



Introduction TNO Under Water Warfare (UWW) “the Wonderful World Underwater”





Contents

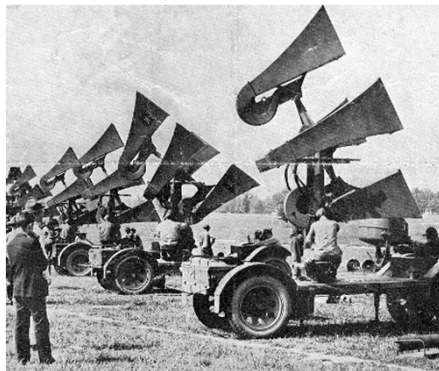
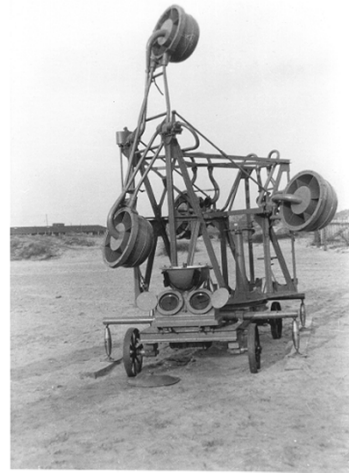
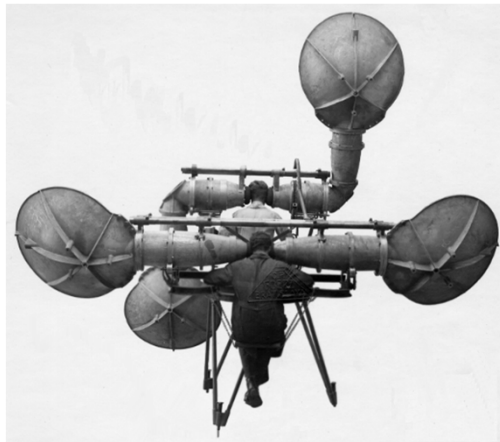
- › TNO Organisation
- › Overview UWW research programmes and results
- › Example products and applications
- › The basin



TNO Organisation

- › TNO was founded by law in 1932
- › Defence Physics Lab established by Ministry of War in 1927 in The Hague, later merged with TNO
- › TNO is independent of public & private interests
- › Development and application of innovative knowledge

- › Clients: Government, Companies and Public organisations
- › 3511 employees
- › Total Turnover 563,8 M€ (2010)
- › 369,0 M€ Market turnover (2/3 domestic, 1/3 foreign)
- › 194,8 M€ Government funding



Example of early work: experimental listening device for the acoustic detection of aircraft, developed by Groot and van Soest in 1929. The device was developed after testing other available devices from that period, and had better bearing resolution because the sound could reach the ear of the operator undistorted.

Source: <http://www.museumwaalsdorp.nl/en/airacous.html>



Themes and innovation areas





Defence, Safety and Security theme

Innovation area

- › Defence research

Business line

- › Cost-effective operations
- › Information superiority
- › Force protection
- › Human effectiveness

Innovation area

- › Safety and security research

Business line

- › National and urban safety and security
- › Effective safety and security operations



Military Information Superiority - MIST

- › **At a time of widespread reduction in available manpower, the need for and availability of information are increasing exponentially.**

- › Based on our technological expertise and knowledge about the defence domain, TNO is able and has the ambition to support defence forces in four core areas:
 - › EM Sensors
 - › EM spectrum control - EMSC
 - › Situational Awareness – Information and Intelligence
 - › Underwater Warfare - UWW



