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THE NAVIGATOR

Inspiring professionalism in marine navigators

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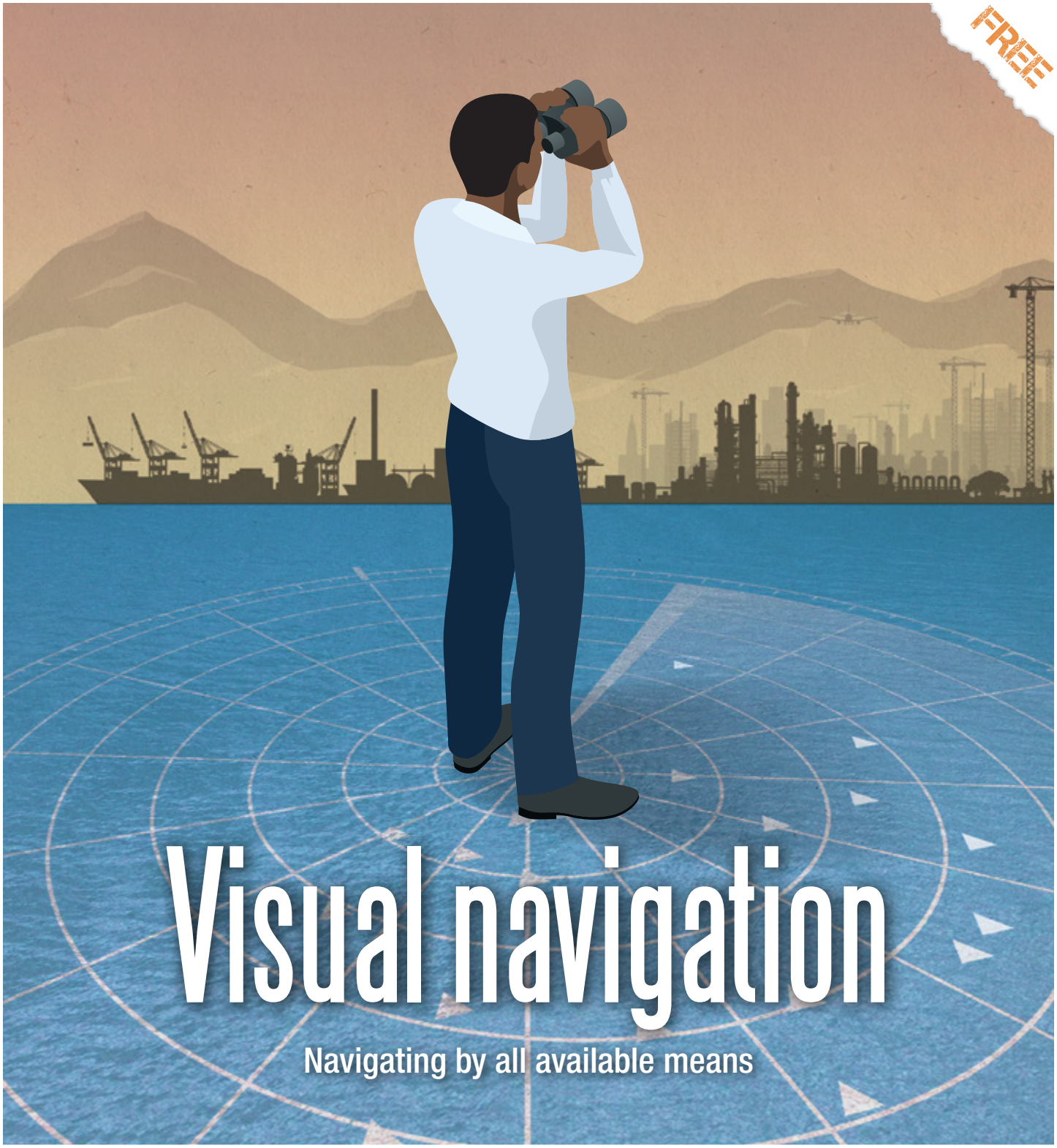

Visual navigation

Navigating by all available means

A free publication by **The Nautical Institute** in association with the **Royal Institute of Navigation**

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NAV BRIEF

David Patraiko FNI
Director of Projects, The Nautical Institute

Look, see and understand

All experts develop a sense of what to look for. A farmer will look at a field very differently to a tourist; a meteorologist will look at the sky very differently from an amateur star gazer and an experienced navigator will look at the horizon very differently to an inexperienced one. Knowing how to look, see and understand are fantastic skills for a navigator to hone – and all areas that can be constantly improved.

