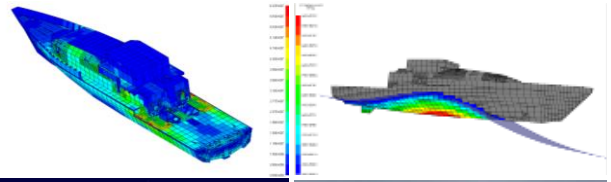
Maritime Division
DSTO

A/Chief – Kevin Gaylor

Maritime Division S&T Capability areas

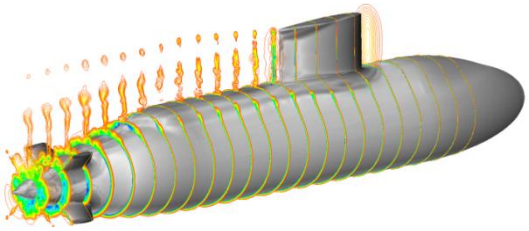


Naval Architecture

Acoustic Signature Management

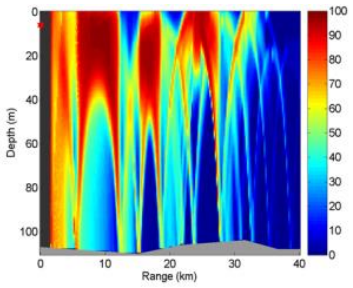
Non-acoustic Signature Management

Platform Survivability

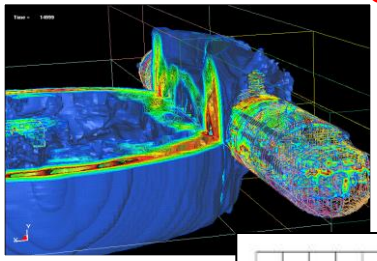


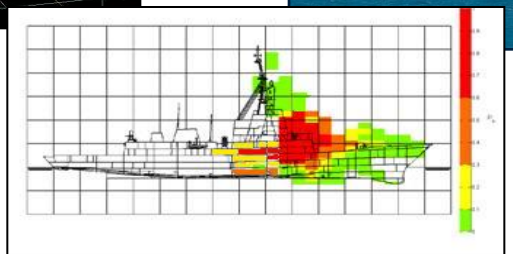
Maritime Autonomy

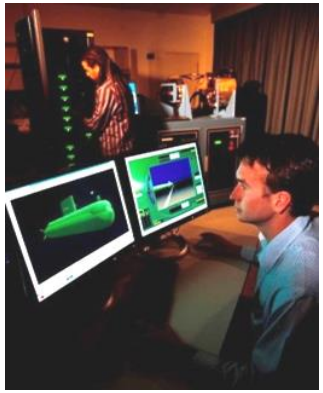
Undersea Command and Control

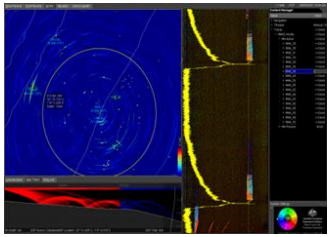


Sonar Technology and Systems









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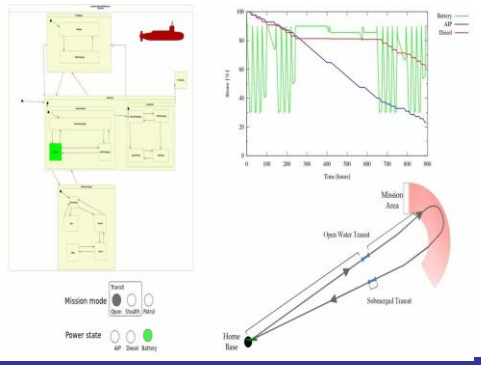
Maritime Division MSTC: NAVAL ARCHITECTURE

Platform System Analysis



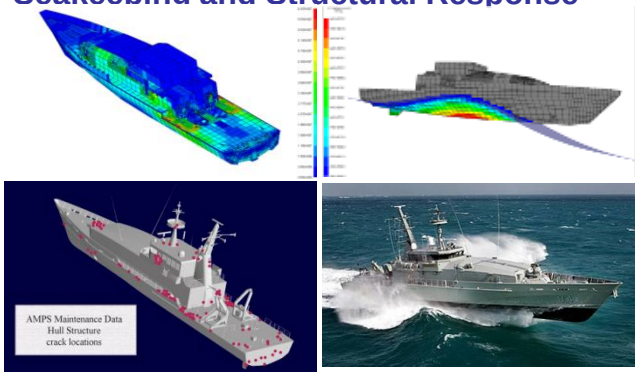
Research Leader

Dr Stuart Cannon

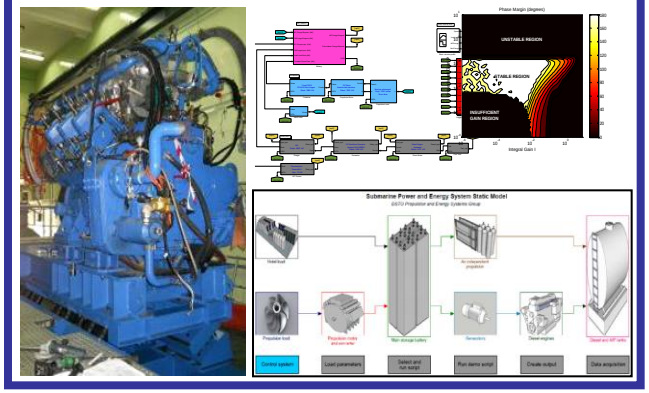
Aims:

To ensure the RAN have platforms that are safe, efficient and sustainable for their desired operational envelope

Seakeeping and Structural Response



Power and Energy Systems



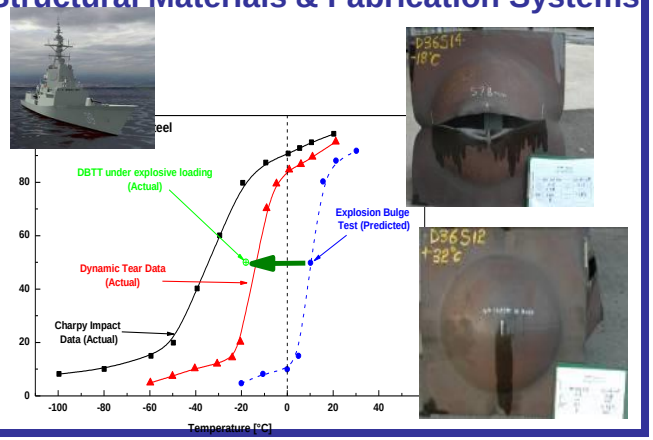
Successes

HMAS Choules transformer investigation and analysis.

Selection of D Grade Steel for AWD

Improved structural reliability for the Armidale class Patrol Boats

Structural Materials & Fabrication Systems



Partnerships And Outreach:

Universities
Australian Maritime College
University of Melbourne
University of Wollongong
DMTC

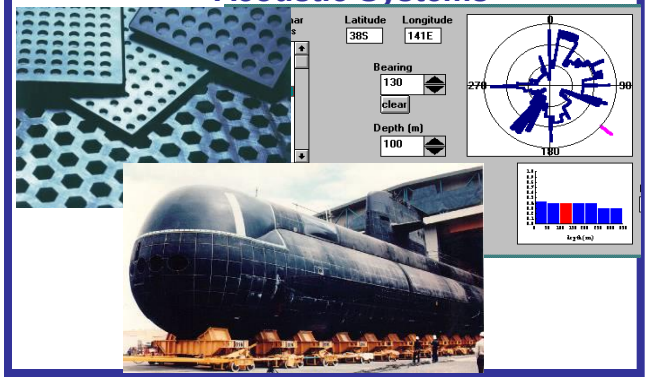
Industry
Defence Maritime Services
Qinetiq / GRC
Bluescope Steel
ASC