Information Superiority

Four “primary” subjects – tracks

- › EMSC – EM Spectrum Control
Yolanda Rieter-Barrell – Stefan Vossen

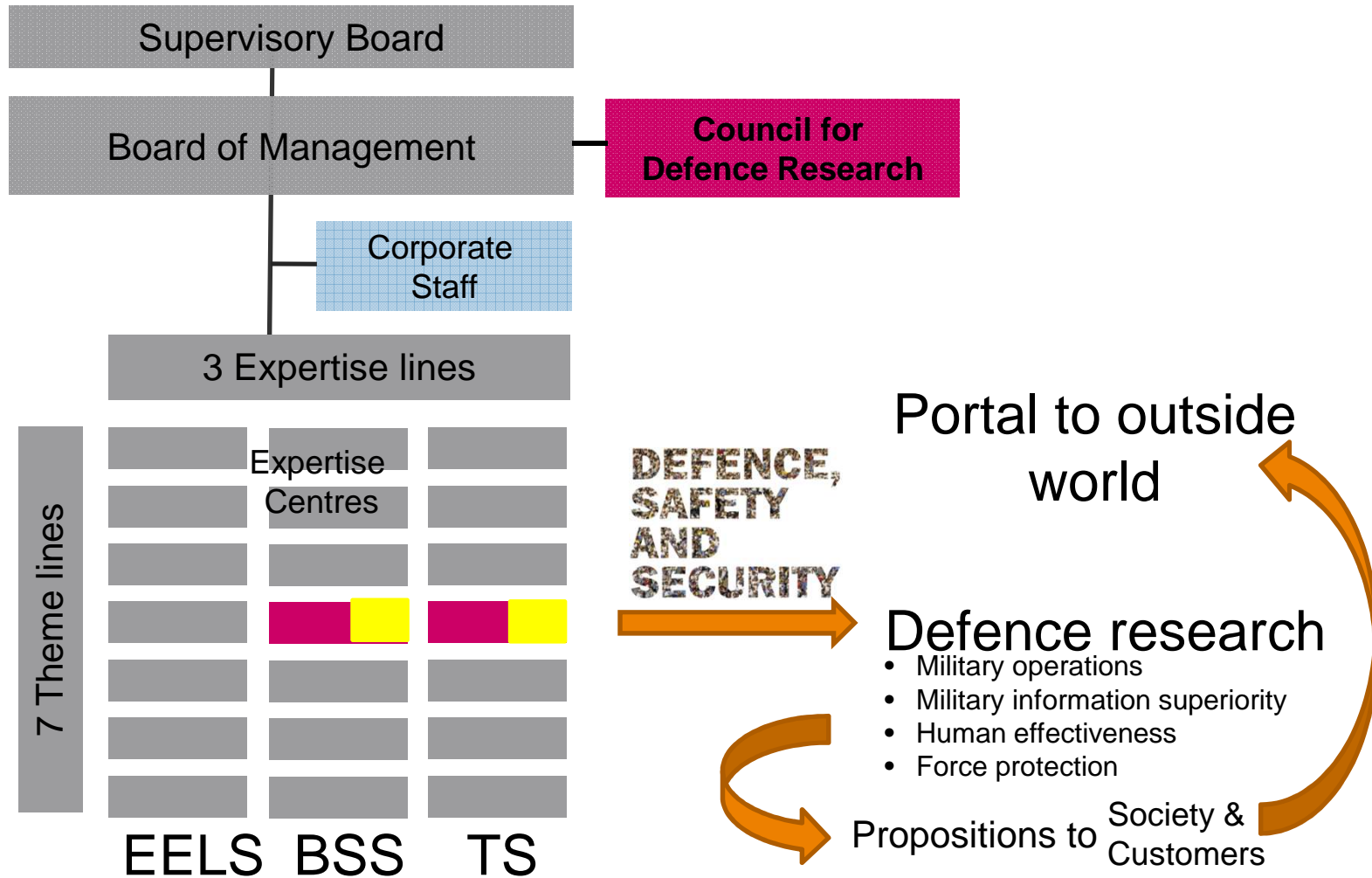
- › SA&I2 – Situation Awareness – Information - Intelligence
Jasper Lindenberg – Arthur Smith