When I started out at sea, I used to think the Master, the pilot and I were all seeing the exact same thing when we looked out of the same window. How naïve I was! As Masters and pilots began to mentor me, I learned about the many visual techniques that professional navigators use to improve their situational awareness.

To a casual observer, it may seem like experienced navigators are just sitting there, gazing out to sea. In fact, they are constantly assessing the risk of collision, often getting a solution quicker than could be provided by the ARPA or AIS. One of my favourite visual techniques is to use the edge of a bridge window to assess whether the relative bearing of a target is steady (risk of collision), or opening (will pass ahead or astern).

Many years ago, The Nautical Institute ran a study into the value of physical aids to navigation (buoys, beacons etc) in an age where some people mistakenly think that GPS/GNSS is sufficient. Mariners in all types of craft, from leisure and fishing to commercial and naval, still rely hugely on buoys and beacons. In his article on page four, Captain Marso Law AFNI shares his experiences as a pilot in Hong Kong. Not only does he use aids to navigation for visual clues but also tall buildings and cranes. He points out that GPS can be disrupted by bridges and buildings and that using visual clues can often make an accurate assessment of speed quicker to achieve.

Captain Aly Elsayed AFNI explains on page six how you can improve your visual techniques. When you are next on watch, try estimating the range of a target without electronics. See if you can work out the rough range, bearing and closest point of approach visually and then check it against your electronics. Your skills will improve over time and, as you get better, will help you master an invaluable technique that will serve you well when you need a quick decision, or when electronics are not available. Practise identifying types of craft and, based on that, consider what their next manoeuvres might be.

Like all tools, human eye and thought process are not perfect. However, they can be continuously improved with a little bit of effort and time. Ask other people what they are looking at and why. If you get a chance to share your own knowledge about visual techniques with others please do.

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The Nautical Institute
200B Lambeth Road, London SE1 7JY, UK
Tel:+44 (0)20 7928 1351 Fax:+44 (0)20 7401 2817
navigator@nautinst.org www.nautinst.org

With support from: 1 Kensington Gore, London, SW7 2AT, UK
Tel: +44 (0)20 7591 3134 Fax: +44 (0)20 7591 3131
www.rin.org.uk

Editorial committee:
Editor Emma Ward
Design Phil McAllister
For The Nautical Institute
Steven Gosling AFNI, Lucy Budd, Aly Elsayed AFNI, David Patraiko FNI
For the RIN George Shaw FRIN

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ALL AT SEA

Emma Ward

We welcome your news, comments and opinions on the topics covered in *The Navigator*

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We welcome your news, comments and opinions on the topics covered in *The Navigator*. We reserve the right to edit letters for space reasons if necessary. Views expressed by letter contributors do not necessarily reflect those held by The Nautical Institute

Visual value

Understanding visual cues is crucial for safe navigation at sea. Here are some useful insights and online resources to help you increase your knowledge and skills.

If you spot any broken links, or would like to suggest resources that we have not included here, please do get in touch!

Safety first with *The Navigator*

We are currently navigating in the Caribbean Sea from Kingston, Jamaica to Rio Haina, Dominican Republic and expecting a rough sea due to Hurricane Beryl. As an officer in charge of passage planning, reading *The Navigator* helps me find key points to apply, especially around safe navigation.

Caroline Lea, Third Mate,
Malayan Colleges Laguna, Philippines

OCEAN's Seven

The Operator-Controlled Enhancement of Awareness in Navigation Project, or OCEAN Project, has released seven free training videos in collaboration with The Nautical Institute. They address gaps in navigational awareness and maritime safety and provide mariners with the tools they need to navigate safety in today's dynamic maritime environment.

You can watch the videos here:
https://ocean-navigation-awareness.eu/maritime-training/

Up periscope

Visual navigation is so important for all kinds of ships – even submarines. Why, in the age of GPS, AIS and inertial navigation systems, are visual navigation and visual referencing required at all? All these systems are only as good as the data they receive. Over time, they can degrade, which is why all navies validate their data by using other means of navigation, including visual techniques. Being able to use visual navigation cues once you draw close enough to land is key – and you have to be able to do it in 20 seconds.

