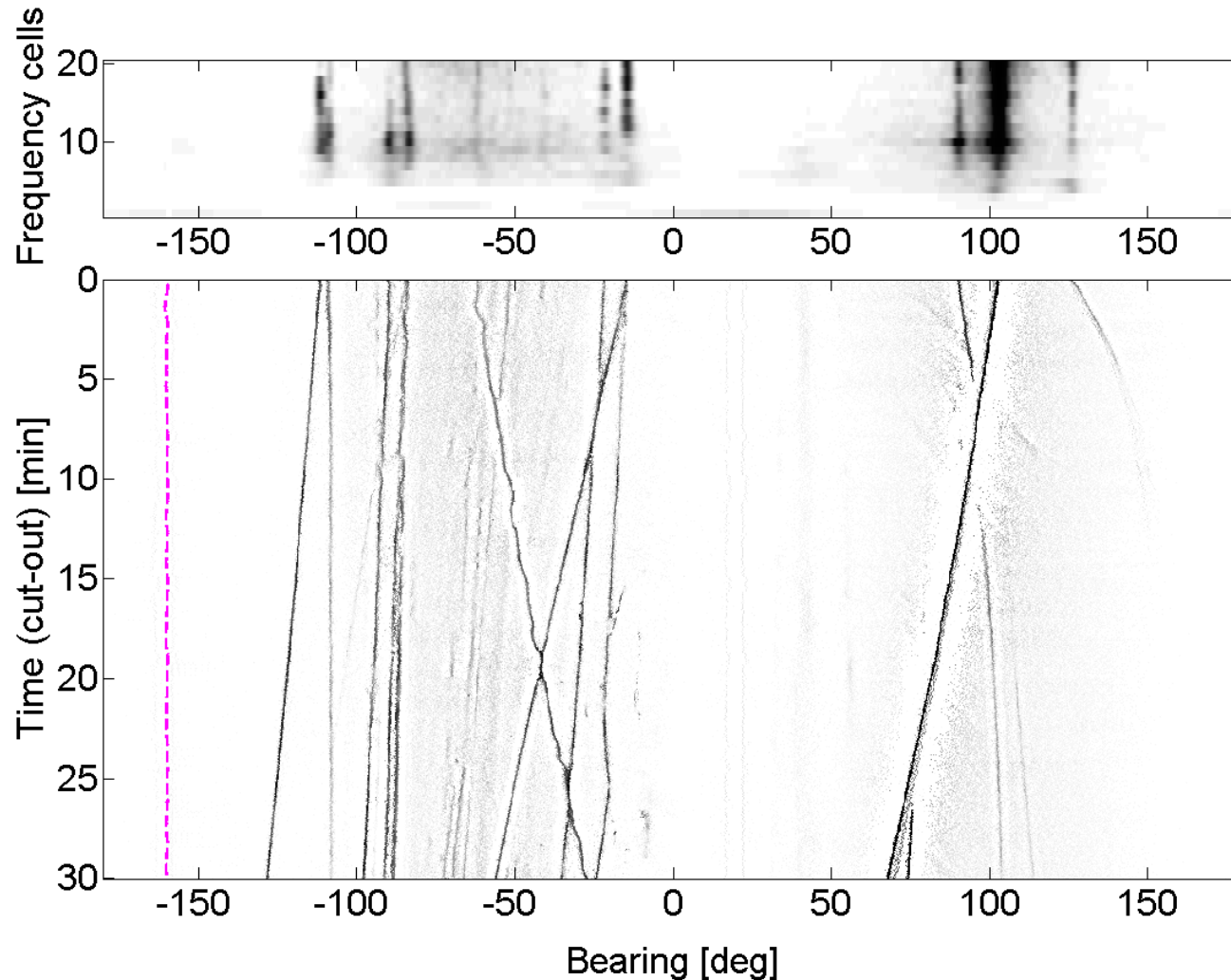- Expanded Flank Array, Flank Array
- Towed Array