International
TTCP MAT & MAR
MARIN (Holland)
ABCANZ

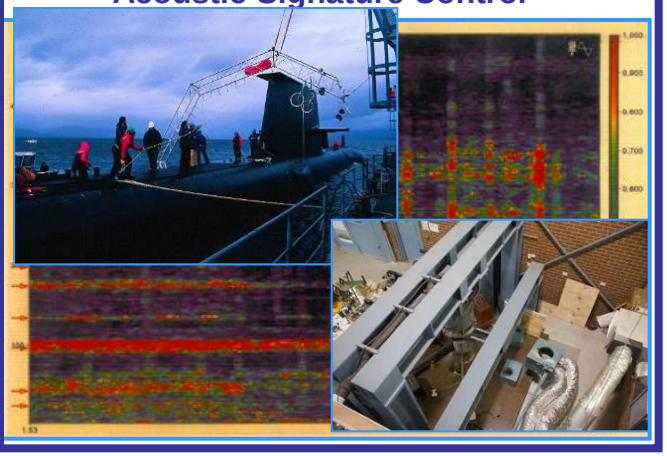
DSTO

Maritime Division MSTC: ACOUSTIC SIGNATURE MANAGEMENT

Acoustic Systems



Acoustic Signature Control



Research Leader

Dr Chris Norwood

Aims:

To control and manage the acoustic signature of RAN platforms providing increased operational effectiveness and improved survivability.

Successes

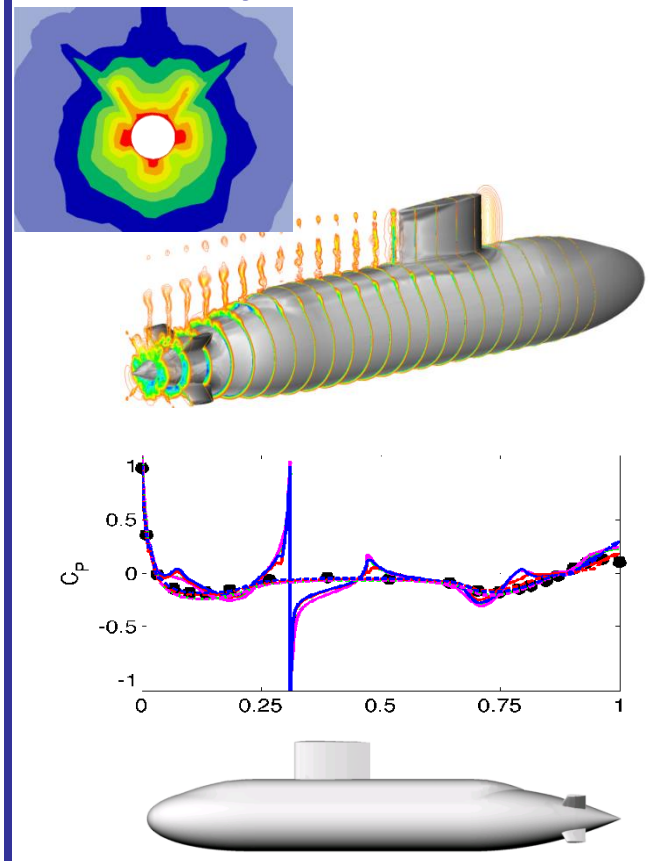
Anechoic tiles for Collins class submarine

Collins class noise reduction program

FFG 7 rudder noise treatment

Acoustic signature monitoring system for Collins class

Hydroacoustics



Partnerships And Outreach:

Universities
University of New South Wales
Australian Maritime College
Adelaide University
University of Melbourne
UWA

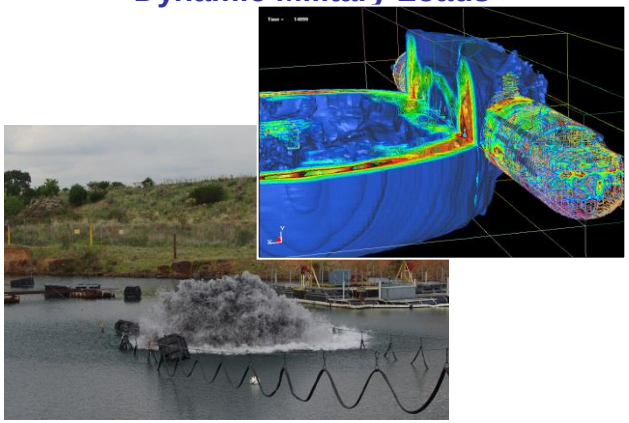
Industry
Fraser Nash
ASC
McKay Rubber
QinetiQ

International
TTCP MAR
MARIN (Holland)
NSWC (USA)
DE&S (UK)
FOI (Sweden)

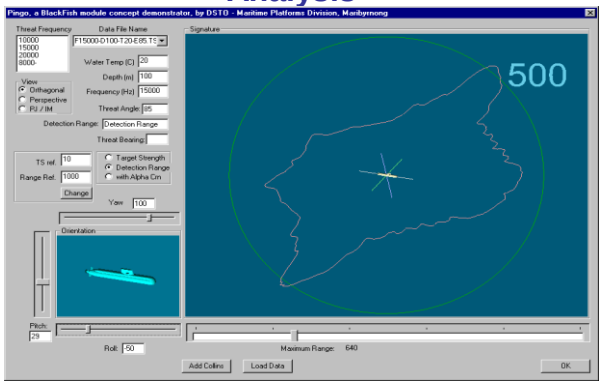
DSTO

Maritime Division MSTC: PLATFORM SURVIVABILITY

Dynamic Military Loads



Susceptibility and Signature Threat Analysis



Research Leader

Chris Gillard (Acting)

Aims:

To ensure the operational survivability and capability of RAN platforms.

Successes

Collins class hull valve

Collins class shock trial

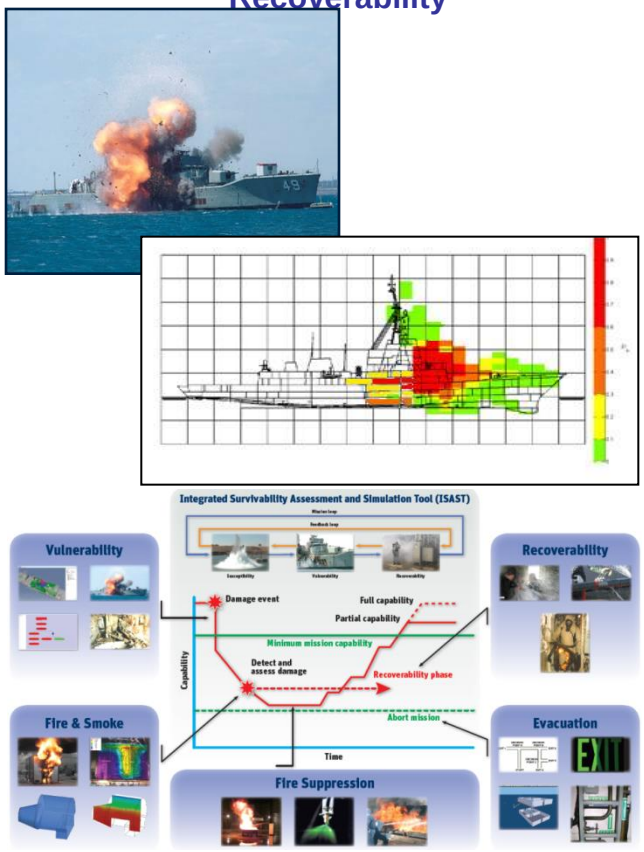
MHC shock testing

Warramunga crew fatigue study

AWD fire modelling and fire protection

JASSM vulnerability modelling and missile damage prediction

Vulnerability, Damage Control and Recoverability



Partnerships And Outreach:

Universities
Australian Maritime College
Victoria University
RMIT University
University of Greenwich

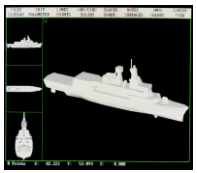
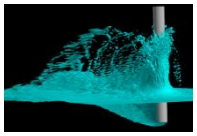
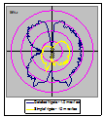
Industry
Widelinger UK
ASC
L3
QinetiQ

International
TTCP MAR and Weapons
NSWC (USA)
Dstl (UK)
ONR (USA)
DRDC (Canada

Maritime Division MSTC: NON ACOUSTIC SIGNATURE MANAGEMENT

Electromagnetic Signature Control




Specialised Coatings





Research Leader

Leo De Yong

Aims:

To ensure the RAN have platforms that have improved operational performance and increased survivability as well as reduced cost of ownership.