By using all visual bearings available to you, you can find an estimated position and arrive at the desired location at exactly the right moment. In other words, you know where you are – and where you are not.

Captain Ryan Ramsey,
former submarine commander

A navigator's guide to visual cues and techniques

As ships get bigger and bigger, and technology becomes ever more advanced, it might seem fair to ask whether there is still a place for 'old-fashioned' visual navigation techniques that rely on the human eye. **Captain Marso Law AFNI** from the Hong Kong Pilots Association argues that there is and shares lessons from his personal experience

As navigators, we make the best use of all the latest navigational equipment on board. Lives, and ships, are much safer as a result. However, visual navigation continues to be a very important part of the range of safety precautions available to us. Colregs require every vessel at all times to maintain *a proper lookout by sight and hearing*, as well as by 'all available means' as appropriate. Making a full appraisal of the situation in this way is visual navigation at its most fundamental.

This is especially important when you are in a situation where there are many targets, such as fishing boats, tugs and tows, coasters, etc. Those targets on a steady or nearly steady bearing with you and getting closer are a collision risk, and you should apply Rule 7 of the Colregs as required.

It is good practice to use visual navigation techniques to monitor and crosscheck information coming from electronic equipment such as ECDIS and GPS. Just as it is vital to double check rudder angle indicators and engine repeaters, it is essential to check the input from the sensors is working in the way we want it to. GPS and ECDIS might be interrupted when passing under a bridge or be affected by a tall building nearby, for example. It can sometimes take digital systems a few seconds to accurately calculate speed over ground. One simple way to check whether you are still moving without instruments is that the engine wash comes to nearly the bridge front position when the ship stops over ground.

What to look for during visual navigation

Coastal navigation

Look out for landmarks that will help your navigation, such as leading lights, directional lights, lighthouses, beacons, building and cranes. Sometimes, buoys or even big trees or tall buildings on the coastline can help you monitor your ship's position and speed.

A thorough passage plan taking into account all the surrounding landmarks as you make landfall will be very helpful. This

allows you to plan your speed and angle of approach with reference to known coastal features. For example, look for the transit of two buildings at the point where you start altering course, and when you come into the transit of the leading lights. That way, you can be confident that you are on the correct track.

The length of the wash from buoy(s) is a useful indicator of the strength and direction of the tidal current. The direction of the ships lying at anchor, the weight and leading angle of the anchor chain and the drift of smoke from the funnel (not that there should be much, these days) all indicate the strength and direction of the wind and current.

If you always pass the same objects at the same distance, and you know how the ship typically reacts, you will immediately notice the difference if you are setting towards shallow water in strong wind and/or current.

Berthing operations

Looking at the tips of any cranes around you will give you an excellent indication of how the tidal current is acting at the basin, especially when the space available is restricted – which is often the case for today's larger ships.

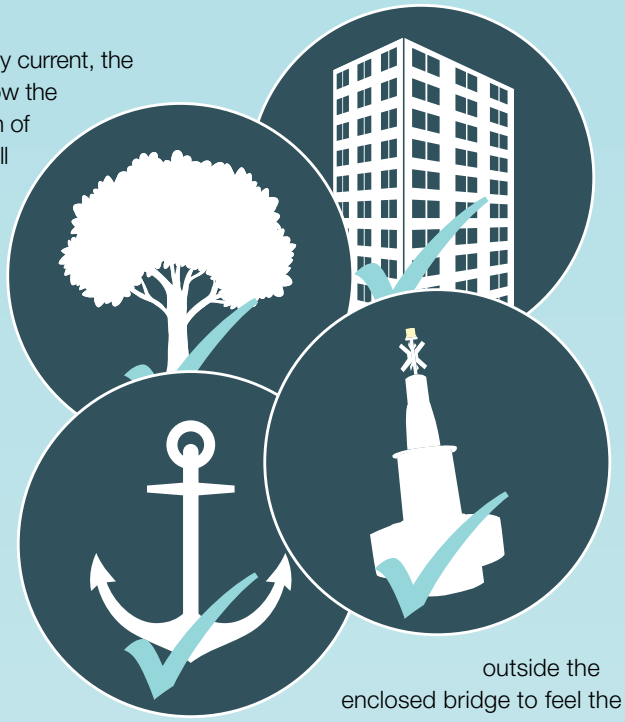
Make no mistake, the ECDIS and portable pilot unit (PPU) are both essential pieces for berthing and unberthing ships. Often, you cannot really see the water from the bow or stern of a 400m-long vessel! So, does that mean that visual navigational techniques are not useful for handling vessels of this size? Not at all.