Comparsion DSBF – ABF: Sea Data FAS
DSBF BDT 1
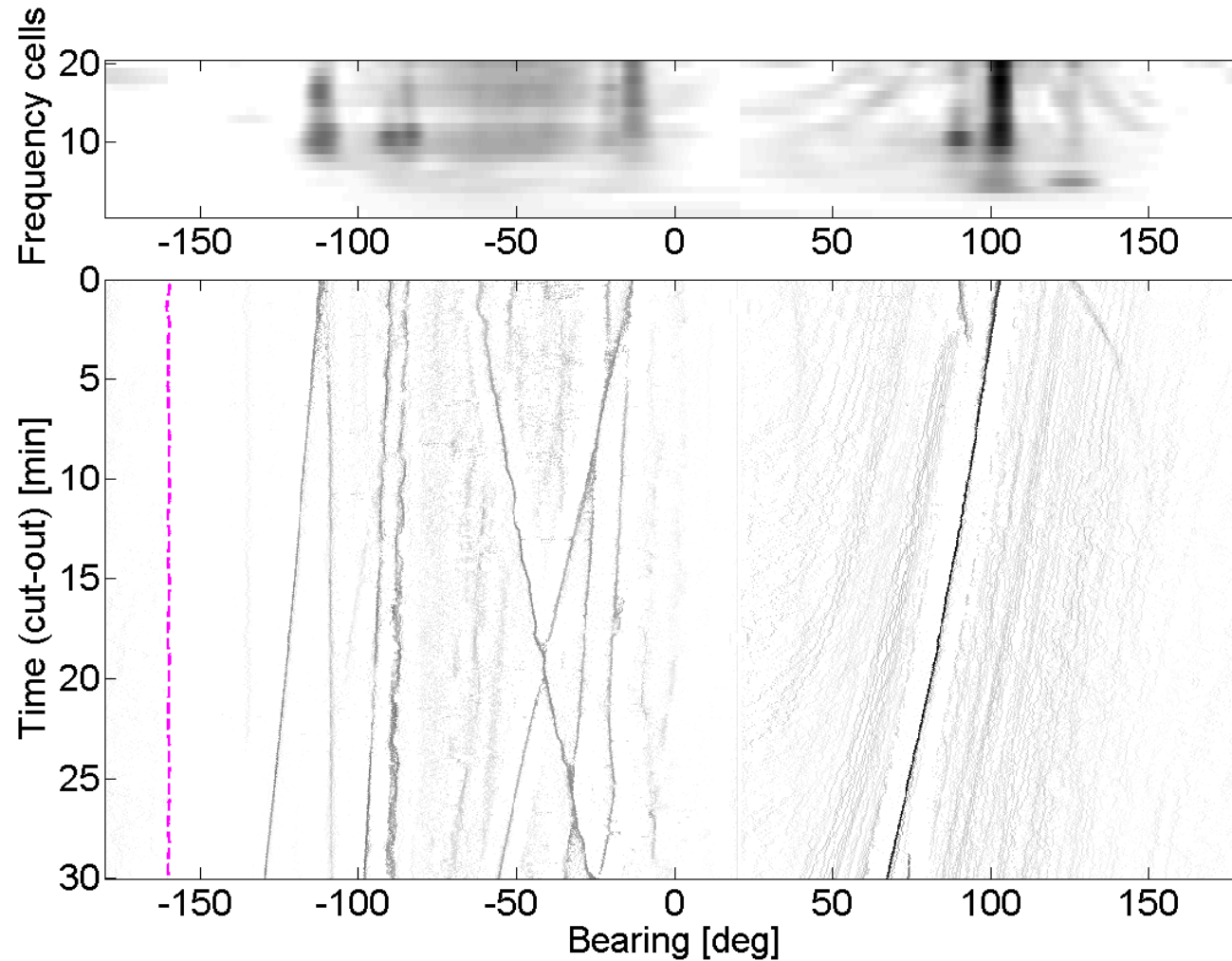
Comparsion DSBF – ABF: