THE NAVIGATOR

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Inspiring professionalism in marine navigators

GNSS disruption

Jamming, spoofing and spotting the signs

The Nautical Institute | Royal Institute of Navigation

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THIS ISSUE

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FREE RESOURCES

US Coast Guard
www.navcen.uscg.gov/global-positioning-system-overview
An overview of GPS and how to report anomalies and problems.

NATO Shipping Centre
https://shipping.nato.int/nsc
Latest news and insights into GPS and other topics from NATO Shipping Centre.

Maritime Global Security
www.maritimeglobalsecurity.org
Guidance and updates on the latest risks, security issues and geographical hotspots from Maritime Global Security.

Shipowner's Club
https://www.shipownersclub.com/latest-updates/news/jamming-and-spoofing-responding-gnss-and-ais-interference/
How to detect and respond to jamming and spoofing threats and attacks.

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NAV BRIEF

with **David Patraiko FNI**
Director of Projects,
The Nautical Institute

GNSS Denial

Do you know where your ship is? Now imagine that the satellite navigation system has failed, and the position is now longer marked on the ECDIS – or is showing as somewhere the ship cannot possibly be. Now what happens?

Global Navigation Satellite Systems (GNSS) have become almost indispensable to maritime navigation today. We are not unique in this, as everything from car satnavs to international banking and telecommunication systems relies on GNSS for positioning, navigation and timing (PNT).

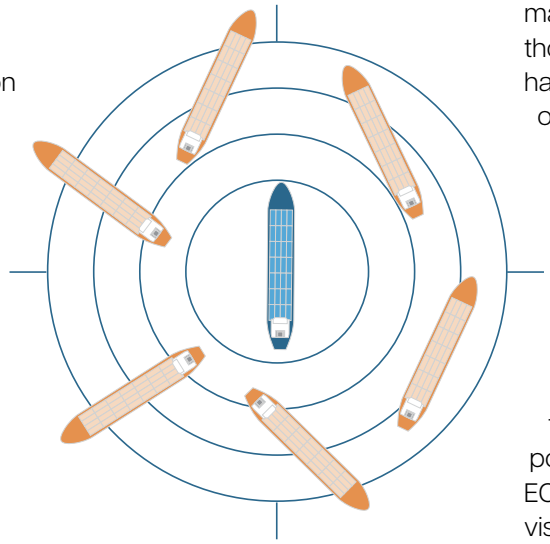
Unfortunately, although GNSS has proved to be very reliable and accurate, it is becoming much less reliable, particularly in regions where there is conflict or upheaval. The trouble generally can be divided into two categories: jamming and spoofing.

Jamming and spoofing

GNSS signals are generated from satellites which are largely solar powered, the transmitted signal power tends to be fairly weak. That weak signal can be degraded or totally denied by either intentional or unintentional activity. Unintentional jamming could be caused by environmental conditions such as solar flares, or by malfunctioning land based sources such as powerful radar or TV transmissions.

Spoofing is far more rare but also harder to detect. This is when a real signal is masked with a fake signal, providing plausible false positioning information to the mariners onboard ships. A common saying is that jamming causes receivers to die, and spoofing causes them to lie.

As a navigator, you must be aware of these risks and how to react if they are detected or even suspected.



A COMMON SAYING IS THAT JAMMING CAUSES RECEIVERS TO DIE, AND SPOOFING CAUSES THEM TO LIE

Fortunately there is a wide range of information sources available to assist, and for the alert mariner, some reasonably effective countermeasures that will keep the ship safe. An excellent source is the InterTanko guide *Jamming and Spoofing of Global Navigation Satellite Systems (GNSS)*, which is available to InterTanko members and also from some security sources (the current version was published in 2019 but an update is expected later this year).

Don't panic!