If anything, we should have *more* landmarks around the turning basin to help visually identify anything which might have gone wrong. If your speed has not dropped as much as you expect, for example, you need to take early action to rectify the situation. Visual clues can help us recognise the need for that action in time.

Benefits and weaknesses of visual techniques

Visual navigational techniques do not rely on technology to work. They offer immediate feedback and can take in multiple targets – provided the visibility is good. Sometimes that information is not available in other ways. For example, with an eddy current, the existing equipment may not show the change in strength and direction of the current, but your eyes will tell you at once, and you can take action accordingly.

On the other hand, it is always harder to orient yourself or find sufficient input at night or in poor visibility. Your ability to judge depth and distance will be especially affected.



Open to all

Never think that it is only the senior pilot or captain who needs to know how to navigate visually. As with all other techniques, the more you notice and the more you practise, the better you will be. Some techniques take time to develop.

You can learn to judge speed by estimating your speed and position based on what you see from the bridge wing, and then compare it with what you see on the ECDIS or GPS. Always look out for navigational marks and transits for reference. All the navigational marks were put in place for a reason!

This technique applies mainly to shiphandling, but can also be useful in coastal navigation. You will be amazed how accurate it can be.

Better seamanship

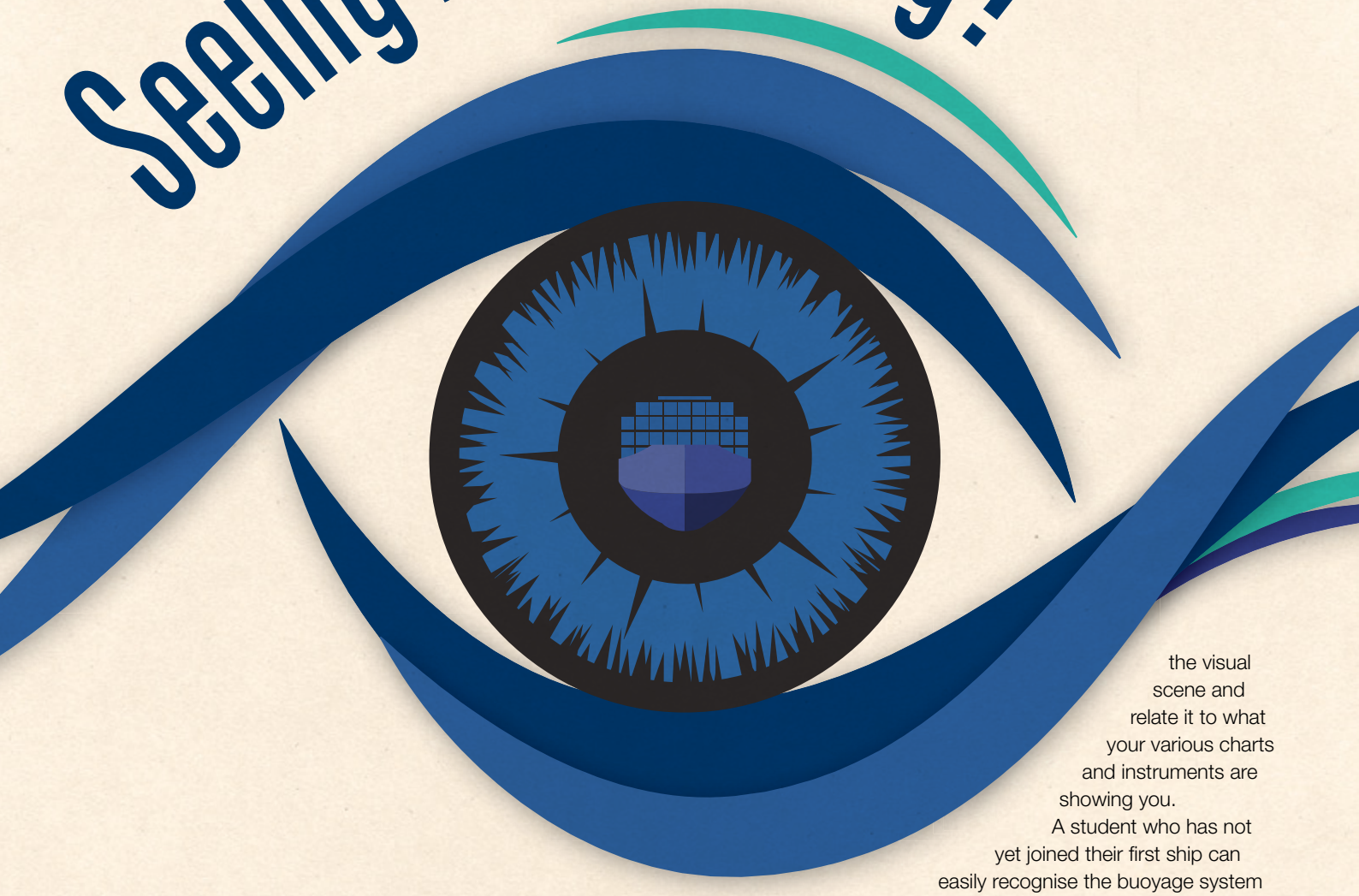
It is very important to conduct a thorough risk assessment of your route before setting off, and plan accordingly. Add the information needed for different stages of the voyage – safe speed, landmarks for parallel indexing, contingency anchorages, areas where you will need to adjust your speed for heavy traffic density. Then add monitoring points, such as places for a visual check on the ship's speed, or assessing the strength and direction of tidal current when passing certain buoys or beacons. Look at the strength of chain on anchored vessels to get a feel for the combination of wind and tidal current. Go outside the enclosed bridge to feel the wind, look out for other ships and check for other visual cues that could help keep you safe. Many people wait until the last minute to go outside the bridge, when it could be too late to make practical use of any visual cues you might pick up.