Sea Data FAS 2
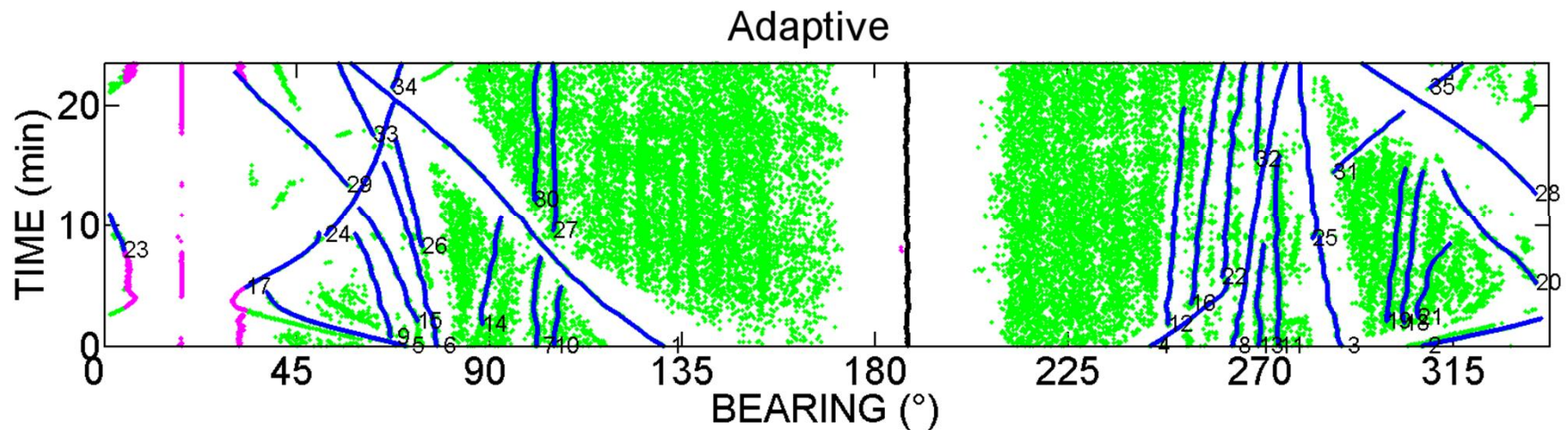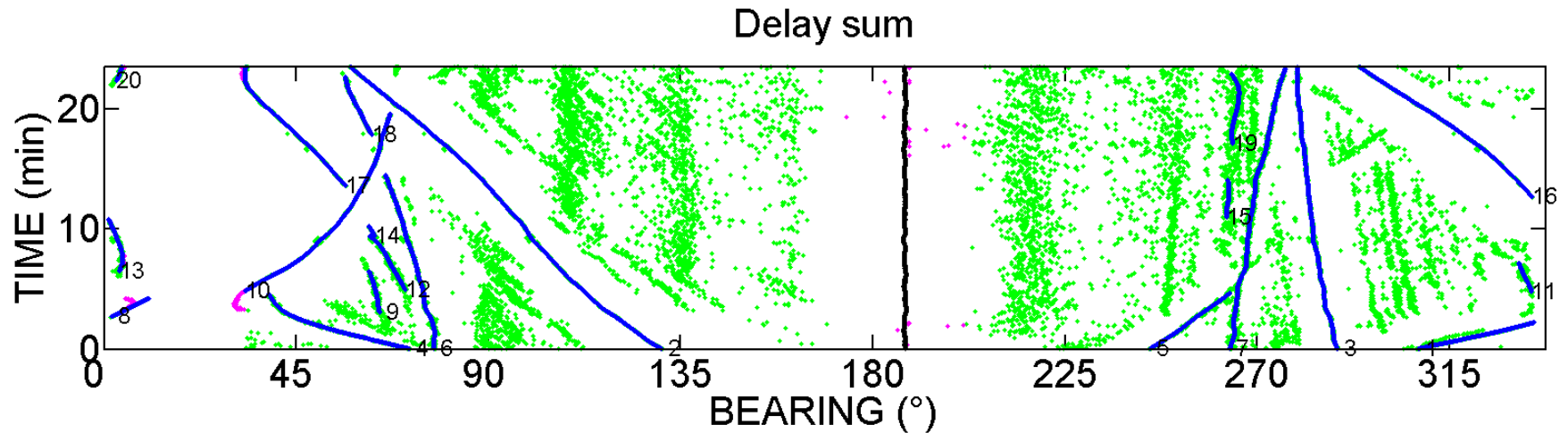# ABF BDT 1

