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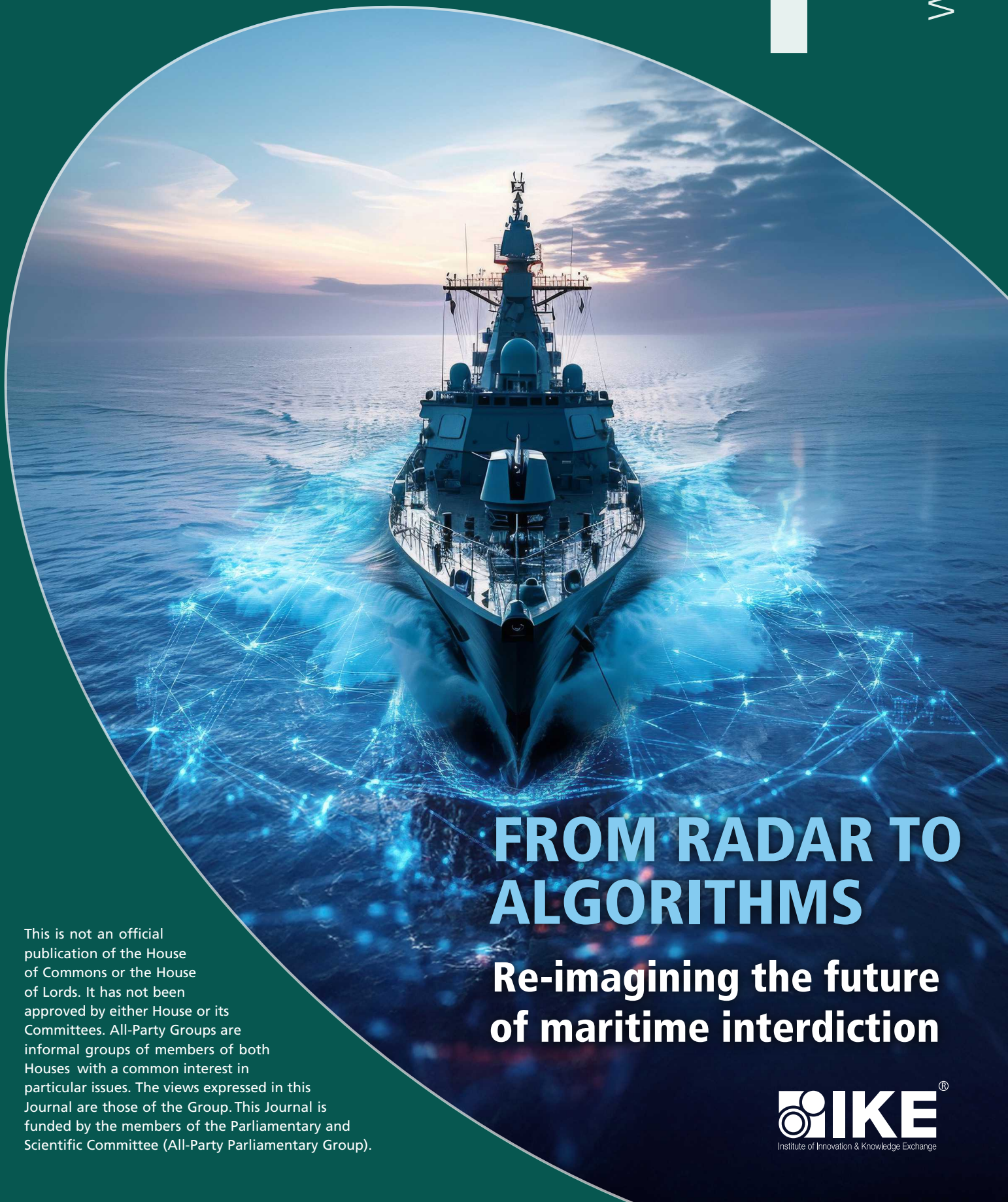

FROM RADAR TO ALGORITHMS

Re-imagining the future of maritime interdiction

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SCIENCE DIARY

Forthcoming discussion and other meetings

■ Tuesday 20th January 2026
DISCUSSION MEETING
Building a Thriving UK Neurotechnology Ecosystem
In partnership with the Newcastle Upon Tyne Hospitals NHS Foundation Trust and Newcastle University
5.15pm to 6.30pm, Palace of Westminster
Chairman's Reception 6.45pm to 7.30pm, One Parliament Street