Looking ahead

Last but not least, safe navigation is the ultimate duty of everyone to secure the safety of lives at sea, protect the ship and operate responsibly on behalf of the owners of the ship and cargo, the environment and the port. Having a 'feel' for what you are doing is always important – if you feel something is strange, pay attention! Are you too fast? Off track? Is the ship behaving differently to how you would expect? Making the most of visual and electronic cues will help you find out.

As a young navigator, developing a good navigational routine, including visual navigational techniques, will certainly help you in your career. Navigators encounter different challenges every day. Working at sea is important and rewarding – and keeping up with your knowledge and studying visual navigational cues to help increase the safety margin and improve your skills at sea will help keep it that way.

Seeing is believing?



Like any cognitive skill, visual perception skills can vary from person to person. The good news, however, is that, like any skill, it can be improved. **Captain Aly Elsayed AFNI**, Senior Technical Adviser at The Nautical Institute, explains how.

Visual perception is the brain's ability to process and interpret visual information from the environment. In navigation, being able to tell the difference between different shapes and objects is crucial, as is the ability to recognise and recall these forms and picture them in various orientations. This is particularly important for tasks such as recognising landmarks, following specific visual tracks or identifying hazards and targets.

Interpreting the visual scene

There is a great deal of emphasis on the importance of keeping a good lookout – and rightly so. However, it is also important to know what you are actually looking at. In other words, you must be able to interpret the visual scene and relate it to what your various charts and instruments are showing you.

A student who has not yet joined their first ship can easily recognise the buoyage system or cardinal buoys on the charts or ECDIS screen in front of them because they are visually standardised. This may not be the case at sea though. Four buoys that look identical on the chart may appear very different in reality, due to their design, location and physical conditions.

Recognising and interpreting these differences is all part of visual perception. We use the same methods to recognise the actual appearance of buoys, channels, terminals, targets, heavy traffic and so on in varying conditions, day or night. Although the symbols on the chart always stay the same, what you actually see in real life will vary depending on water depths, ship position, background, traffic locations, sea state, visibility and many other factors.