Automatic Tracking and Track Data Fusion

Automatically Initiated Tracks (AIT)

- Aim: track all detected sonar contacts
- State-of-the-art Multi-Hypothesis Tracking algorithms
- Automatically initiated

Sonar Track Manager (SOTRAM)

- Automatic track data correlation and fusion of all Passive Sonar sensors
- Exploit all redundant / complementary track information (target crossings, bad sector)
- Aim: ONE TARGET = ONE TRACK
- Display and Operation of the fused tracks are performed in a new detection display: Target Evaluation Display
- Man-in-the-loop concept retains the operator's autonomy

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AIT: Multi-Hypothesis Tracking on Sea Data

Sonar Track Manager (SOTRAM)

Sonar Sensors

Tracker

Track Data

Data Fusion and Track Management

Human Machine Interface

Cylindrical Array
- Broadband Detection
- Narrowband Detection
- Intercept Detection

Expanded Flank Array
- Broadband Detection
- Narrowband Detection
- Intercept Detection

Aft Sector Array
- Broadband Detection
- Narrowband Detection
- Intercept Detection

Intercept Arrays
- Intercept Detection

Automatic Target Tracking (×10)

Data Association and Fusion

Track Management

Target Evaluation

Target Motion Analysis

Multi Hypothethis Tracking (MHT) for each acoustic sensor

TEV displays for representing consolidated information

Automatic fusion of acoustic/non-acoustic track data by ITB

Automatic Tracking and Track Data Fusion
ISUS Next Generation Testbed

We invite you to come to Bremen to see our SOTRAM Demonstrator implementation at our ISUS Next Generation Testbed.

ATLAS ELEKTRONIK
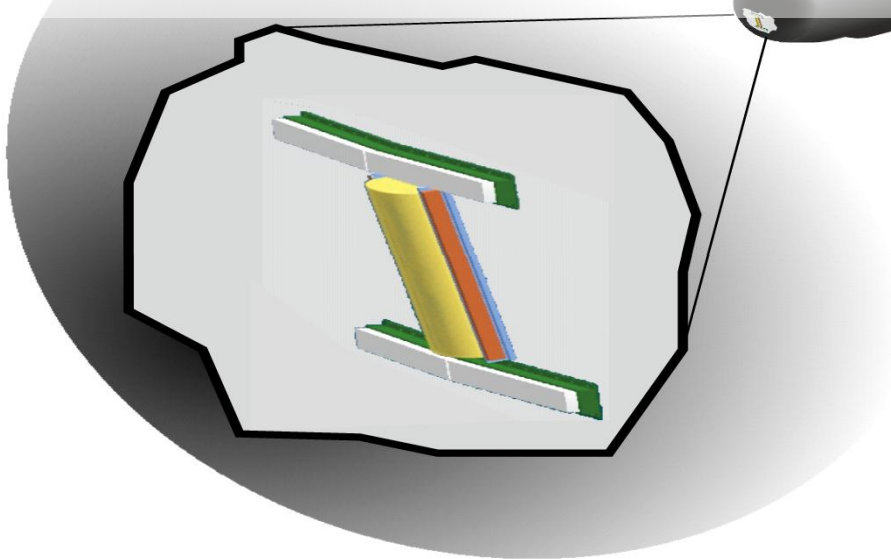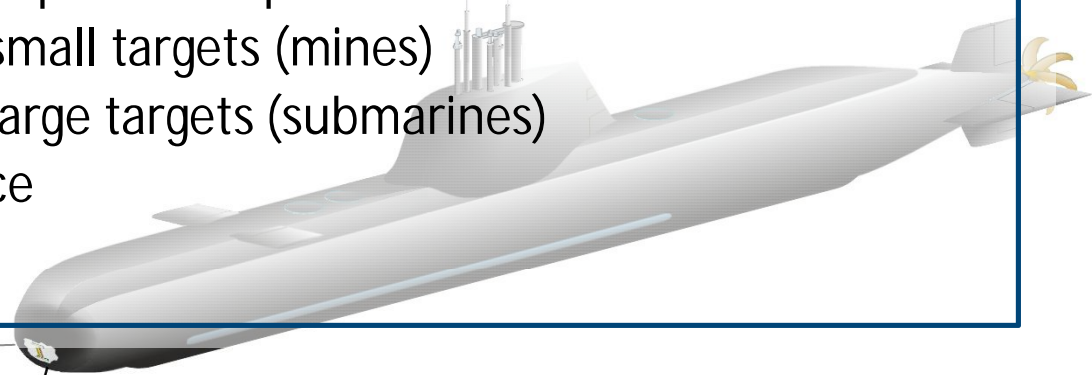A joint company of ThyssenKrupp and Airbus DS

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Forward Looking Active Sonar (FLAS)

Transmission Concept

- Application of single frequency / high bandwidth concept
- Centre frequency of 50 kHz represents optimum balance between
  - Detection ranges against small targets (mines)
  - Detection ranges against large targets (submarines)
- Forward looking performance
- Low probability of intercept

FLAS: Mine Avoidance Sonar (MAS) Mode

Applicable for detection of

- floating mines
- moored mines
- obstacles
- small submarines

Additional Features

- Depth classification
- Automatic tracking
- Automatic alarm
- Automatic collision avoidance course proposals
- Horizontal detection sector: 120°
- Vertical detection sector: 60°