Successes:

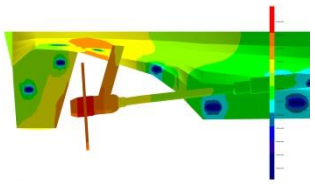
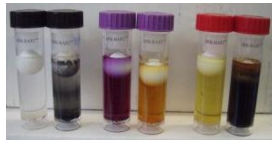
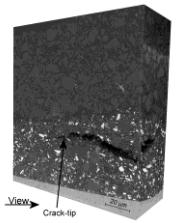
Radar absorbing materials for Collins class submarines and surface ships

RF interference shield for Anzac class

New generation foul release coatings on ACPBs with quantified fuel savings

Haze Grey colour for RAN ships

Corrosion Science

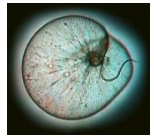





Environmental Signatures









Partnerships And Outreach:

Universities
University of Adelaide
Swinburne University
University of Melbourne
DMTC

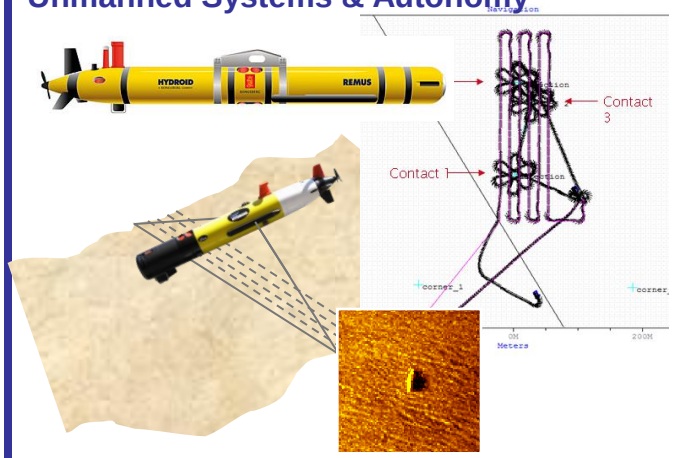
Industry
Mackay Consolidated
PPG, Akzo Nobel
ASC
BAE

International
TTCP MAT & MAR
NATO SET
ABCANZ

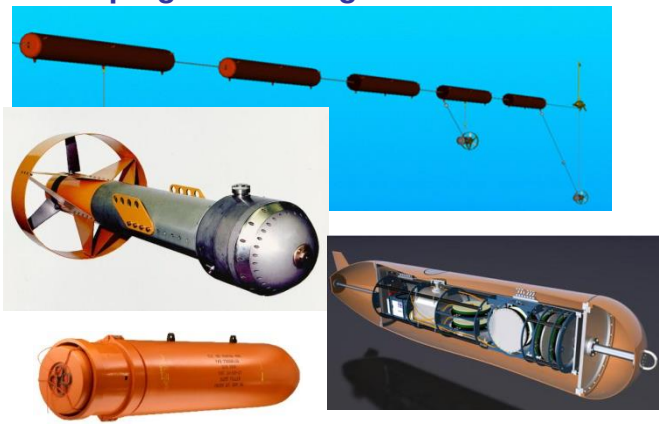
DSTO

Maritime Division MSTC: MARITIME AUTONOMY

Unmanned Systems & Autonomy



Underwater Influences, Naval Mine Sweeping & Jamming



Research Leader

Vacant

Aims:

To advance Navy's capabilities through the use of modular portable unmanned systems with a focus on the littoral operating environment through the provision of technical advice and niche system development.

Successes:

Autonomous operation of a REMUS 100 through on-board decision making for adaptive search, detection and classification capabilities.

Littoral environment characterization from hyperspectral data analysis.

The development of naval mine sweeping and jamming systems.

Payload Sensors

Partnerships And Outreach:

Universities
Sydney University
UNSW
New Castle University
CUDOS

Industry
THALES
Resonance Technology
Kraken Sonar Systems

International
TTCP MAT & MAR
NATO MCG3
ABCANZ

DSTO

Some sobering facts about mines

- Mine warfare began in 1776 when David Bushnell invented “Bushnell’s keg”, which was filled with black powder.
- Since World War II, more U.S. Navy ships have been damaged or lost due to mines than to all other causes combined.
- In past wars, a navy often discovered that an area was mined only after a ship entering a minefield was sunk or damaged.

- USS Tripoli –1991
- Struck a mine off the coast of Kuwait
- 5 m x 7 m hole
- Four serious injuries
- $20M+ damage
- USS Princeton subsequently damaged by other mines while giving assistance

DSTO

Unmanned mine-countermeasures

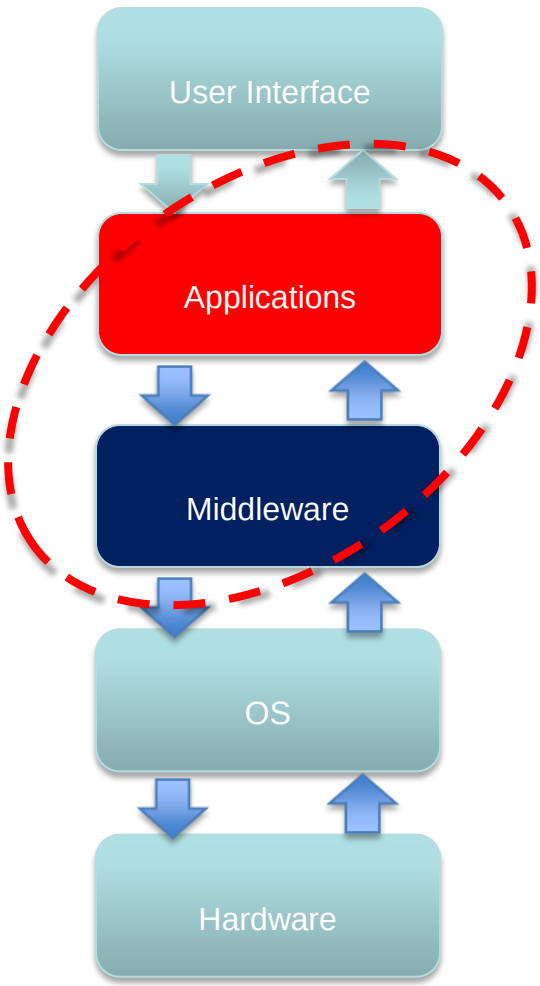
- Mine countermeasures (MCM) remains a tedious, labor-intensive, and dangerous job that puts personnel and vessels in harm's way.
- In March 2003, during Operation Iraqi Freedom, REMUS 100 autonomous underwater vehicles (AUVs) were deployed to find mines in the port of Umm Qasr.
- It was later concluded that each vehicle could do the work of 12 to 16 human divers, and they were undeterred by cold temperatures, murky waters, sharks or hunger.
- The locations of over 100 mines were mapped.