Even if there is no chart involved, what you think you are seeing with your

eyes may be quite different to what is actually there. Darkness or fog can make interpreting visual information particularly challenging. Scale can also play tricks: a bigger ship can appear closer than a smaller ship even though it is actually further away; a VLCC in ballast condition will look larger than the same vessel when it is fully loaded. A port entrance or passage between islands may seem to be very narrow, or even invisible, as you come to it from the side, and only be apparent as you approach it head on. This is called parallax error. In some ports and in some vessels, it may be necessary to begin a turn before you can actually see the space you are turning into.

Visual sequential memory

Navigators tend to have better situational awareness when they have a mental picture of both:

- where landmarks and navigation aids are relative to the ship, and
- where those landmarks and navigation aids are relative to each other.

Interpreting cues from visual information (including navigational aids), along with using those cues to identify potential hazards and make precise decisions, is known as wayfinding.

Being able to remember and recall a sequence of visual information is essential for maintaining situational awareness while navigating. This might include the symbols on a chart, the shape of a headland or the sequences of leading marks when entering harbour. This skill is especially relevant when navigating through dynamic and changing environments, such as port approaches and areas of heavy traffic. It is a primary aspect of successful navigation during fog or sandstorms when visual information is obstructed, or if information from navigational equipment is unavailable because of system or sensor failure.

Understanding and being able to picture the likely sequence of events, as well as what you will see at each stage, is important because your decisions should be based on the process as a whole, not on individual elements of it. That way, you are cross-checking your own work.

Sharpen your perception

No matter what your experience as a navigator, it is important to sharpen your own perception by consistently training both your eyes and your mind.

Here are some strategies to enhance your ability to create and manipulate mental images. This is a long-term plan for everyone, regardless of their level of experience:

Practise regularly: Dedicate time each day to engage in mental visualisation exercises.

Start simple: Begin with straightforward mental images, such as different types of ships and navigation buoys; comparing them with what is in the chart. Identify the height of the tide. Try to do the same at day and night. Then try to compare objects close to you and far away.

Progressively complex imagery: Start with simple objects and scenes, then move on to more intricate scenarios or tasks. For example, try to imagine an approach passage plan in your mind. Initially, do it step by step and then imagine it as a whole.

Optical positioning: Try to determine a vessel's position using visual observations and references and with the aid of optical instruments. Use this in combination with electronic navigation systems, such as radar, GNSS and ECDIS, to enhance safety and accuracy, especially in adverse weather conditions or when visibility is limited.

Observe and describe: Carefully observe and describe details in your surroundings and try to replicate them in your mind. For example, if you are reporting targets during watch, practise visually determining the distance, bearing, speed, CPA and time of CPA. Compare this with information provided by the navigation equipment.

Imagine a different perspective: Consider how the Master sees things, what the pilot looks for or how your ship appears to other targets on the radar. What aspect is visible to them? Imagine what the tug Master can see while assisting the ship. Or, if you are on the tug, what do you think the view (and your vessel!) looks like from the ship's bridge?

Learn from the experts: Learn from those who excel in mental imagery, such as Masters and pilots, by observing their techniques. This could help you learn how to visually measure a distance from an object at mooring station, for example, or discover how the same distance looks different from the deck and the bridge.

The Ocean Project video 'Looking, seeing and observing' (number six in this link) discusses the issues in this article in more detail and lets you see what these techniques look like in practice.

Visualisation

'Visualisation' means creating images within your mind, or picturing the steps within a process – what might be referred to as 'mental practice'. It helps break down complex problems into manageable steps and identify solutions effectively.

Actively practising mental imagery exercises can help maintain and strengthen your visualisation skills and prepare you for different scenarios. Imagine an experienced tanker Master who is assigned to navigate through the Singapore Strait for the very first time. They turn to the sailing directions, ECDIS and Singapore Guide Charts. These documents give a guided visual task, filled with detailed information about the strait's characteristics, limitations, turns, speed, depths, current traffic, guidelines, etc. The Master can use all of this information to prepare and envision each stage of the passage (appraisal, planning, execution and monitoring) and how they might need to react to various scenarios.

WATCH-OUT

In this series, we take a look at maritime accident reports and the lessons that can be learned

The danger of distractions during lookout

What happened?

A small cargo vessel was moving at around 12 knots in daylight with good visibility. The OOW, who was alone on the bridge, had looked out of the window to ascertain that there were no dangers of collision ahead. He then turned away from the window to attend to some admin tasks on the computer located aft in the wheelhouse.