■ Monday 9th February 2026
DISCUSSION MEETING
In partnership with the National Oceanography Centre
5.15pm to 6.30pm, Palace of Westminster
Chairman's Reception 6.45pm to 7.30pm, One Parliament Street

■ Monday 2nd March 2026
DISCUSSION MEETING
In partnership with Applied Microbiology International
5.15pm to 6.30pm, Palace of Westminster
Chairman's Reception 6.45pm to 7.30pm, One Parliament Street

■ Tuesday 17th March 2026
STEM FOR BRITAIN 2026
Palace of Westminster

■ April 2026 (date to be confirmed)
DISCUSSION MEETING
In partnership with the Met Office
5.15pm to 6.30pm, Palace of Westminster
Chairman's Reception 6.45pm to 7.30pm, One Parliament Street

■ Tuesday 12th May 2026
DISCUSSION MEETING
In partnership with the Nuffield Council on Bioethics
5.15pm to 6.30pm, Palace of Westminster
Chairman's Reception 6.45pm to 7.30pm, One Parliament Street

■ Tuesday 9th June 2026
DISCUSSION MEETING
In partnership with The Physiological Society
5.15pm to 6.30pm, Palace of Westminster
Chairman's Reception 6.45pm to 7.30pm, One Parliament Street

■ Tuesday 30th June 2026
ANNUAL LUNCHEON
House of Lords

British Science Week will take place between 6th–15th March celebrating science, technology, engineering and maths.

The theme for 2026 is "Curiosity: What's Your Question?"
www.britishscienceweek.org

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Sam Carling MP
Chair, Parliamentary & Scientific Committee

A warm welcome to our Winter Edition.

I'm delighted to be taking over as Chair of the Parliamentary and Scientific Committee. Huge thanks to my predecessor, George Freeman, for all his great work with the Committee.

With a background in pathology, I'm passionate about building strong links between MPs, Peers and our scientific industry across academia, industry and the broader sector. There is so much potential for the P&SC to fill that role, and I look forward to working with members to deliver that vision together.

We've got some fascinating events coming up this winter. In January, we're partnering with Newcastle University and the Newcastle NHS Trust for a discussion meeting around the work on neuroscience coming out of the city. We're also looking forward to welcoming the National Oceanography Centre and Applied Microbiology International in the second half of the season.

Capping off the winter we have the wonderful annual STEM for Britain event, offering Members of Parliament an insight into the outstanding work of early-career researchers in biological and biomedical sciences, chemistry, engineering, mathematical sciences and physics.

We have lots of brilliant articles in this edition focusing on the scientific issues of the day, such as AI, our industrial future, and microplastics. Many thanks to our contributors for their work on these key issues at the forefront of our national discourse.

To echo the comments made in the previous edition of Science in Parliament, we live in extraordinary times. Making sense of a muddled world is tricky, and it's where science can be our most valuable tool – cutting through the noise when we need it most.

Finally, I want to say a huge thank you to Leigh, Karen, Kinga, and all the team. Their tireless efforts are vital to keeping the P&SC thriving.

Wishing you a very Happy Christmas and New Year,

Sam

EDITOR'S NOTE

At the AGM on the 27th October, the following Officers were elected for 2025–26:

Sam Carling MP (Labour), Chair; **Viscount Stansgate** (Labour), President; **George Freeman FRSA MP** (Conservative), Co-Chair and **Baroness Walmsley** (Liberal Democrat), Vice-Chair.

My congratulations to Sam, Stephen, George and Joan on their election.

I am also very happy to confirm that our former Chair, **Stephen Metcalfe**, has been awarded Life Membership of the Parliamentary & Scientific Committee.

A number of new members have joined since the publication of the Autumn journal. A warm welcome to:

Parliamentary:	**Baroness Bottomley of Nettleton, Lord Shamash, Daniel Aldridge MP**
Commercial:	**R2AI**
Universities:	**University of Lancashire**
Scientific & Technical:	**Society for Endocrinology**
Individual:	**Dr David Schley**, Deputy Director, Sense About Science

Finally, I am delighted to report that we have received an excellent response to STEM for BRITAIN 2026, with applications from Early Career-Researchers up 12% on last year.