- › EMSensSys – EM Sensor Systems
Frank van de Bogaard – Ronald van Waard

- › UWW - Underwater Warfare
Guus Beckers – Ton van Koersel



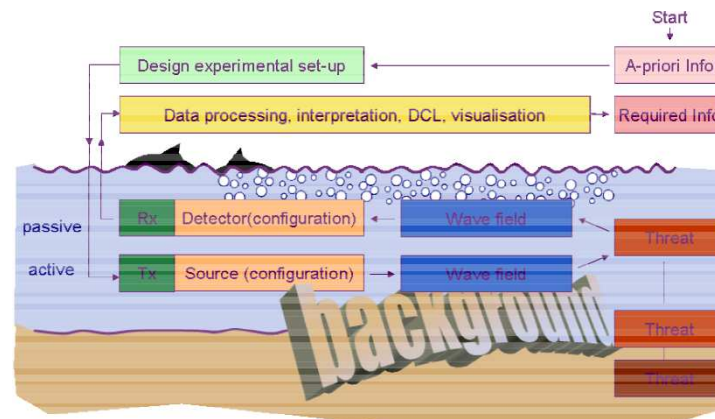
TNO Strategic partner for NL MOD





Sonar expertise at TNO

- › To design, realize and test passive and/or active sonar systems for application in anti-submarine warfare, mine counter measures and torpedo defense
- › To be a supplier of innovative underwater technology systems in cooperation with international industrial partners.
- › To be a trusted partner of the Royal Netherlands Navy and offer them consultancy services in their role as smart specifier, smart buyer and smart user of underwater technology.
- › We concentrate on the following three sub-technologies or areas of expertise:
 - › underwater systems
 - › underwater environment
 - › underwater threats.



Each sonar system consists of (many of) the building blocks shown. Our research typically focuses on the contents of these blocks, including the environmental effects



Sonar expertise at TNO

“We know how to detect, classify and localize underwater threats like mines, torpedoes and submarines in the dynamic underwater environment, and how to realize complete systems together with international partners”

- › Staff description in keywords:
- › Large technological expertise
- › Excellent relation with RNLN
- › International recognition
- › Expertise working at sea
- › Currently 37 employees
- › Large number of PhD's (18)

Source: Know-How Base Description (Blacquiere)



TNO magazine interviewed two project leaders at the NL MOD in 2007.



Current UWW research programmes & projects

DR&D

- › V931 Environment and underwater RMP (the effect of the complex underwater environment on sonar system performance)
- › V932 Underwater systems and threat (research on underwater sensor-processing and weapon systems for own units, threats and unmanned systems)
- › V1026 Environmental effects of sonar systems
- › V1206 MCM operations with AUV's
- › V1210 Coordinated deployment of underwater sensors

Contracts

- › Contracts for MOD-NL, EDA and Industry: EDA RACUN (UWCOMMS), MAPS, MANTA, EDA Siramis, FATA, SAKAMATA, MUD, APPROXA, MSPOT, PRIMA