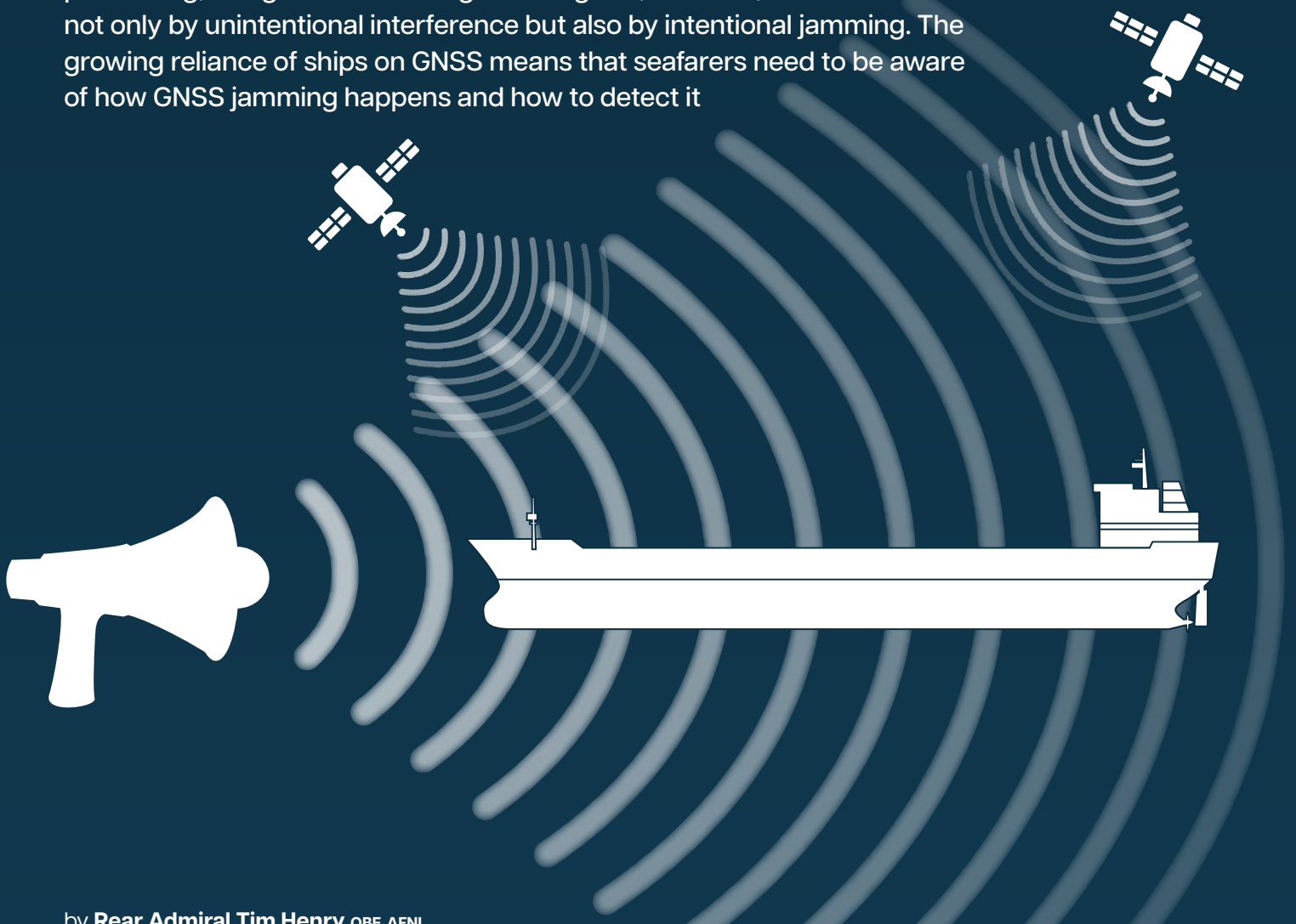
While the loss of GNSS is certainly concerning, navigators have been managing safely without it for thousands of years. The golden rule has always been never to rely on any one source of positioning. For this purpose all GNSS systems (GPS, Galileo, GLONASS or BeiDou (BDS)) should be considered as a single source – they all have similar risks due to their common transmission bands and weak power. It is critical that that mariners constantly take fixes and check the resulting position against the one given on ECDIS using other means – radar, visual navigation, physical aids to navigation celestial, depth sounder, ECDIS interlays (overlays and underlays), parallel indexing or even dead reckoning (DR) and estimated positions (EP).

The results should be compared with GNSS information to check plausibility. If there is any doubt, the Master should be called immediately and consideration be given to slowing or stopping the ship to ensure safety. It is also essential that all watch keepers, both officers and lookouts, are familiar with the signs of GNSS denial and that the bridge team practises good BRM techniques, mentoring and good situational awareness. The professional navigator must be skilled in manually plotting positions on the ECDIS. Regular drills are also a good idea.