Leigh

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CONTENTS

Science in Parliament has two main objectives:

Inform the scientific and industrial communities of activities within Parliament of a scientific nature and of the progress of relevant legislation

Keep Members of Parliament abreast of scientific affairs

From radar to algorithms:

Reimagining the future of maritime interdiction

Professor Sam Medhat PhD MPhil CEng FIET FRAeS FRSC FCIM FCMI FRSA FIKE FIoD FIRL
Chief Executive, Institute of Innovation & Knowledge Exchange; Visiting Professor of Innovation and Digital Transformation, University of Westminster; Senior Mentor NATO Allied Command Transformation

NATO's ability to disrupt evasion of sanctions, illegal transfers at sea, and grey-zone threats around critical subsea infrastructure, depends increasingly on how cleverly it fuses data, deploys automation and updates doctrine.

Maritime interdiction has always balanced seamanship, intelligence and law. What has changed rapidly is the tempo and texture of the oceans themselves.

Uncrewed systems now loiter for months. Stellites listen for radio-frequency (RF) traces of ships that 'go dark' by switching off their Automatic Identification System (AIS, a shipborne transponder). Artificial Intelligence (AI) ranks voyage-risk faster than a duty officer can brew a cup of tea!

For NATO, this is not a niche technology story, but a strategic 'Inflection Point'. The Alliance's ability to disrupt evasion of sanctions, illegal transfers at sea, and grey-zone threats around critical subsea infrastructure, depends increasingly on how cleverly it fuses data, deploys automation and updates doctrine.

Why Interdiction is being rewritten

Three forces are converging.

First, the target set has expanded from pirates and drug smugglers to those evading sanctions (e.g., 'shadow fleets' bypassing oil caps), illegal, unreported and unregulated (IUU) fishing, arms embargoes and hybrid activity near offshore energy networks.

Second, commercial space and edge-AI (Artificial Intelligence running on satellites and drones) have matured: RF Geolocation and Synthetic Aperture Radar (SAR) expose regularly vessels with their AIS-off, while on-board interference shortens the 'Sensor-to-Decision' loop.

Third, uncrewed systems (e.g., drones in the air and Uncrewed Surface Vessels – USVs at sea) deliver cost effectiveness. Such systems make it possible to enable manned-uncrewed vehicle teaming – a model that the US Navy's Task Force 59 (TF-59) demonstrated from 2024 through 2025 in their Fifth Fleet.[1]

Europe is also reshaping the legal perimeter. The European Union Artificial Intelligence Act (EU AI Act 2024) restricts certain law-enforcement uses of AI (notably some real-time biometric identification), nudging maritime users towards behaviour-based analytics with strong audit trails.

The UK has tightened sanctions' practice through maritime services and price-cap guidance, explicitly flagging deceptive shipping practices such as AIS manipulation and opaque ship-to-ship transfers. The US Department of Homeland Security's AI Roadmap in 2024, and the associated Blue-Ribbon Advisory Board emphasise safe, mission-aligned AI adoption across homeland security, including the maritime domain.[2]

Across NATO waters, then, interdiction is moving from episodic patrols to *predictive, multi-sensor, legally-literate operations*. The implications for doctrine, and thus, training are profound.

NMIOTC's moment: from courses to a digital ecosystem

NMIOTC in Souda Bay is NATO's dedicated hub for Maritime Interdiction Operations (MIO) training. It already delivers boarding (visit, board, search and seizure – VBSS), Weapons of Mass Destruction (WMD) interdiction, and surveillance courses.

Commodore Piyis Periklis, NMIOTC Commandant said: "Digital transformation is not simply about new technologies; it is about reshaping how we think, train, and operate at sea. At NMIOTC, we are forging digitally-empowered maritime professionals who can out-think, out-decide, and out-pace emerging threats, thus, turning data into decisive action across every interdiction mission."

Ioannis Pantazis, Department Head of the NATO Education and Training Digital Discipline, at NATO Communications and Information Academy, stated: "To lead in the digital era, particularly in the volatile and diverse maritime domain, we must train within a living digital ecosystem that brings together operational instructors, data engineers, legal advisors, and AI safety specialists".

So, what needs to happen to meet the digital transformation aspirations and goals?

Here are the initial guiding steps to delivering effective digital maritime capability:

1. Build the 'NATO Interdiction Cloud'
A secure, exercise-grade data fabric that ingests AIS, SAR, RF, electro-optical imagery and open-source data in near real-time. Curated, privacy-aware datasets would be available for training and red-teaming. Instructors could replay

real interdiction timelines, swap in synthetic data to protect sources, and benchmark AI tools under common scenarios.