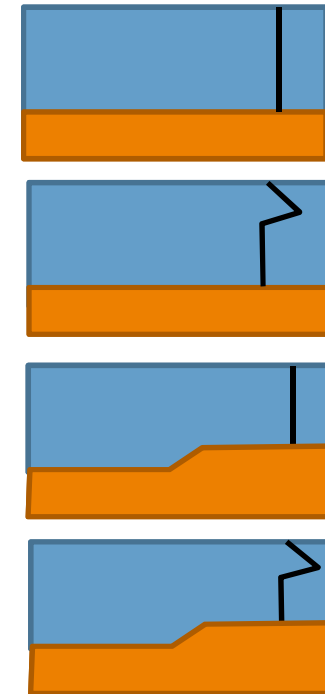
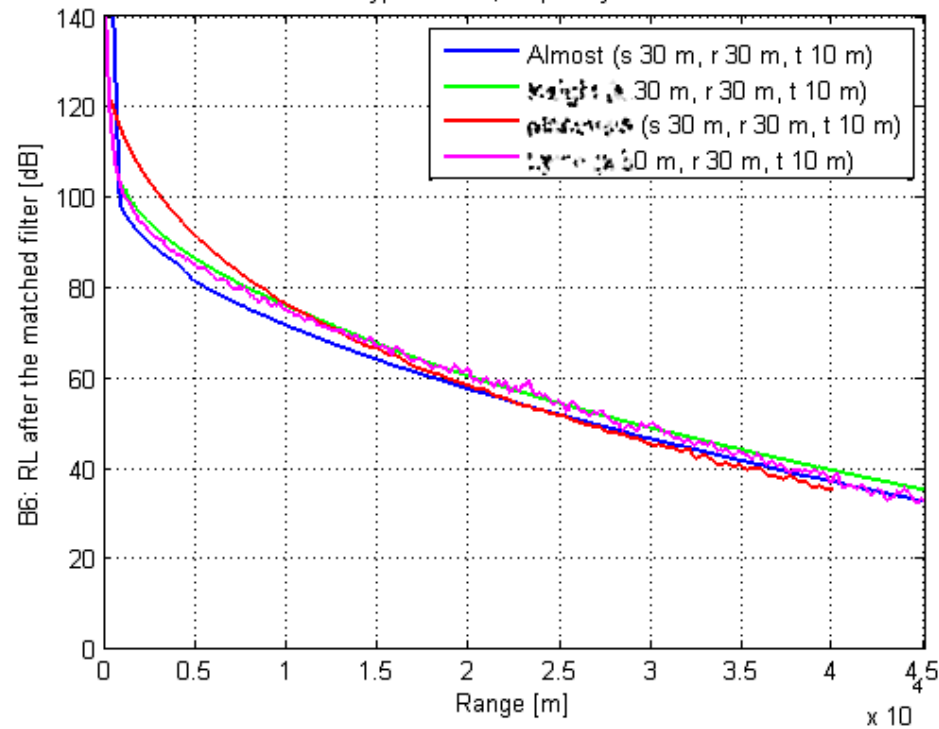
V931 Environment and underwater picture compilation

- › Military oceanography; oceanographic modelling and integration with acoustics
- › Acoustic environment, range dependent acoustic propagation, sea surface and bubble influence, automatic bottom classification
- › Sensor innovations and advanced processing; Technology watch on sensors for autonomous systems, automatic target recognition and high-resolution SAS, Detection of buried mines
- › Environmental effects of sonar (regulations)



International collaboration to define benchmarks and compare different models

B6: RL after the matched filter - problem I, subcase 0
Pulse type = GSP, frequency = 3500 Hz





V932 Underwater systems and threat

Research on underwater sensor- processing and weapon systems for own units, threats and unmanned systems

- › Future ASW sensors
- › Torpedo DCL
- › Wideband techniques
- › Trials



Hr.Ms. Van Amstel test prototype sonarsysteem

WILLEMSTAD Hr.Ms. Van Amstel heeft vorige week nabij Curaçao een geslaagde Torpedo Firing Exercise uitgevoerd met een prototype van een nieuw sonarsysteem.

Doel van de oefening was het beproeven van een nieuwe torpedodetectie aan boord van de Van Amstel. Het fregat sater het prototype laagfrequent actieve sonarsysteem (SLFAS) in. Ook diende de oefening om de prestaties van de exercitietorpedo's te evalueren en de eigen bovenzichtoparobemannings getraind te houden in het lanceren van torpedo's.

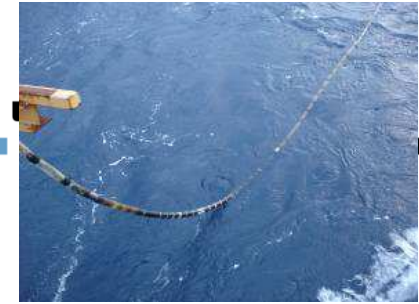
Van Amstel diende in de test als doel-schip. De Lynx bovenzichtoparobemannings vijf MKGII exercitietorpedo's in verschil-

lende inzetmoden af op het fregat. Het sonarsysteem opereerde hierbij tegelijkertijd in actieve en in passieve status om zo de torpedo te detecteren en te volgen. Gedurende iedere test was de Van Amstel met haar sonarsysteem in staat om op ruime afstand van het schip de torpedo te detecteren en continue te volgen. Deze door TNO-onwikkelde sonarsysteem zal vanaf 2013 worden toegepast aan boord van de M-fregatten. Het hulp-schip Hr.Ms. Pelikaan ondersteunde bij het opklaren van de torpedo's.