On a final point, the magazine has had a refresh in design to celebrate its 40th issue. We hope you enjoy your new-look *Navigator*!

What every mariner needs to know about GNSS jamming

GNSS such as GPS, GLONASS, Galileo and BeiDou are key elements of positioning, navigation and timing. Their signals, however, can be affected not only by unintentional interference but also by intentional jamming. The growing reliance of ships on GNSS means that seafarers need to be aware of how GNSS jamming happens and how to detect it



by **Rear Admiral Tim Henry** OBE AFNI

GNSS satellites orbit Earth at an altitude of approximately 20,000 km. They transmit very faint signals orders of magnitude below background noise levels. GNSS receivers can detect these faint signals through complex processing, but this also means that the signals can be overwhelmed by any stronger radio signal being emitted at the same frequency.

In addition to the distance that GNSS signals need to travel, they must also pass through the Earth's atmosphere (including the ionosphere and troposphere). This further dilutes and distorts the signal, leaving it susceptible to natural interference. This can be from solar storms, ionospheric scintillation (turbulence in the Earth's atmosphere) or heavy rainfall. However, deliberate interference by jammers is the most serious threat, because it can suppress signals instantly and mislead those trying to read them.

Jamming is when a device deliberately transmits on or near GNSS frequencies with the intention of obstructing or dominating authentic satellite signals. This is easily done because GNSS uses fixed and well-known frequencies and a simple jammer can prevent GNSS receivers from operating over a large area. A jammer putting out only a few milliwatts of power can cover hundreds of metres or more to deny GNSS service.

How does GNSS jamming work?

- **Broadband noise jamming:** A jammer emits very high noise that is distributed across a wide GNSS frequency range, lifting the noise floor and interrupting the receivers' ability to track satellite signals. Since GNSS signals are weak, this requires little power. Broadband jammers can have a simultaneous impact on multiple GNSS constellations; not just GPS, but also Galileo, GLONASS and BeiDou, since they all have intersecting frequency bands.
- **Continuous Wave (CW) Interference:** Interference is sent as a calibrated, narrow CW tone on or near a GNSS carrier frequency. It prevents receivers from correlating or comparing signals. It is power-efficient and, if the frequency is correct, can impact receivers at long range.
- **Swept-tone or chirp jamming:** A swept-tone jammer quickly moves a narrow signal back and forth across GNSS bands, striking multiple frequencies with relatively low power. Chirp jammers are also standard in low-cost devices, such as 'privacy jammers,' which are used to interfere with GNSS across a wide band.
- **Pulsed jamming:** A pulse jammer transmits short bursts of noise or tones. Even if these do not entirely block the reception of GNSS signals, they may decrease the receiver's ability to lock or generate reliable position data. Pulses synchronised with the receivers' acquisition windows are particularly disruptive.

Maritime navigation disruptor types

- **Personal privacy jammers (PPJs):** These small gadgets, sold online as 'GPS blockers,' are designed to conceal the location of their users or a vehicle. Not only can they jam a ship's GNSS receivers but also ECDIS, AIS time sync and dynamic positioning. These devices are typically made to be plugged into a vehicle cigarette lighter or USB port and they emit just enough power to jam GNSS signals within tens or hundreds of metres. Due to their common use and low cost, PPJs are a frequent source of interference.
- **Shipborne jammers:** In order to conceal illegal activities, evade detection or even confuse coastal authorities, certain vessels deploy more powerful jammers. These devices can interfere with the GNSS of other ships over several kilometres, especially in crowded or confined waters.
- **Shore-based jammers:** Jammers placed on land (eg by criminal and state actors) in proximity to ports, straits or coastlines can generate GNSS-denied zones. Even low-power shore jammers can create significant problems for vessels manoeuvring in port or transiting through confined waters.

How can you tell if your GNSS is being jammed?