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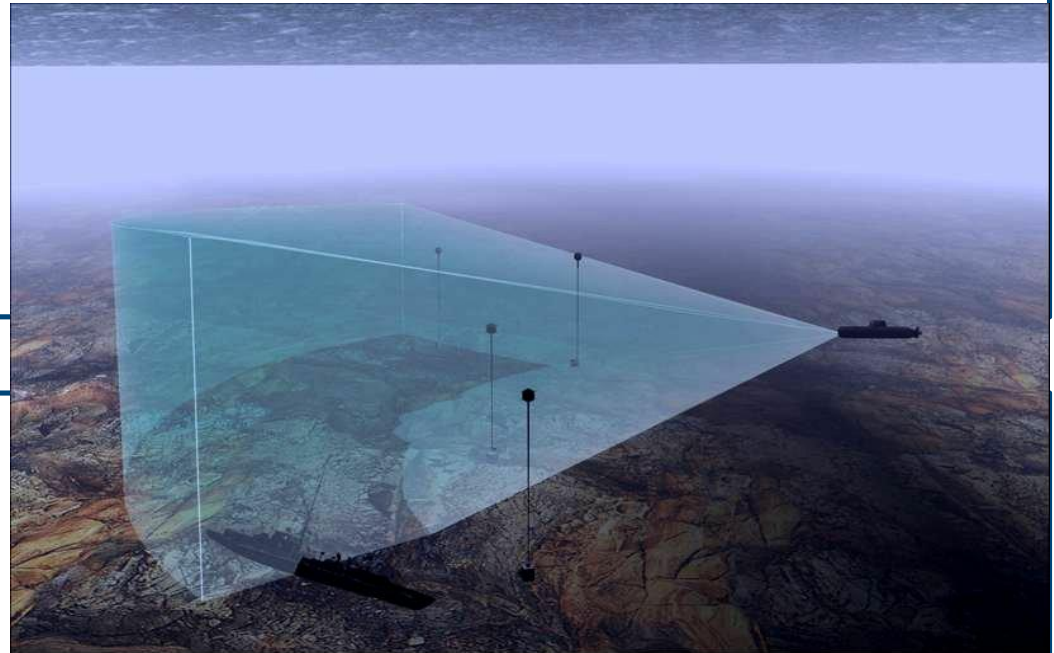
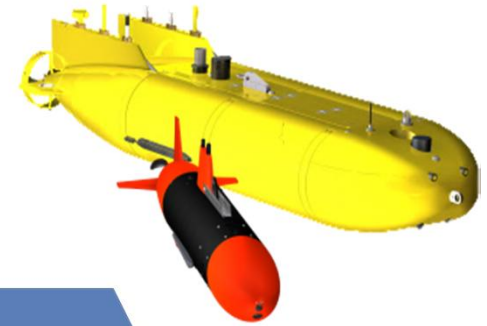# FLAS: Forward Looking Sonar (FLS) Mode