A fishing trawler was operating nearby. The AIS had been set to passive, as the vessel had previously been trawling for prawns and wished to keep the prime fishing location secret from other boats in the area. The trawler was drifting slightly astern at around one knot due to the current and weight of the trawl net. The skipper saw the cargo vessel approaching directly and reactivated his AIS. However, he did not think it was necessary to communicate with it due to the clear visibility. Once he realised that a collision was about to occur, he took corrective action but it was too late and the two vessels made contact.

Both vessels sustained damage but no one was hurt in the incident. The two vessels returned to port for inspection and repairs.

Why did it happen?

> The OOW of the cargo vessel relied on his look out of the window to judge the conditions outside without using any other means to back up his conclusions.
> The OOW then took his attention away from the window to attend to admin on the computer, despite being alone on the bridge.
> The fishing trawler only activated its AIS when the crew spotted the cargo vessel directly ahead.
> Neither vessel communicated with the other, meaning that the collision occurred before anyone could take successful evasive action.

What lessons have been learned?

> It is vital for those keeping watch not to allow any distractions to pull their attention away from what is going on outside the vessel, even if they are work related.
> Vessels do not always have AIS activated, for various reasons, so assiduous lookout procedures, including visual means, are crucial to the safety of all.

THE OOW, WHO WAS ALONE ON THE BRIDGE... TURNED AWAY FROM THE WINDOW TO ATTEND TO SOME ADMIN TASKS ON THE COMPUTER

Read the full report at https://tinyurl.com/yc76rt9j

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.

A deck cadet's view of life at sea

Brazilian deck cadet and Nautical Institute Younger Member Ambassador **Luciana Bezerra** discusses her path to her current position, shares her future plans and explains why she uses manual charts to back up electronic navigation methods

Why did you decide to pursue a career at sea?
I wanted to follow in my parents' footsteps, who both worked in the industry. They used to take me to maritime events when I was growing up to show me how things worked. I loved it then and now I am at sea myself, I still do!

What do you find most interesting or challenging about your current role?
I find my career very dynamic and enjoy the privileges of having beautiful views during voyages and getting to know people from many different nationalities. I also enjoy learning lots of new skills and operations. The most challenging aspect for me is having to spend a lot of time away from my family.

Where do you see yourself in five years' time? Ten?
In five years' time, I see myself working offshore, continuing to travel the world and develop my seafarer skills. In ten years, however, I can see myself moving to a shore-based position, as I will want to stay closer to my family and not travel quite so much after I become a parent myself.

What are some of your preferred visual navigation techniques and why?
Whenever I am navigating, I use my charts to mark and track what I see outside the vessel. I look out for visual references in the vicinity and then cross check them with my radar. This makes it easier for me to see how my vessel is responding. If any of my electronic equipment then stops working, I still have the chart references to help me with my navigation.

Name: Luciana Bezerra

Current position: Deck cadet, *HOS Taurus* (Hornbeck Offshore Services)

Lighting the way

George Shaw from the Royal Institute of Navigation asks whether the oldest methods of visual navigation still have a place alongside today's evolving technology

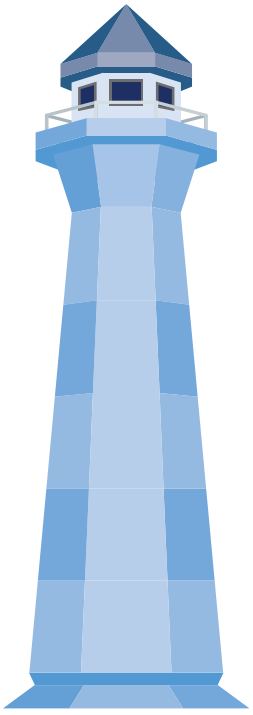
Built in the third century BCE and operated until 1303 CE, the Pharos (Lighthouse) of Alexandria was the third longest surviving wonder of the ancient world. It was also one of the first visual aids to navigation (AtoN) ever built, guiding ships safely to port from more than 40km away. To this day, the visual cues and bearings provided by lighthouses remain important, long-term contributions to safe navigation in increasingly complex sea spaces. They are complemented by electronic aids and digital bridge systems to provide the best possible visual navigation support system for modern seafarers.

In the spirit of the great pioneers, modern developments in AtoN have built on the concept of using visual cues at sea. These have included such innovations as automation, solarisation, high performance LED arrays and 24/7 remote monitoring.