Underwater robots to the rescue!
But first, a few wrinkles…

Off-the-shelf autonomy…

DSTO

Advanced, customised payload autonomy

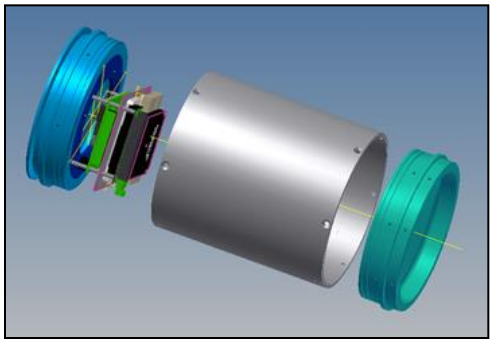


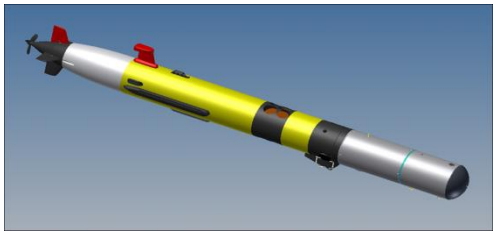
- The autonomy architecture resides onboard a customised payload computer
- The OEM vehicle computer and basic control software remains untouched
- This decouples the basic control of the vehicle (speed, heading, etc.) from the intelligent autonomy
- Changes in intelligent capabilities (behaviours) are affected through the autonomy software
- The payload computer is easily ported to different platforms
- Applications developed so far include robot navigation, path planning, vehicle/sensor simulation, automatic target recognition (ATR) and more

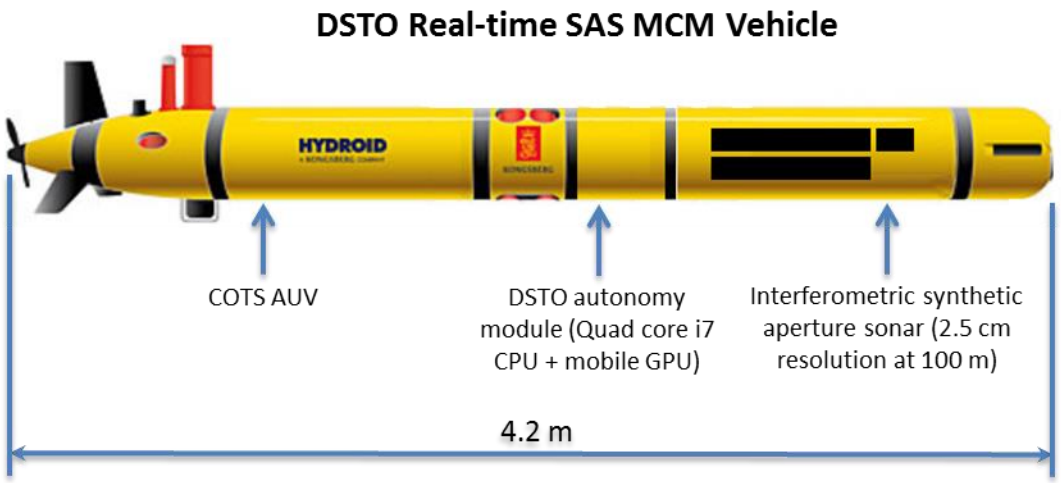
DSTO

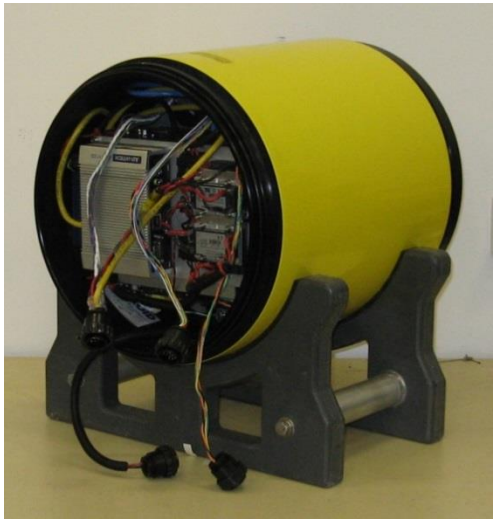
DSTO MCM payloads

- Advances in embedded processing mean that sensor data can now be analysed *on-line* via automatic target recognition (ATR) algorithms which can trigger intelligent vehicle behaviours.
- At the same time, better sensors in the form of synthetic aperture sonars (SAS) have become economical, giving higher image resolutions and unprecedented detection ranges for objects of interest.



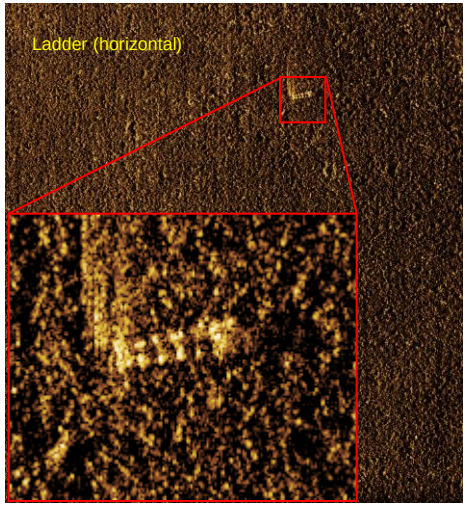


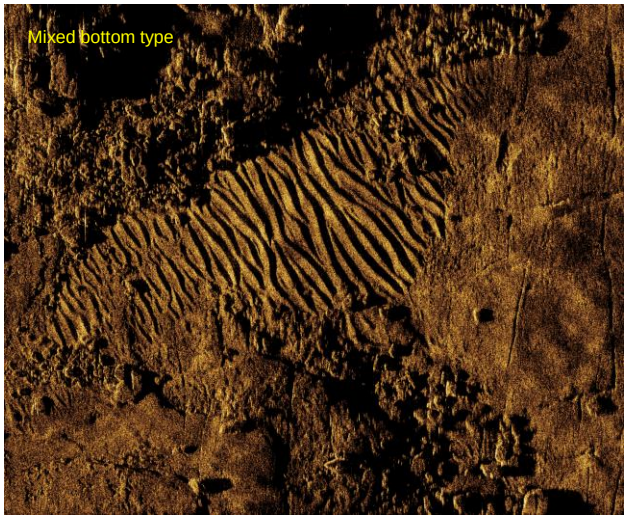


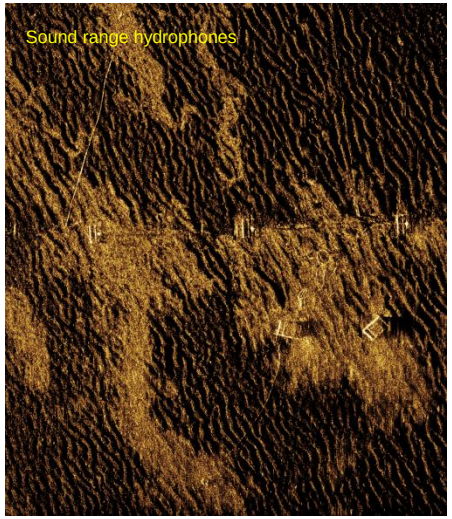


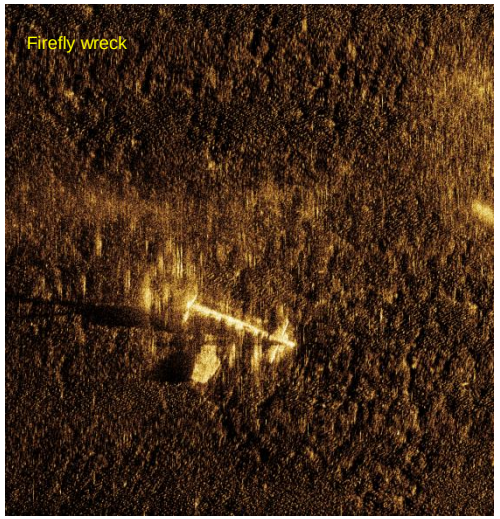
Imagery from Jervis Bay 23rd – 26th April 2013

- Approximately 1.2 TB of data were acquired during the Jervis Bay sea trial.
- The effective half-swath range of the sonar at the appropriate altitude exceeded 100 m.
- The resolution achieved appeared to be better than 5 cm, roughly in-line with the specified performance.