If you notice one or more of the following, jamming might be taking place:

- **Loss of signal or position:** The receiver displays 'NO FIX' or equivalent messages.
- **Inconsistent positioning:** The vessel's reported position jumps or the speed and course over ground (SOG and COG) change unrealistically.
- **Time sync problems:** Equipment using GNSS time (eg AIS, GMDSS, ECDIS) shows timing errors or alarms.
- **Multiple receivers being affected at once:** If all receivers are losing lock at the same time, it is likely to be something external causing it, such as jamming.
- **Receiver interference alerts:** Some GNSS receivers are equipped with internal interference detection, which warns when high power signal levels are occurring and/or there is a sudden drop in the signal-to-noise ratio.

Another sign might be an abrupt loss of satellite-based augmentation systems (SBAS) differential corrections (eg SouthPAN or ESMAS), followed by a degradation in position accuracy before signal is lost completely.

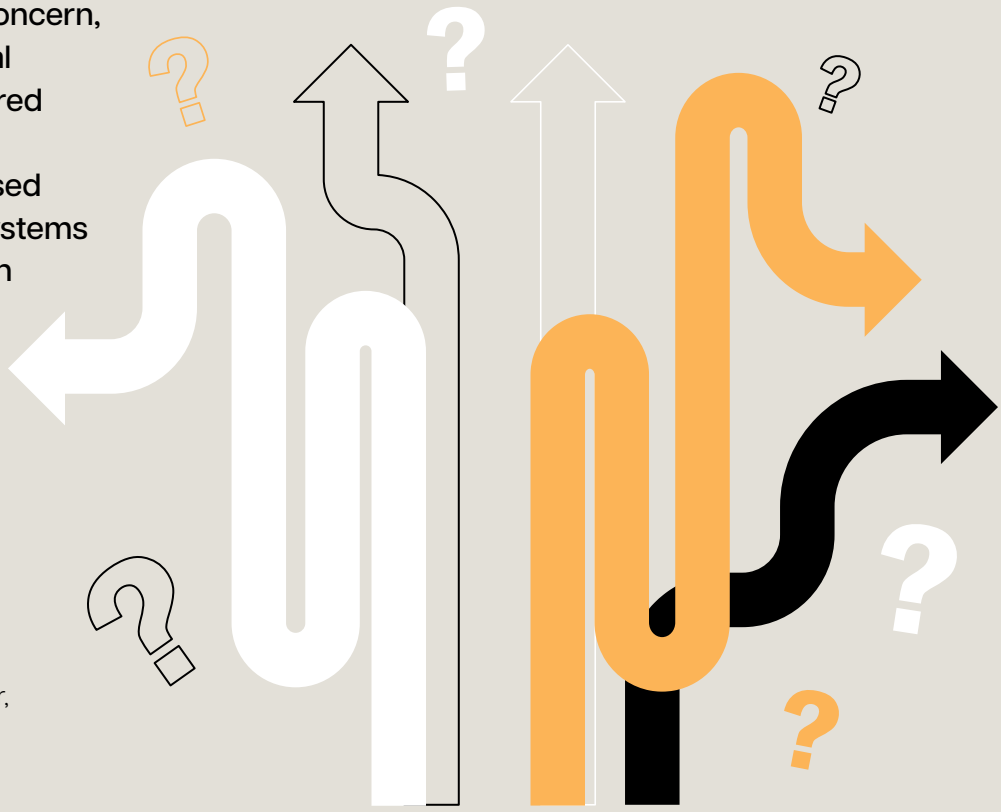
Where is jamming is most likely?

- **Near conflict zones:** Military forces often employ GNSS jamming to protect their operations. This can spill over into nearby shipping lanes, affecting commercial vessels.
- **High-risk ports:** Ports in areas with a history of GNSS problems, such as parts of the Black Sea or the eastern Mediterranean, regularly experience outages reported by mariners.
- **Regions with smuggling or illegal fishing:** Ships in areas with high criminal activity may use jammers to hide their movements from authorities.
- **Onboard sources:** Crew or passengers with PPJs can jam their own ship's navigation systems without realising it.

Disrupting GNSS is illegal under international law. The International Telecommunication Union (ITU) explicitly bans intentional radio interference, and most countries enforce severe penalties for owning or using jammers. Despite this, GNSS jamming happens every day, posing a threat to safety at sea. By understanding how jamming occurs, identifying its signs, and learning to be able to quickly make use of alternative means of navigation, mariners can continue to operate safely in the absence of GNSS. An essential part of keeping your ship safe when satellite navigation fails is to stay alert and always expect the unexpected.