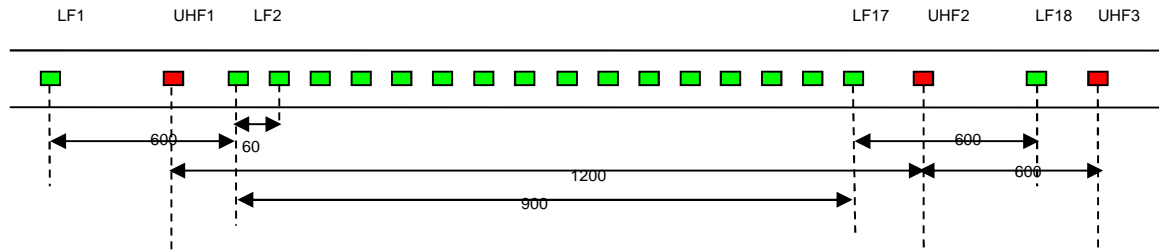


V1026 Environmental effects of sonar systems

- › Develop acoustic detection, classification and localisation
- › Effect of sonar on eco systems (by contribution to controlled exposure experiments with FFI, SMRU and WHOI)
- › Analysis of results and reporting
- › Advice for implementation in SAKAMATA



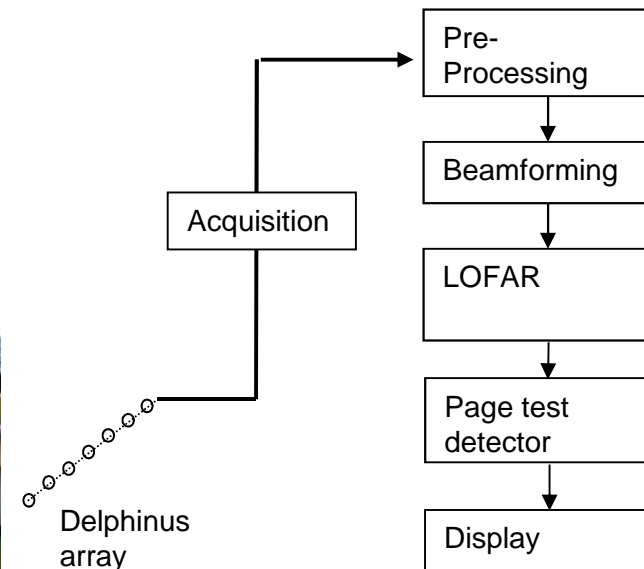
PAM & DCL – The Delphinus system



Delphinus Wet end

- › 700 m tow cable
- › Delphinus Processing:
- › Pre-processing and beamforming,
- › Real-time automatic transient detection,
- › Localisation
- › Audio and spectral analysis

Operation depth: 30 - 200m





The 3S trials



3S goes triple!