Contrast and compare

Lighthouses and other physical AtoN that operate from a precisely fixed position provide navigational resilience that is generally unmatched by current electronic navigation systems. Unlike GPS, visual cues cannot easily be jammed or spoofed. They provide a valuable complement to electronic positioning in cross-checking digital fixes, which though compellingly portrayed on ECDIS can potentially be misleading. The mariner using 'all available means' for safe navigation can gain reassurance from diligent use of visual cues provided by physical AtoN.

GNSS vulnerabilities may one day be further mitigated by future maritime navigation systems-of-systems, combining independent back-up technologies to safeguard the resilience of position fixing. Recent development of an enhanced pelorus (BinoNav®), a binocular instrument measuring and processing visual reference bearings, can already provide direct electronic bearing lines into ECDIS for digital position fixing. This offers seamless integration of visual navigation within an electronic navigation system, operated with minimal workload for the mariner.



VISUAL NAVIGATION MAY HAVE ITS ROOTS IN ANTIQUITY, BUT IT REMAINS AN ESSENTIAL PART OF THE FUTURE

Visual positioning will remain enormously valuable in this mix. However, it will still require mariner training and continued professional development to maintain traditional navigation skills which could otherwise be lost. Visual cues alert mariners immediately to the proximity of danger and aid prompt, safe routing around hazards, enabling rapid responses for urgent, safety-critical decisions.

It is interesting to compare the continued value of visual cues in modern aviation, where lights are maintained alongside numerous electronic back-up navigation systems, for which there is no maritime equivalent. For example, precision approach path indicator (PAPI) lights, akin to maritime sector lights, are still used extensively at airports as a cue to pilots, warning them of height deviations on the final approach.

Lighting the way

Traffic patterns in crowded sea basins are set to change, thanks in part to the rapid growth of offshore wind farms. Visual cues will be crucial, with lights and buoys marking the boundaries of hazardous areas, revised waypoints in more segmented passages and increasing levels of sea traffic management services. Frequent visual observation of the scene and increased situational awareness will be imperative for sea spaces where encounter rates with other vessels may increase significantly.

Physical AtoN will continue to light the way for safe navigation, eventually supporting and facilitating machine vision of emerging autonomous vessels. The practice of visual navigation may have its roots in antiquity, but it remains an essential part of the future.

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

TAKE 10

Ten useful take-aways for tips for improving visual observation and perception skills at sea

1
Mission-critical
Visual observations are critical to safe navigation. Navigators should continuously work on improving their powers of observation.

2
All available means
The value of visual observations is greatly enhanced when combined with relevant electronic tools. Rule 5 of the Colregs requires lookout by 'all means appropriate'. This includes visual, audio, as well as radar, AIS and more.

3
Practice makes perfect
Visual techniques can be continuously improved, but they do need to be practised – this can be very rewarding!

4
On track
Leading (or range) lights and markers are extremely effective in port. Buildings and other fixed objects ashore can also be key indicators to help guide your way.

5
Free-flow
Watching how water flows past a fixed object is a very effective method for identifying the rate and direction of current.

6
Collision cues
Using the edge of a bridge window is an excellent and quick way of assessing risk of collision.

7
Structures and speed
When approaching a berth at slow speeds, comparing your ship's structure with fixed structures ashore (bollards, cranes, etc) can be far more effective than using electronic tools when assessing speed and direction.

8
By degrees
Watching the foremast against the horizon is an excellent means of assessing rate of turn.

9
Gathering clues
Observing visual clues from other vessels, such as propeller wash or anchor chain tension, can tell you a lot about their intended actions and the environment around them.

10
Mentoring matters
Visual techniques are best learned and taught on board; take every opportunity you can to learn from others (particularly pilots) and share your own knowledge with others.

LIKE OUR TOP 10 TIPS?

Find more in your own language at www.nautinst.org/NavInspire

#NavInspire

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...

We love seeing the creative photos Navsnap entrants send in from all over the world (shoutout to BK Goodboy, who sent us a whole photostory!), and hearing where your voyages take you, or where you are studying. This issue's winner is Arbaz Khan, who sent us his picture from on board the container ship *Kota Puri*.

Arbaz Khan
NAVIGATOR CHAMPION