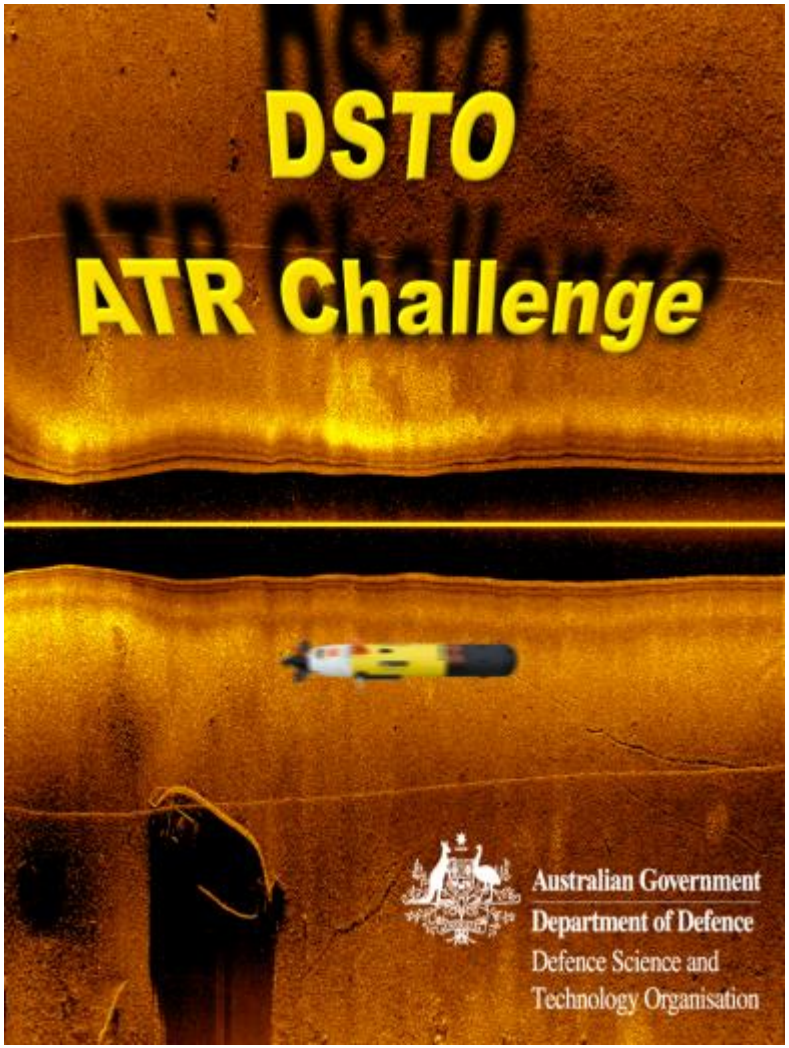






DSTO

The DSTO ATR Challenge - International competition



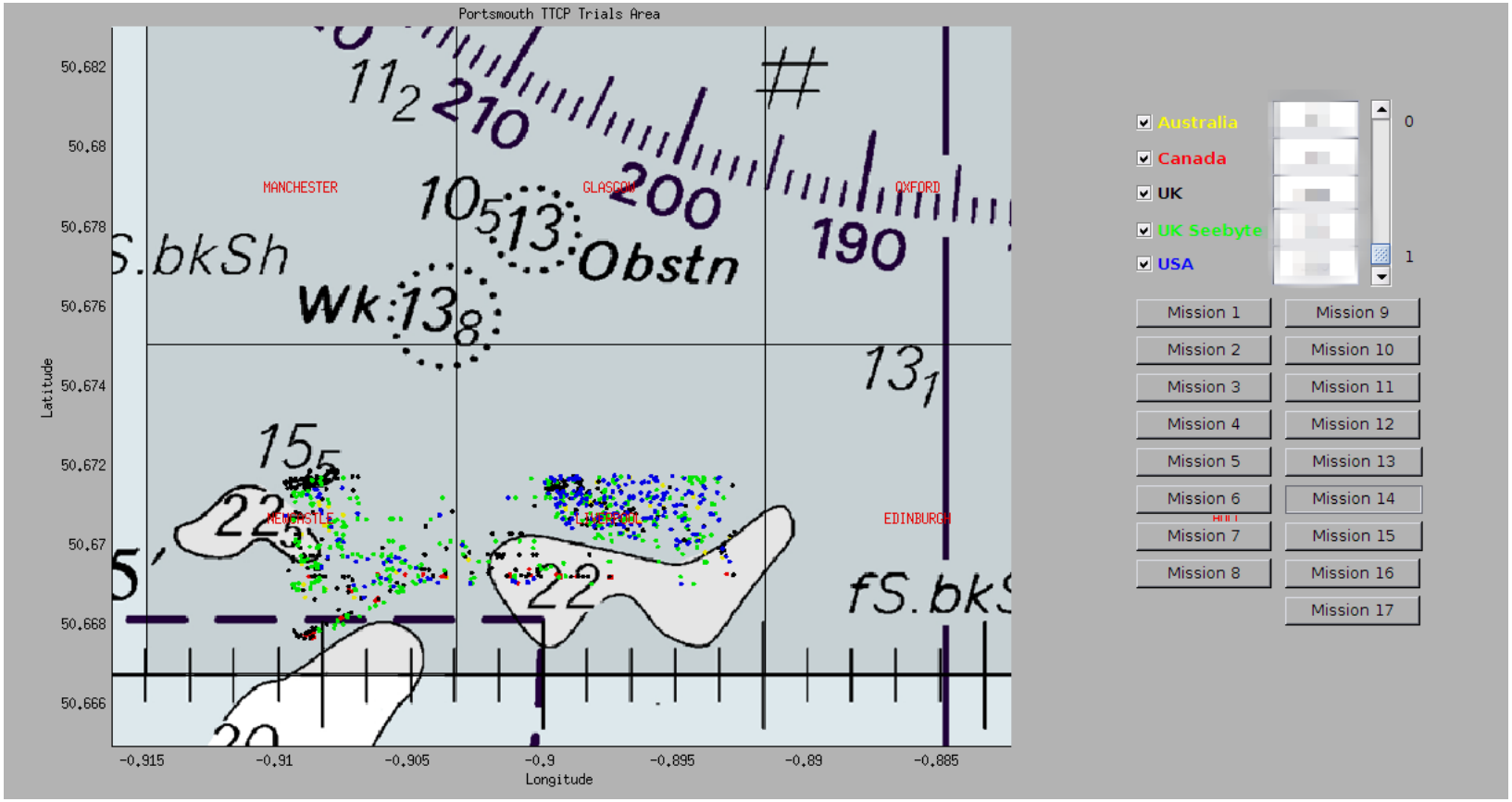
- DSTO instituted a competition for producers of ATR software
- DSTO dataset of 11,202 sidescan sonar images – REMUS 100 @ 900 kHz; range 30 to 50 m
- Training dataset and test dataset
- Participants were invited to run their ATR software through the test dataset and report their results
- DSTO analysed detection performance in comparison to human performance by RAN MW officers

www.dsto.defence.gov.au/news/6989

DSTO

Results of TTCP comparative trials

- Australia performed well in relation to other TTCP nations
- In many cases, false alarm rates were significantly better
- DSTO ATR is ready for use by the RAN

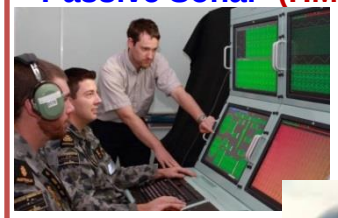
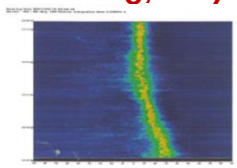
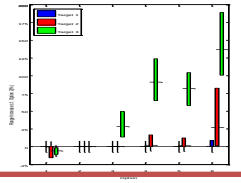


Opportunities for industry and academia

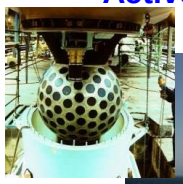
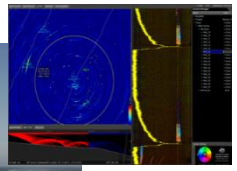
- *Unmanned and autonomous maritime systems are emerging as crucial technologies for the future Navy.*
- *Although the ADF has adopted a predominantly COTS/MOTS approach to the acquisition of these systems, there are still significant opportunities for business and academic involvement in custom hardware, software and algorithm development.*
- *Ultimately, autonomous systems and associated robotic technologies will emerge as important sectors in the Australian economy.*

SONAR TECHNOLOGY & SYSTEMS MSTC

Passive Sonar (HMAS Stirling, WA)


Active Sonar (Edinburgh, SA)


Research Leader

Dr David Liebing

Aim

Raise train and sustain a capability in undersea acoustic sensing and analysis that can be applied to assessing and improving current, enhanced and future ADF ASW requirements.