2. **Make edge-AI and uncrewed teaming the default training lane**
Every boarding package should be preceded by an 'AI cueing' phase where trainees must interrogate an automated risk-score: validate AIS anomalies, check RF hits, and decide whether to escalate to a USV or drone for positive identification. TF-59's operational experience provides a blueprint for realistic, manned–uncrewed vignettes.[3]

3. **Create an 'Evidence-from-Orbit' legal lab**
After France's first pollution conviction based solely on satellite detection in April 2025, NATO MIO teams must understand how to preserve, explain and, when necessary, challenge remote-sensing evidence. A joint legal-forensics cell inside NMIOTC should teach chain-of-custody for satellite/RF cues, model documentation and expert-witness skills.[4]

4. **Institutionalise AI-Assurance and Red-Teaming**
The EU AI Act and Allied policy, point towards model governance: bias testing, performance drift monitoring, and Human-on-the-Loop controls. NMIOTC should run 'AI Failure Festivals', where trainees experience spoofed AIS, adversarial imagery and false positives, and learn graceful degradation tactics (e.g., reverting to independent sensor confirmation).[2]

5. **Integrating sanctions intelligence and due-diligence tradecraft**
Embedding UK/EU sanctions guidance into training will help operators spot deceptive charters, opaque beneficial ownership, and suspicious voyage economics, before a boarding. Decision cells should practice constructing 'case packages' aligned to flag/port-state evidentiary standards.[5]

6. **Credential the talent**
Introduce micro-credentials in maritime data fusion, uncrewed systems CONOPS (Concept of Operations) and remote-sensing evidence management. These should be jointly badged with Allied Command Transformation to lift standards across the Alliance.

Two models for NATO interdiction

Incremental digitisation will not be enough. Two bolder models can create new value pools, and alter the cost-curve of persistence and legality.

Model A: Interdiction-as-a-Service (IaaS) for the Alliance

Think of a standing, federated service managed by NATO that coastal states 'subscribe' to during operations or surges. It would provide: (i) Access to the NATO Interdiction Cloud; (ii) A pooled fleet of uncrewed assets (air and surface) pre-cleared for cross-border exercises; and (iii) An on-call legal-forensics cadre.

Nations contribute sensors, or taskable hours; NMIOTC curates training and standards; the Maritime Command (MARCOM) tasking cycles consume the service. The advantage here, is the lift-and-shift persistence – smaller Allies gain immediate access to high-end sensing and analytics, without acquiring full stacks, whilst larger Allies gain standardised interfaces and shared burden.

Model B: Behavioural Rules of the Road (BRoR) with explainable AI

Rather than chasing identity alone, NATO promulgates a behavioural schema – BroR – that defines Explainable Risk Features: anomalous course/speed relative to traffic, rendezvous patterns in high-risk boxes, RF–AIS mismatches, and emissions signatures. Algorithms trained on these features produce risk scores that are auditable and portable across jurisdictions, easing information exchange under different privacy regimes. BRoR would be taught and stress-tested, including 'Challenge Rights' (how a Master can contest an automated suspicion) to strengthen legitimacy.

Policy, people and pragmatism

Three cautions deserve emphasis.

1. **Law and legitimacy are strategic enablers**
The April 2025 French case demonstrates that satellite-only evidence can meet appellate standards– when provenance is robust, and analysis is transparent. NATO training must inculcate evidentiary hygiene equal to seamanship.[4]

2. **AI must be safe, useful and explainable**
The EU AI Act sets the benchmark in Europe; Department of Homeland Security's Roadmap and Advisory Board illustrate the US appetite to adopt with safeguards. Training should embrace every tool used in training ships with: a Model Card; Documented Failure Modes; and a Human-on-the-Loop concept.[2]

3. **Treat uncrewed systems as teammates, not talismans**
The real value of Task Force 59 (TF-59) lies not in its technology, but in its CONOPS: affordable, persistent systems that promote scarce crewed assets. Training should focus less on the question of "which drone?" and more on "who decides, on what evidence, and how fast?".[3]

Conclusion: seizing the initiative

A digitally transformed NATO Maritime Interdiction enterprise can out-observe, out-decide and out-argue adversaries. If NMIOTC becomes the Alliance's crucible for fused data, assured AI and manned-uncrewed teaming – anchored in law and legitimacy, NATO can create the strategic space to deter, disrupt and, when necessary, detain. The oceans are not getting any simpler. Our training, and our imagination, must get sharper!

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[1] NATO Maritime Interdiction Operational Training Centre (website). https://nmiotc.nato.int.

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[3] US Naval Forces Central Command (2025). Task Force 59 Holds Change of Command Ceremony. 21 August.

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