Features

- generates visual representation of sea bottom profile in forward direction
- applicable as a navigation aid
- Horizontal detection sector: 120°
- Vertical detection sector: 60°
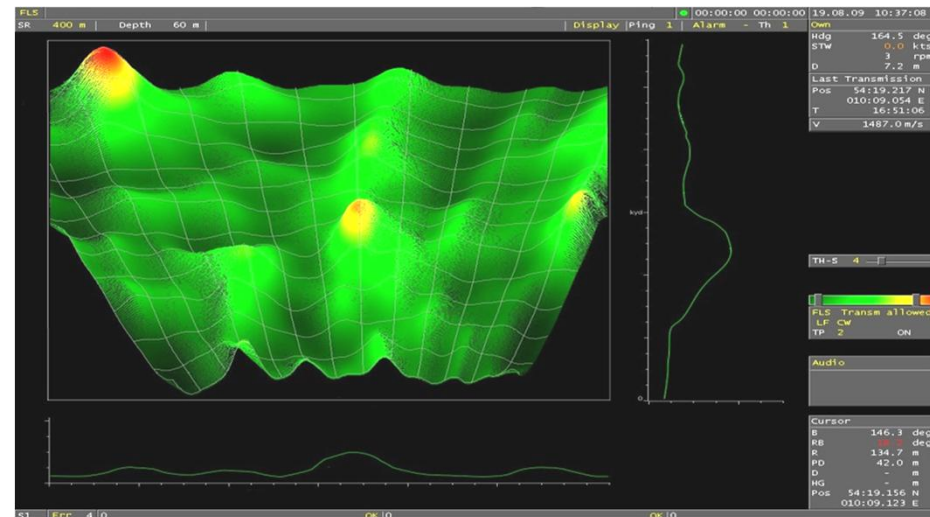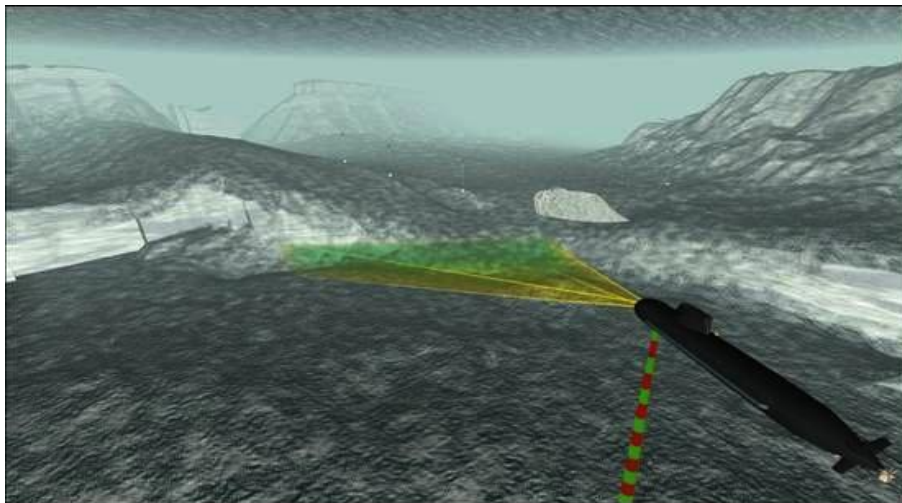
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Operation of AUVs from Submarines

AUV Mission planning and evaluation

Onboard control of AUV communication link

Processing and storage of AUV sensor data, e.g. 3D bottom profiles

SeaCat launch and recovery via torpedo tube

AUV Launch and recovery control

SeaOtter MkII launch and recovery via docking station

Conclusion

The ISUS solution

- Improved Sonar sensor performance for complex littoral waters
- Concise real-time Tactical Picture for effective command decisions
- Full sensor to shooter capability
- Minimum operator workload and maximum performance
- Individually customized open architecture systems

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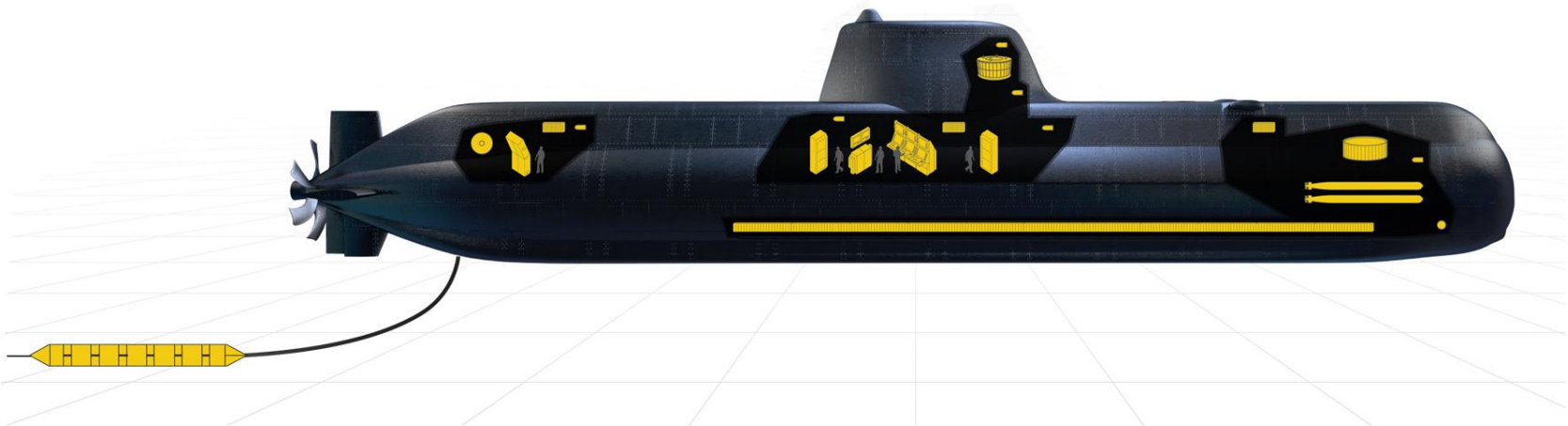
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