Dealing with disruption – and coping with compromise

Far from being a theoretical concern, recent incidents in geopolitical conflict zones have underscored the very real and immediate dangers posed by compromised global navigational satellite systems (GNSS). Gard P&I Club explain why it is imperative that we recognise the signs of GNSS disruption and understand what to do when we come across them



Onboard systems like ECDIS, Radar/ARPA, Gyro compass, course recorder, and the autopilot are all heavily reliant on GNSS feed. This means they are highly likely to be impacted by any disruption to the signal. Mariners must maintain heightened attention and awareness for signs of GNSS disruption when using them.

Depending on whether the disruption is caused by jamming or spoofing, tell-tale signs can vary from clear audible or visual alarms to no alarms at all.

GNSS jamming is the act of blocking or interfering with legitimate GNSS signals by overwhelming them with stronger, unauthorised radio signals. Think of it as trying to have a conversation in a very noisy room – the noise makes it impossible to hear what the other person is saying. GNSS spoofing is the act of transmitting false GNSS signals designed to deceive a receiver into calculating an incorrect position, velocity or time. Instead of blocking the signal, a spoofer imitates a legitimate GNSS signal, making the vessel's receiver believe it's real. The GNSS display will show a position, but it will be inaccurate, potentially by a significant margin. Derived speed and course information will also be incorrect. A table showing a summary of key differences can be found at the top of page 7.

While specific indications for GNSS disruption can vary between equipment and manufacturers, examples shared by Anglo-Eastern's Maritime Training Center, Delhi, India, highlight several key signs that mariners can watch out for:

- Unusually high HDOP (Horizontal Dilution of Provision) values, eg, greater than '4' indicating unreliable accuracy,
- RAIM (Receiver Autonomous Integrity Monitoring) alerts entering caution or unsafe modes, and
- Elevated Signal-to-Noise Ratio (SNR) values.

On ECDIS, jamming can trigger sensor failure alarms, potentially leading to a switch to backup sensors or dead reckoning. Jamming may even freeze the chart display altogether if no secondary source is defined. Conversely, spoofing presents a more deceptive threat as the GNSS receiver might report an incorrect but seemingly valid position, often without RAIM detection.

Feature	GNSS jamming	GNSS spoofing
Effect	Blocks or denies GNSS signals	Deceives with false GNSS
Result	Loss of GPS signal/No signals	Incorrect, but seemingly valid, position fix
Indication	No Fix, "Acquiring Satellites"	Illogical position shifts, mismatch with other aids

In such spoofing scenarios, ECDIS can display incorrect positions, and Radar/ARPA systems, when GNSS-fed, will show incorrect data. Gyro compasses may also enter an alarm state if relying on GNSS for drift stabilisation. Your equipment manufacturer should be able to provide further advice on how GNSS denial will show up on your own bridge equipment.

Alarm fatigue and sensory overload

Alarm fatigue is a significant challenge during GNSS signal loss. The disruption or loss of GNSS signal often triggers numerous simultaneous alarms across the bridge, leading to a sensory overload that can be both disconcerting and distracting. Effectively managing these alarms and prioritising critical information is essential to maintain situational awareness and ensure safe navigation.

Beyond the bell: covert GNSS failures

Situations can also occur where no alarms are triggered, making detection much harder. For example, the Australian Transport Safety Bureau reviewed a near-grounding incident involving a vessel navigating the Great Barrier Reef. In this case, a malfunctioning GPS unit (due to an antenna fault) fed incorrect positional data to the ECDIS, Radars and other bridge equipment. As the ship's position was not being monitored through other means and no alarms were activated, the inaccurate GNSS data and vessel's deviation from its planned course went unnoticed by the crew, pilot and even Vessel Traffic Services (VTS).

While not directly linked to jamming or spoofing, cases like this one underscore the dangers of unaddressed GNSS anomalies, whether from technical faults or external interference. They highlight the inherent risks of relying solely on a sole source of navigational data, even when it appears functional, and emphasise the importance of crew training in recognising and responding to these events.

Responding to GNSS disruption

Once a GNSS interference alarm is triggered, mariners must identify its root cause instead of simply silencing or deactivating it. You should call the Master immediately. The vessel should have a plan in place for actions to take if GNSS signal is lost; make sure you are familiar with it before it becomes crucial. The measures you will need to take will vary from ship to ship.