Successes

FOTA: World-first fiber-laser hydrophone towed array demonstration (DSTO-Thales)

BSAPS/PANORAMA hull-mounted sonar processing system

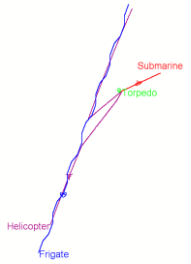
- Licensed to Thales Australia
- RAN FFH/FFG class-wide fits
- RNZN FFH ASW Upgrade

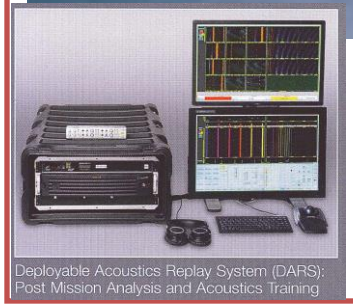
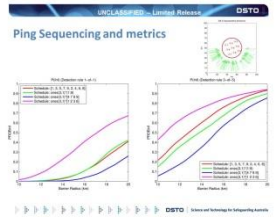
SENTINEL/AUSSnet undersea sensor network (DSTO & L3-Oceania)

GODS: Collins Class Onboard Demonstrator

- CCSM Sonar health monitoring
- CCSM Custom sonar processing

Sonar Processing & Performance Analysis (Edinburgh, SA)



Deployable Acoustics Replay System (DARS); Post Mission Analysis and Acoustics Training


Partnerships and Outreach:

Universities

- Sydney University
- University of Melbourne
- Adelaide University
- Flinders University
- University of Western Australia
- Curtin University (CMST)

Industry & Government

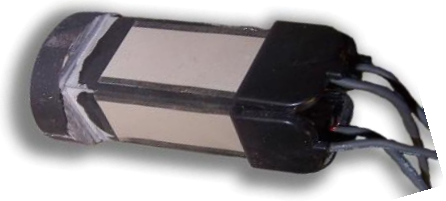
- Thales Australia
- Raytheon Australia
- Ultra (UK, CA, AS)
- STN-Atlas
- L3-Oceania
- Boeing & In-Situ Pacific
- CSIRO & Bureau Of Meteorology

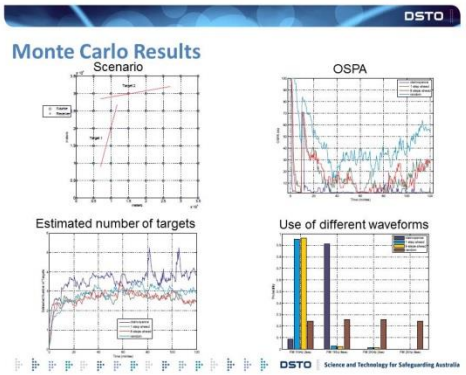
International

- TTCP MAR TP-9 (ASW Systems & Technology
- Office of Naval Research (ONR) – HAASW PA
- NUWC/NAVSEA – IAUWS PA
- DRDC- A (Canada)
- DTA (NZ)

General Areas of S&T Interest

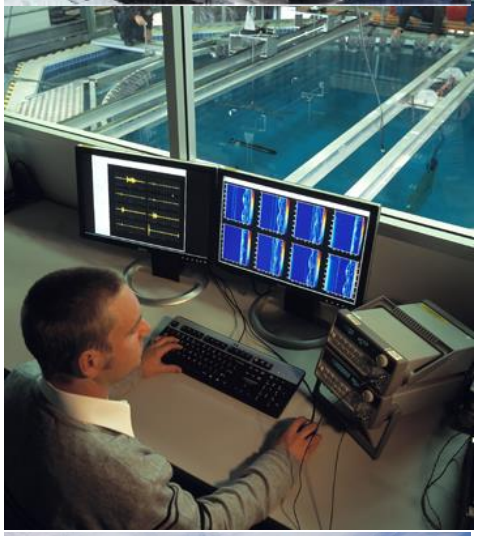
- Undersea sensing technologies
- Sonar signal & information processing
  - Visualisation & display
- Sonar system simulation/stimulation
- Assess & improve sonar performance
  - Human-in-Loop (HiL)





Example Experimental Capabilities

- Sonar Research Projector
  - At-sea measurements
  - Containerised, COOP-deployable
- Underwater Acoustic Scattering Lab
  - Precision, controlled measurements
- Acoustic Test Facility
  - General purpose underwater T&E (SA & WA)
- Deployable concept demonstrators
  - Third-party demonstration/evaluation
- Slocum undersea gliders
  - Long-endurance, unattended oceanographic measurements.

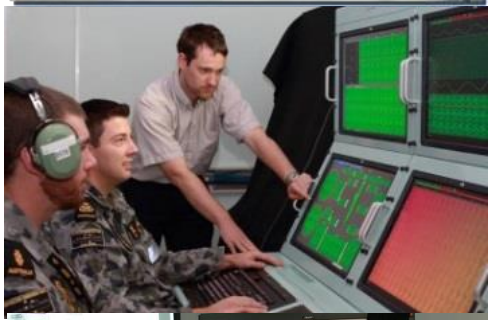


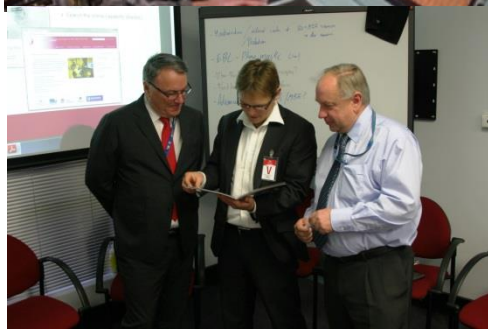
Partnerships – One Example

- DSTO – Thales (Australia)
  - Long duration partnership in undersea warfare
    - Mine, submarine & anti-submarine warfare
  - DSTO focus: lower TRL, higher risk R&D
  - Thales : industrial prototypes; end-to-end system development, test and evaluation; manufacture and customer support.
  - Staff exchanges, CTD program, etc.
- Examples
  - RAN Submarine towed acoustic array systems
    - Geophysical industry spinoff
  - RAN surface combatant sonar processing system
    - Sales to RNZN

Some Areas of Potential Partnership Interest

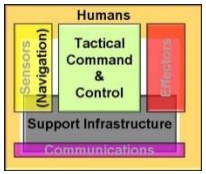
- Start small and grow
- Energy from the undersea/ocean environment
  - Low-power, long-endurance unattended systems
- Undersea acoustic sensing technologies
  - Acoustic and non-acoustic
    - Compact acoustic vector sensor technologies
- Sonar Signal & Information Processing
  - Target tracking, visualisation & display, sim/stim
    - Exploit COTS (e.g. GPU) computing technologies
  - Human-in-the-Loop studies

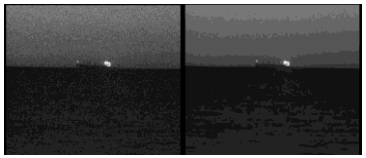




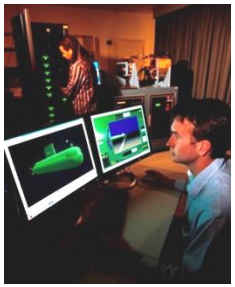
Maritime Division MSTC: Undersea Command & Control

Combat System Architectures





Underwater Weapon Systems



Research Leader

Dr David Kershaw

Aims:

To improve the RAN undersea warfare effectiveness through improving the collection, processing and exploitation of undersea tactical information by undersea platforms and systems.