3S-2009

- Sea mammals
- Sonar
- Safety





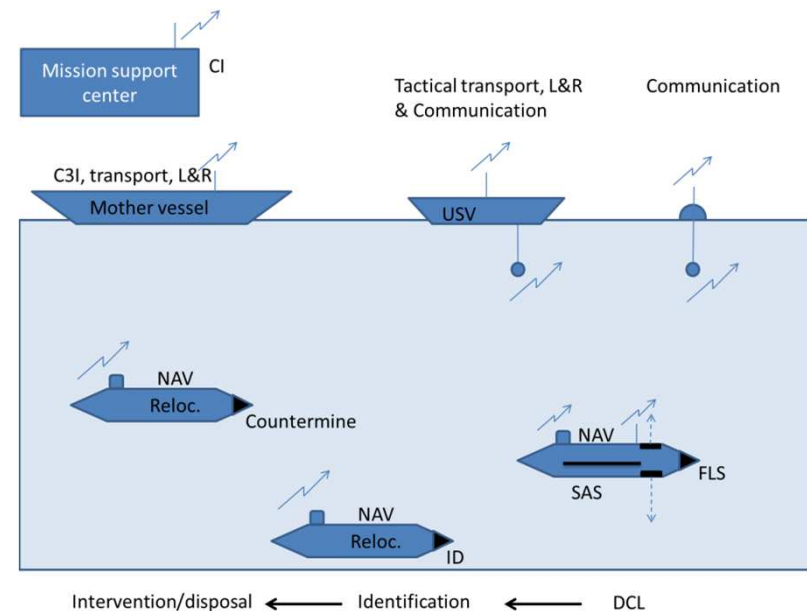
V1210 Coordinated deployment of underwater sensors

- › Development of an Acoustic Support Roadmap
- › Architectural design of future Multi-Use Acoustic Support Suite
- › A Priori planning of underwater operations
- › In Situ planning of underwater operations
- › International collaboration



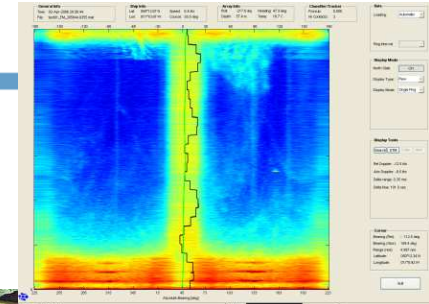
V1206 MCM operations with AUV's

- › Autonomous object assessment (DCL)
- › Environment assessment
- › Navigation and obstacle avoidance
- › Situational awareness and autonomy
- › System design and evaluation

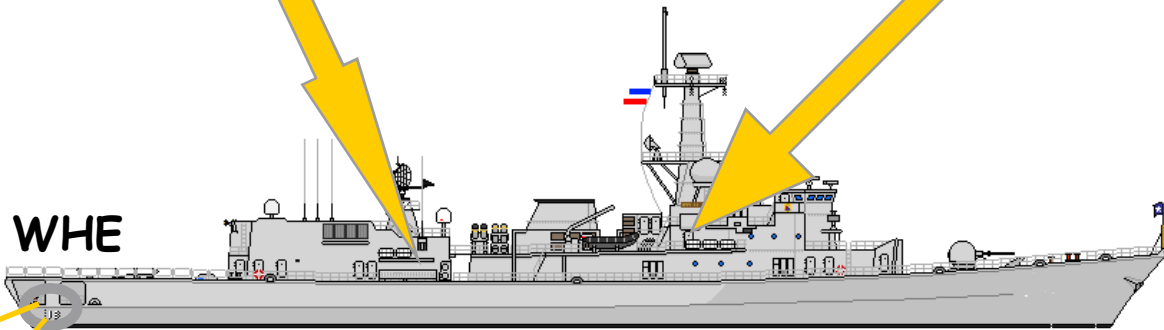
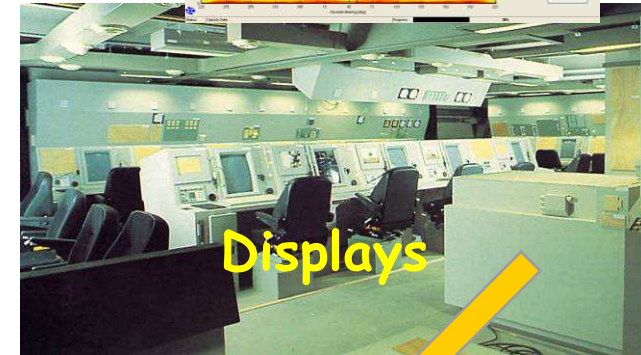