Key strategies include a secondary receiver (if available), employing parallel indexing, utilising Radar overlay on ECDIS and manual position plotting on ECDIS.

While manual position plotting by range and bearing is possible near conspicuous landmarks, it may not be feasible when a vessel is further away from land, navigating a flat coastline or is in an area that lacks discernible objects.

Operational decisions

Beyond any technical measures required, the Master will also need to take vital operational decisions.

They may need to consider:

- Reducing speed, which not only allows more time for assessment but also significantly lessens potential damage during an incident like grounding,
- Increasing bridge resources, and
- Making an informed decision on whether to proceed with the voyage.

These critical decisions should be guided by a comprehensive set of considerations that are ideally integrated into the vessel's GNSS disruption response plan.

Such factors include:

- The complexity of the passage,
- Available room to manoeuvre,
- The availability and capability of pilots or local tugs for assistance,
- The reliability of buoys and fairway markings,
- The presence of safe anchoring points along the route,
- The density of traffic,
- Effectiveness of Vessel Traffic Service (VTS) management,
- General visibility, and
- The geographic extent of the GNSS disruption.

Should the vessel stop?

Vessels, of course, do not navigate by GNSS alone. While GNSS has undoubtedly enhanced navigation safety, ships have successfully sailed without it for centuries. However, the simple fact is that GNSS disruptions will often have an adverse impact on the operation of a vessel. This might mean speed reductions, deviation from the intended route, or even the interruption/suspension of the voyage.

All suspected GNSS disruptions should be reported to the relevant authorities and organisations to aid wider situational awareness and warnings.

Loss of GPS leads to groundings, disruption and delay

In this series, we take a look at issues affecting the safety of mariners and the lessons that can be learned from incident reports and examples. The following case studies and analysis have been provided by Gard P&I Club

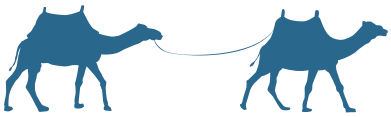
Example One: Coral collision

A vessel experienced a loss of GPS signal in the Red Sea and consequently relied on the Estimated Position (EP) function of its ECDIS for navigation towards the port. Hours later, the crew observed an unusual sea surface coloration, which they mistakenly believed was seaweed. The vessel ran aground on corals at a speed of 11.3 knots, incurring substantial damage to its bottom plating and double bottom ballast tanks – and the coral reef.

To ascertain the exact grounding site, the safety manager contacted the flag state. They were able to confirm the vessel's position using the IMO's LRIT (Long Range Information and Tracking System) – and found it was more than 40 nautical miles away from the estimated position displayed on the ECDIS.

Example Two: Desert disruption

While preparing to depart a port in the Red Sea after cargo operations, a vessel experienced severe GPS interference, showing it as being inland in a desert. Other nearby vessels were similarly affected by GPS disruption. The Master deemed it unsafe to depart without a functional GPS. The interference lasted over a week, delaying the vessel's departure and leading to a lengthy dispute between the owners and charterers.



THE FLAG STATE... CONFIRMED THE VESSEL'S POSITION WAS MORE THAN 40 NAUTICAL MILES AWAY FROM THE ESTIMATED POSITION DISPLAYED ON THE ECDIS

Lessons learned

These two case studies highlight several key points:

- GPS interference is a real and present danger, particularly in regions of geopolitical tension, as it can render primary navigation systems unreliable.
- These disruptions force seafarers to make critical 'go/no-go' decisions with contrasting choices and outcomes, as observed in the two cases above.
- The first case underscores the dangers of trusting an Estimated Position (EP) derived from ECDIS when underlying GPS data is compromised – especially when there are no conspicuous objects in the vicinity for visual cross-referencing.
- The successful use of LRIT in the first incident, operating on a different satellite communication frequency than GPS, emphasises the vital role of tracking systems other than GPS play in confirming a vessel's actual location.

The Nautical Institute's Mariners' Alerting and Reporting Scheme (MARS) – https://www.nautinst.org/resource-library/mars.html – comprises a fully searchable database of incident reports and lessons, updated every month. If you have witnessed an accident or seen a problem, email Captain Paul Drouin at mars@nautinst.org and help others learn from your experience. All reports are confidential – we will never identify you or your ship.