Successes

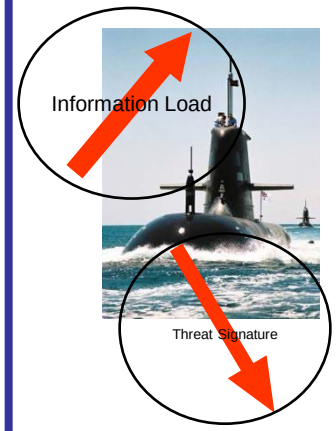
Insertion of Australian algorithms into the MK 48 HWT and the AN/BYG Combat system

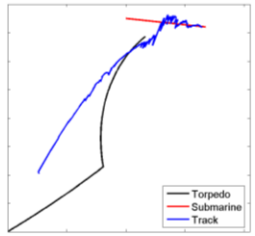
Improved weapon control displays for Collins Class submarines

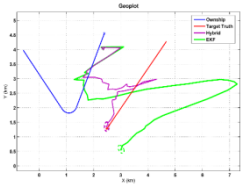
Improved signal libraries for RAN torpedo countermeasures

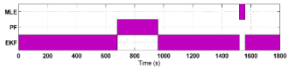
Early Human Systems Integration advice for SEA 1000

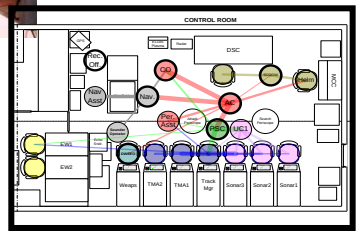
Human Systems & Information Integration











Partnerships And Outreach:

Universities

Australian Maritime College
RMIT
University of Adelaide
Curtin University
University of Western Australia

Industry

BAE Systems
Lockheed Martin
Raytheon
Thales
Ultra

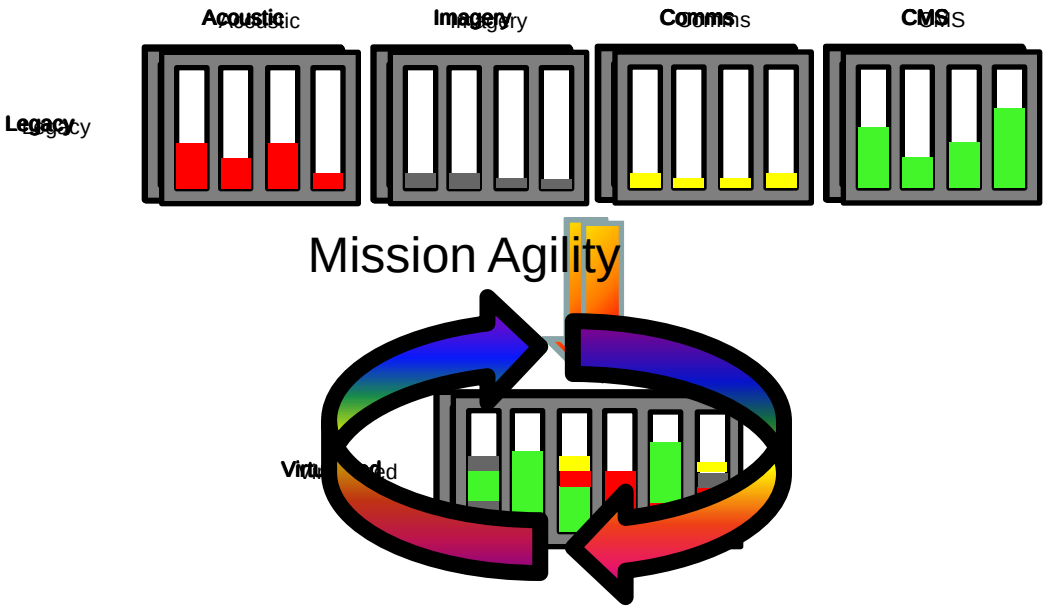
International

TTCP HUM & MAR Groups
NUWC / NAVSEA (USA)
ONR (USA)
SPARWAR (USA)

DSTO

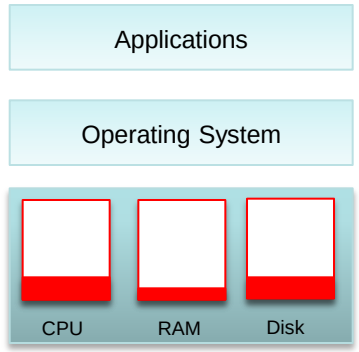
Combat System Architectures Research

Mission Agile Combat System

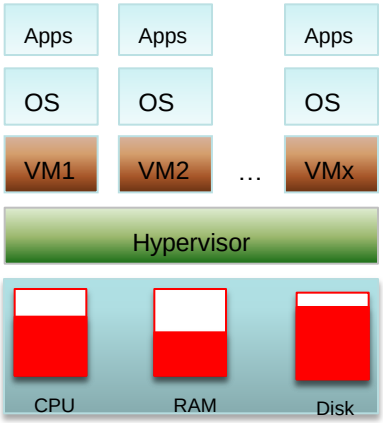


Mission Agile Combat System

- Underlying philosophy for our Combat System Architectures program
- Model behaviour to understand operational implications, risks and issues with deployment
- Investigating technologies for:
  - Efficient implementation with a focus on Space, Weight, Power and Cooling
  - Obsolescence management
  - Enhanced distribution of processing requirements
- Designing systems while being cognisant of Cyber Security threats and implications