IRLFAS Technology Demonstrator

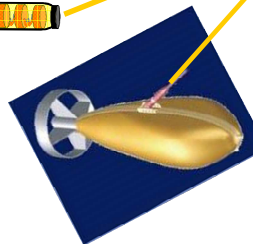
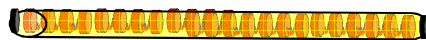


16 foot
Container



M-Frigate

IRLFAS-array



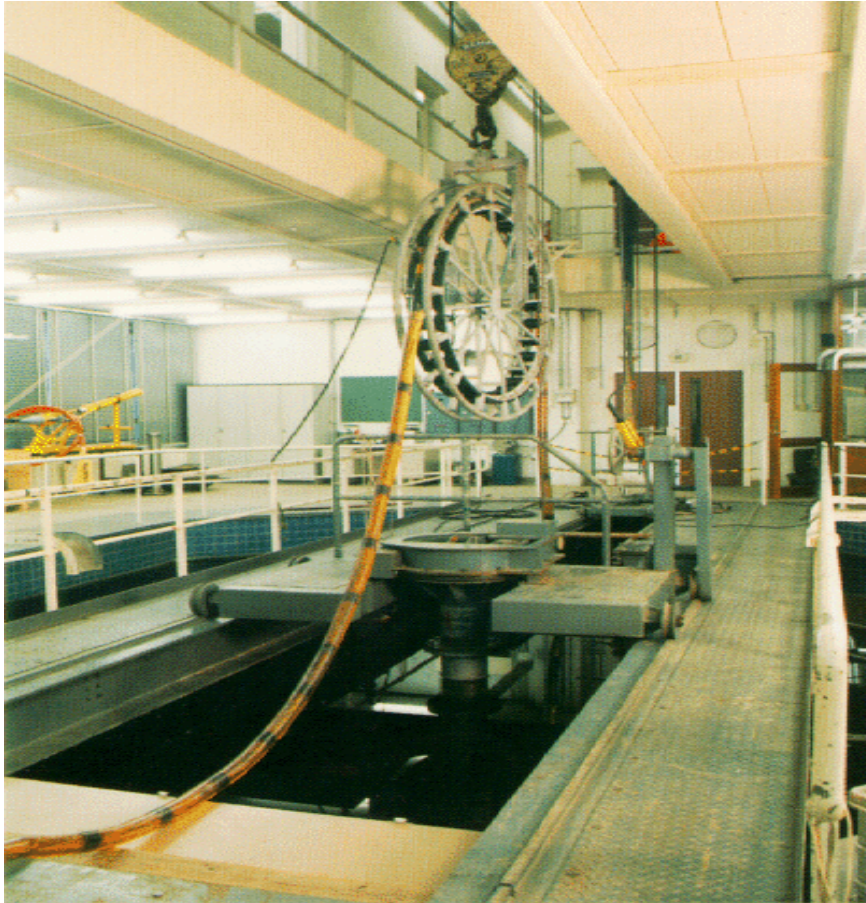
SOCRATES2



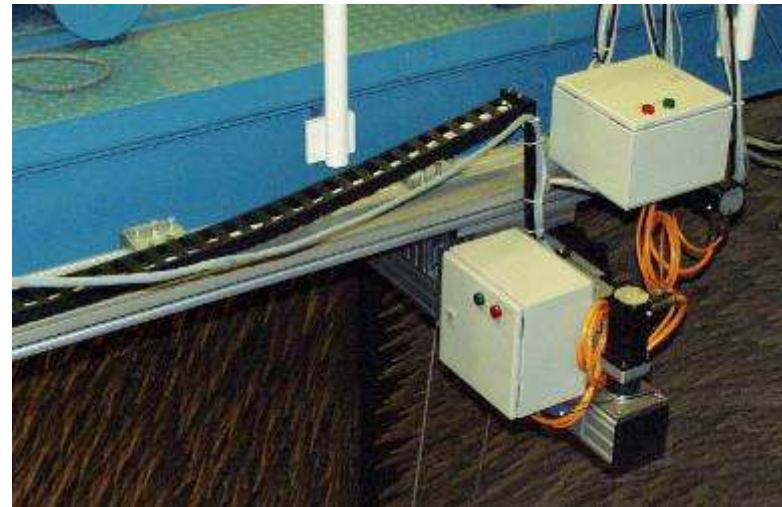


Anechoic basin

Signatures, near field measurements



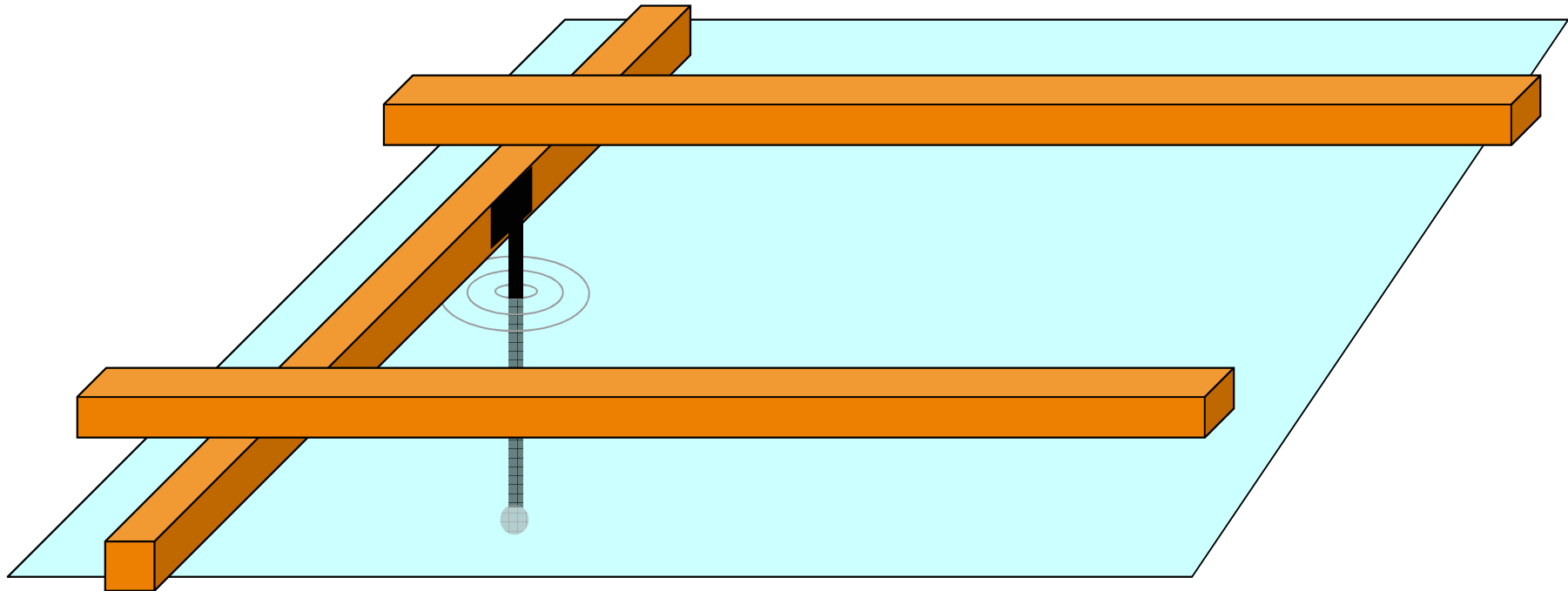
- › Basin: 8x10x8 m
- › Turntable for measurement of directivity pattern
- › Scanframe: 6x4 m, 0.1 mm





Anechoic basin scanframe

- › Scansurface 6 m x 4 m
- › Precision positioning 0.1 mm
- › Scale model measurements
- › Near field measurements (acoustic imaging/holography)



Questions ??

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