WHO'S NAVIGATING

Name: Scarlett Barnett-Smith
Current Position: Third Officer
Company: DFDS

Sailing, shipping and building mutual respect

A love for life on the water led Third Officer Scarlett Barnett-Smith to pursue a rewarding career at sea

Q Why did you decide to pursue a career at sea?

A It was because of my love for the water and sailing. I began my career on the tidal Thames working for the Port of London Authority, and from there I ventured out to sea to broaden my experience. I have loved life at sea ever since.

Q Where do you see yourself in five years' time? Ten?

A In five years, I aim to progress further in my career and broaden my experience across different vessel types. In ten years, I would love to achieve my ultimate goal of becoming a Captain.

Q What do you find most interesting about your current role?

A I love that Britain is an island nation, and by working on a ferry for DFDS I am directly contributing to the flow of vital trade. It's rewarding to see how essential shipping is to everyday life and to play an active part in keeping it moving.

Q How do you use GNSS and GPS to increase your skills and help you in your duties?

A I use GNSS and GPS every day as essential tools for safe navigation, passage planning and monitoring a vessel's progress. They are fundamental in building situational awareness and developing my navigational expertise.

Calling navigators!

The Royal Institute of Navigation (RIN) have launched a Working Group to investigate and report on the effects, mitigations and solutions to GNSS jamming and spoofing in the maritime sector.

Interference has been pervasive for years now in areas such as the Baltic Sea and the Black Sea. In the Strait of Hormuz alone, almost 1000 ships per day experience GNSS interference, impacting crew safety and the security of their cargo. Collisions and groundings are a very real threat – as the rest of this issue of *The Navigator* shows.

Please consider joining our Discord channel and sharing your insights in our survey - we need your help in gathering the information needed to conduct this important study.

The Working Group will publish their report by the end of the year – we'll keep you updated.

Ramsey Faragher, Director of the RIN

For more information:
www.rin.org.uk/RIN_Maritime_Report

Contact RIN at: 1 Kensington Gore, London, SW7 2AT | +44 (0)20 7591 3134 | www.rin.org.uk

Staying alert to jamming and spoofing

George Shaw from the Royal Institute of Navigation explores how GNSS can become vulnerable to jamming and spoofing and what mariners can do to stay on course

GNSS are principal sources of maritime positioning. However, they are all vulnerable to signal interference – both natural and deliberate (jamming). Unlike aviation's provision of alternative electronic positioning inputs independent of GNSS (eg radio beacons, ILS, high-grade INS), maritime versions have limited backup systems.

A vessel's GNSS-derived position and course, portrayed so precisely by ECDIS, remains a compelling indication for mariners even if GNSS errors are suspected. Positioning resilience for safe passage during GNSS disturbance is primarily dependent on mariners' alertness and frequent cross-checks combined with manual intervention using traditional navigation skills.

The world is seeing increasing instances of geopolitical conflicts. As a result, GNSS jamming at sea is becoming more commonplace in some regions such as the Middle East and eastern Europe, which raises severe risks to shipping. Several years ago, live GPS jamming trials using Trinity House vessels revealed shocking effects that can still be experienced today. Relatively low power jamming, insufficient to deny GPS fully, induced a slow increase in position errors that went undetected and grew sufficiently to affect the autopilot and alter the vessel's course. This was all without any alarms sounding on the bridge. At higher jamming power levels, GPS was fully denied and the crew were alerted by the receiver triggering alarms.

GNSS JAMMING AT SEA IS BECOMING MORE COMMONPLACE IN SOME REGIONS SUCH AS THE MIDDLE EAST AND EASTERN EUROPE, WHICH RAISES SEVERE RISKS TO SHIPPING

Errors and alarms

Responses of vessels' systems to jamming vary, as even type-approved receivers can behave differently. When GNSS is denied, the displayed position may freeze or be extrapolated by Dead Reckoning (with errors growing significantly due to inertial drift). Digital bridge systems are becoming increasingly integrated, meaning that undetected erroneous PNT information can be fed instantly to multiple applications, and affect AIS reports. In live trials, GPS denial caused multiple bridge systems (eg stabilisation of the Radar display) to alert in rapid succession, with a cacophony of alarms sounding, temporarily overwhelming mariners' cognition.