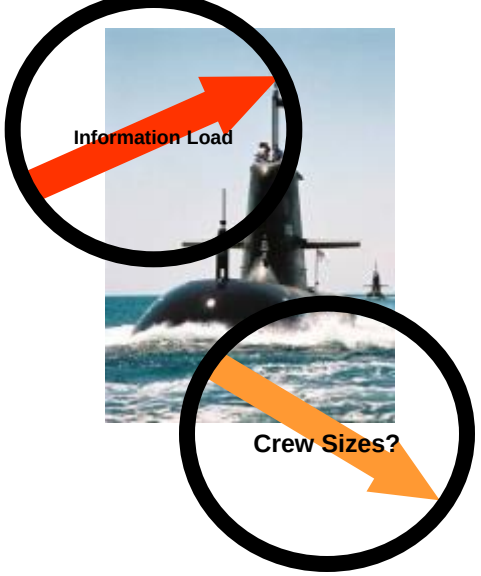
Physical



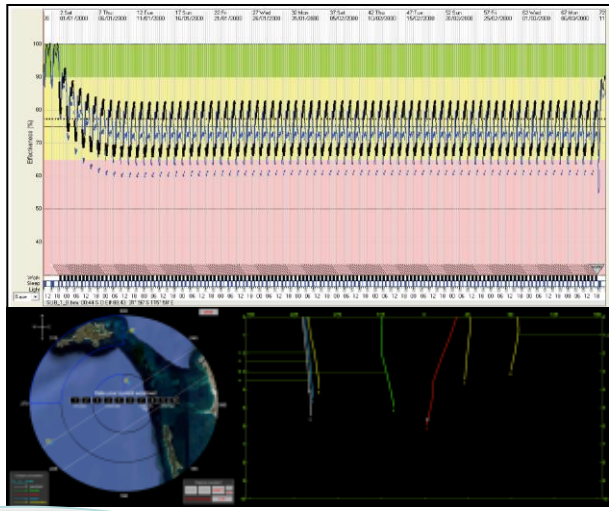
Virtual

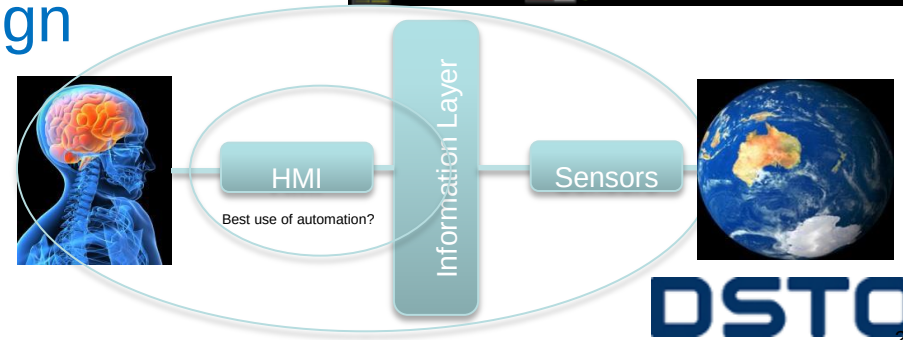
DSTO

Human Systems & Information Integration

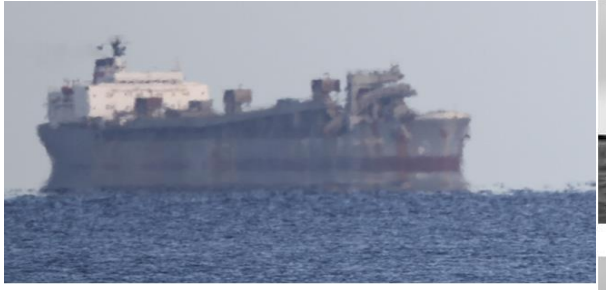


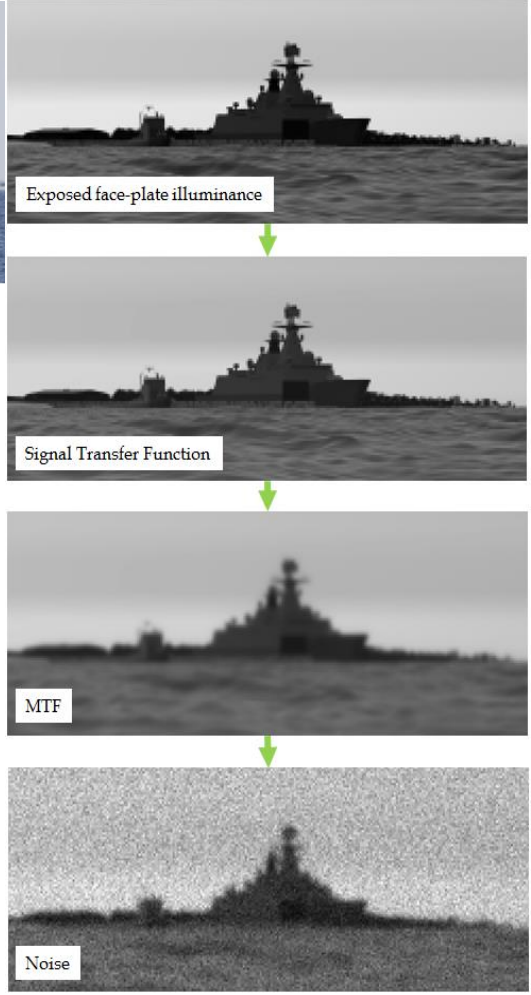
- Endurance R&D
  - Fatigue science to Habitation design: Maximise human performance
- Information Integration R&D
  - Situation Awareness and Automation: Knowledge in the Head (not the HMI)
  - Better harnessing automation
  - Efficient control room information flows for control room design



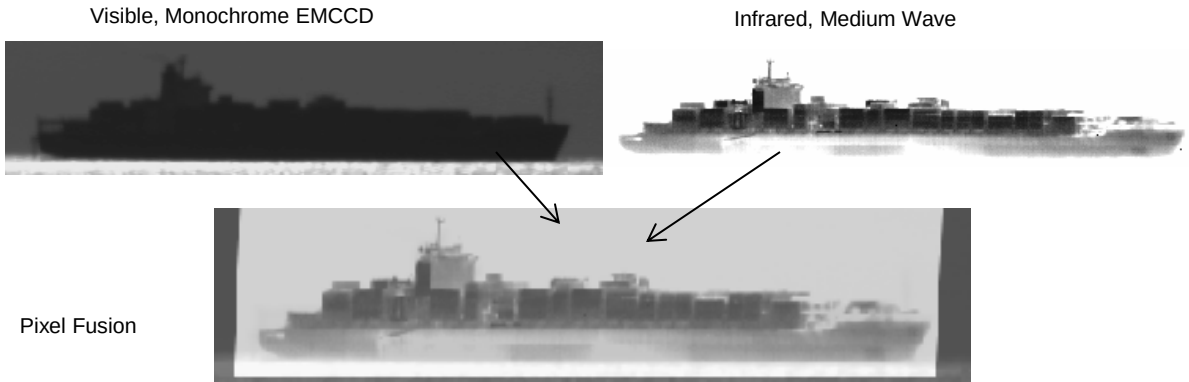


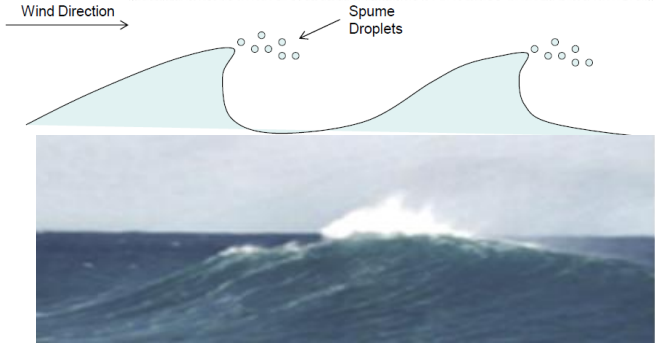
Submarine Optronics





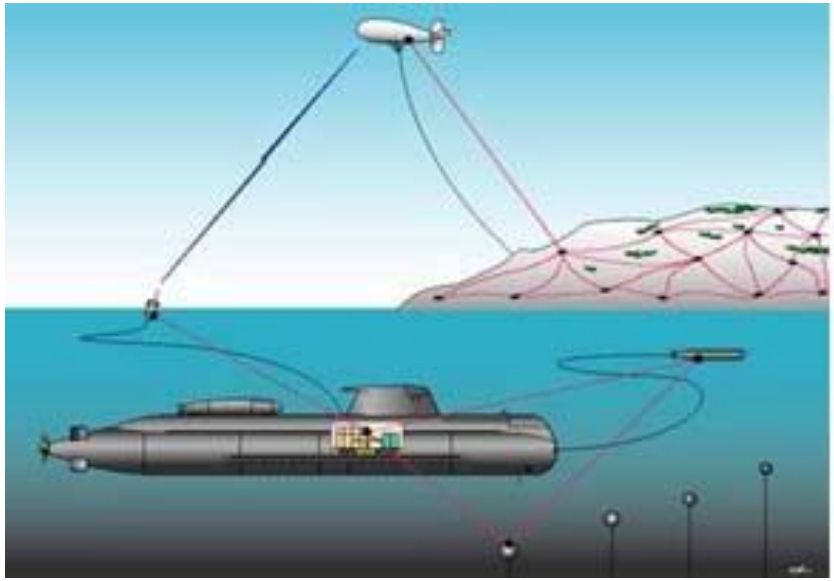
- Effects of the atmosphere
  - Measurement & Modelling
- Sensor Effects Simulation
  - Imaging sensor performance from saturation to extinction
- Image Enhancement
  - Fusion, Noise reduction





UCC Future Directions

Submarine organic sensors and systems



Submarine as a central node for off-board sensors and systems

DSTO

Questions?