Additionally, the threat of GNSS spoofing is expanding, particularly in areas such as the Red Sea, Gulf and Black Sea. Counterfeit signals can take over the receiver's tracking from genuine signals, gradually offsetting the position solution without being detected by the ship's systems or being readily noticeable to the mariner. This is a more insidious effect than AIS spoofing, which typically introduces more obvious position errors.

GNSS jamming and spoofing are becoming more widespread, with emerging evidence of some malicious transmissions from satellites. Regulatory action for future type-approved receivers is underway to counter these threats, but most vessel implementation is years away. Longer term, cross-sectoral solutions are being explored, some necessitating extensive ground infrastructure: dedicated Low Earth Orbit PNT satellites or innovative PNT applications of existing LEO communications signals (eg Starlink).

For the foreseeable future, mariners must hone traditional navigation skills (ideally with bridge simulator training safely providing a wider experience of threats) and navigate using all available data sources. Mariners should monitor possible discrepancies of ECDIS portrayed position and track when cross-referenced in coastal waters with radar overlay and regular visual bearings. Always consider that GNSS can present hazardously misleading positions even if no alarms are raised.

TAKE 10

Ten top tips to help navigators at all stages in their careers get to grips with GNSS – and its absence

1 What is GNSS?

Global Navigation Satellite Systems (GNSS) are constellation of satellites providing signals from space to support mariners (and the rest of the world) with global positioning and accurate timing.

2 Origin story

GNSS are provided by different countries and include GPS (USA); Galileo (EU); GLONASS (Russia); and BeiDou (China).

3 Common weakness

Different systems have their own strengths and weaknesses; however, they share the common weakness of being fairly easy to jam and spoof.

4 Golden rule

Never trust a single positioning system – whether it's visual, Radar, echo sounder, celestial or even GNSS. Always corroborate any position by other means – and be acutely aware of where the limitations lie.

5 Jamming

Jamming can be unintentional and caused by space weather or faulty equipment; or intentional, caused by individuals or governments. Due to the low power signal from space, jamming is fairly easy to achieve, and somewhat easy to detect.

6 Spoofing

Spoofing is the intentional fooling of a receiver in order to deceive the navigator. This can be harder to detect.

7 Risk assessment

The current geo-political turmoil around the world is making GNSS disruption and denial a lot more common. Disruption may affect many systems and ships in your area.

8 ECDIS

For navigation, it is essential that you can effectively use an ECDIS without GNSS input, using other manual plotting techniques as well as DRs (Dead Reckoning) and EPs (Estimated Positions).

9 Check your sources

Information sources about GNSS issues are being constantly updated. Ensure your company and crew remain aware of the latest advice, and seek further support from P&I Clubs, shipping associations, manufacturers, flag states etc.

10 Sharing is caring

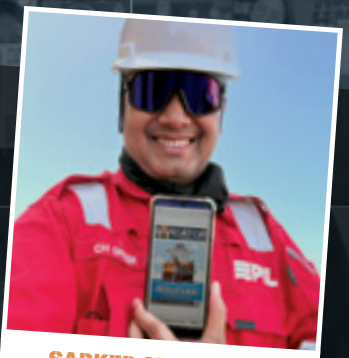
Issues around GNSS disruption and denial and how to respond are complex. It is always good to share information and thoughts with the entire bridge team to enhance overall situational awareness.

WIN AN iPAD

Just post a picture of you with your *Navigator* on Instagram, including the hashtag #NAVsnap, or send us a message on Facebook with your photo attached (www.facebook.com/thenauticalinstitute) and tell us the name of your ship or your college, if you have one. Let us know if you're a member of The Nautical Institute, too (everyone gets entered in the draw, whether you are a member or not!) Or send us the information in an email!

AND THE WINNER THIS ISSUE IS...

Congratulations to one of our longest-standing Navsnap entrants, Sarker Mojiuddin Hasnat Lenin, Chief Officer with Pacific International Lines. Over the years, he's sent us photos with his copy of *The Navigator* from around the world; this one was taken off the New Zealand. We're delighted to name Sarker as our winner for this landmark 40th issue of *The Navigator*.



SARKER MOJIUDDIN HASNAT LENIN