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 SECTOR SPOTLIGHT | STABILISERS

DON'T ROCK THE BOAT

POWERED STABILISERS THAT DAMPEN A BOAT'S MOTION HAVE SEEN A REDUCTION IN COSTS, MORE RESPONSIVE MOTORS AND GREATER SYSTEMS INTEGRATION

WORDS: JAKE KAVANAGH



▲ Whatever the size of your boat, there will be a powered stabiliser solution, with several models in each brand. The 11m sports cruiser seen here is fitted with Humphree interceptors, whilst the superyacht market has been targeted by the makers of large 'driven' gyrostabilisers such as those from Gyromarine

THE MARKET FOR stabilisers, both on new-builds and retrofits, appears to be doing well, with proven technology harnessed to meet the challenges of unusual hull shapes and high-speed operation. Marine professionals, particularly those operating workboats and passenger vessels, have long recognised the need to reduce motion afloat, most obviously for crew comfort. A more stable ride doesn't just help prevent seasickness, it also greatly reduces crew fatigue, and on commercial vessels in particular, this leads to fewer accidents. "Each movement of a boat, whether from pitch, roll or yaw, inflicts acceleration forces on your passengers and crew," explains Alessandro Cappiello, CEO of Italian stabiliser specialist **CMC Marine**. "It is these accelerations that induce nausea and fatigue, not the actual angle of the boat."

"Zero speed technology – the ability to stay relatively motionless at anchor, forever changed the entire yachting industry," says John Allen, president and CEO of Quantum Marine Stabilizers. "This opened the doors of yachting to people who previously suffered from motion sickness. As the technology has improved, so have customer expectations. Our systems have progressed from a 35% roll reduction in the early days, to up to 95% roll reduction in similar

conditions today. With so much progress over the last 20 years, we have always ensured that our innovations are backwards compatible and current installations are future-proof."

Whilst the humans onboard will appreciate a smooth and 'directionally-stable' ride, so does the boat. Proper trim and minimal roll is also kinder on the structure and machinery, and can lead to some significant savings in fuel.

RIVALS TO THE FIN

The fin has long been the mainstay of the stabilisation market, but is facing competition from rivals. The need for stabilisation at high speeds and in waters where hull projections may be damaged has led to other technologies being developed. These include retracting foils and rotors, and the use of the gyro. "Not every vessel can

► The traditional fin arrangement, such as CMC Marine's new Long Range system with an all-electric actuator, is designed for easy retrofit

fit the traditional fin stabiliser," says Tony Elms at Italy-based Gyro Marine. "This may be due to the shape of the hull, or because the yacht will be venturing into ice. This is why solutions such as the gyro are becoming more mainstream. Our gyro system, for example, is proving very popular with explorer yachts."

A comfortable vessel encourages more time afloat with family and friends, as marginal weather is less daunting, anchoring is more restful, and the boat is easier to handle at speed. A lower fuel bill is also welcome. For commercial users, less crew fatigue and fewer accidents more than repay the investment, and for the military, there is the added bonus of being able to shoot straight, too.



THE FOUR TYPES

There are essentially four main types of marine stabiliser available. ➔

▲ Quick S.p.A's MC X 19K is a compact gyro system designed for fast spool up and no need for external cooling

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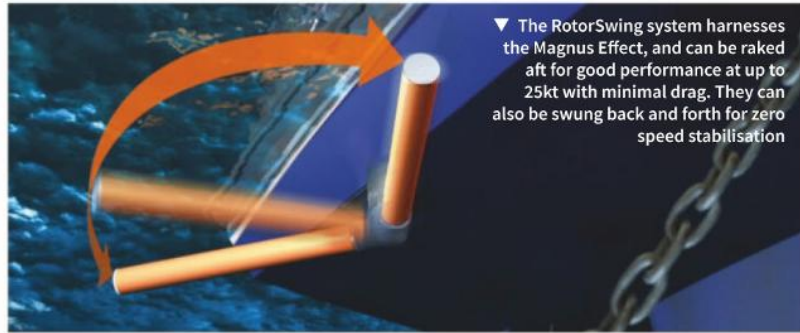
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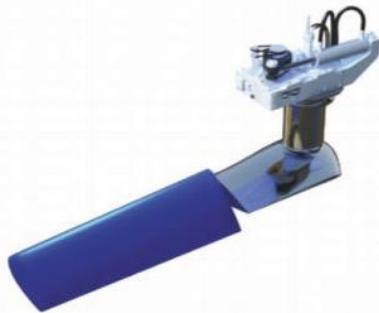
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▲ Sidepower's Vector fin stabilisers have been curved to optimise zero speed and cruising efficiently, and provide lift to offset drag



▼ The RotorSwing system harnesses the Magnus Effect, and can be raked aft for good performance at up to 25kt with minimal drag. They can also be swung back and forth for zero speed stabilisation



▲ The DYNA-Foil system from Quantum offers a high degree of response, but can also fold into the hull when the yacht is moored, or in compromised waters such as ice floes

Three of these – namely the fin, the foil, and the rotor – all project from the hull, while the fourth, the gyro, is installed internally. This is usually in the engine room along the centerline, but technically it could be anywhere aboard with sufficient support.

A fin system usually involves a single or double pair of articulating blades that protrude at around 45° from the bilge area. These are powered by either electric motors or hydraulic rams and can be responsive enough to counter a rolling motion when the vessel is stopped. Originally the domain of the superyacht due the power required to run them, these 'zero-speed' stabilisers are proving very popular on craft of more modest dimensions, especially as OEMs develop increasingly compact and energy efficient units.

Foils are another version of the fin, but typically can be swept back and forwards, and retracted when necessary. This high

degree of articulation is combined with an efficient cross section to maximise lift for minimal drag.

The All-In-One from DMS, for example, takes this a stage further by allowing the foils to swing under the transom and double as trim tabs at speed.

The rotor stabiliser such as the RotorSwing or Quantum MAG-Lift uses a submerged rotating cylinder. This harnesses the Magnus Effect, whereby a spinning cylinder mysteriously produces a substantial amount of lift. When large versions are mounted vertically on a ship, they act as 'zero wind sails' and literally suck the ship along. This can save up to 20% in fuel costs, despite the energy needed to spin them.

A gyro-stabiliser utilises the damping effects of a spinning metal flywheel, which exerts a counter force to the rolling motion. They have become small enough to fit into boats of just 8m (24ft) but they remain quite costly. Gyros are usually only found on motor vessels, as the keel of a sailing yacht can interfere with the forces of gyroscopic 'precession'.

Whilst effective against roll, stabilisers are also becoming better at controlling pitch. Traditionally, this has been left to trim tabs to counter, optimising the angle of attack to allow the hull shape itself to give an easier ride. However, the march of connectivity is allowing a computer to work the fins, rudder and trim tabs together to give much greater directional stability, especially when on the plane.

So, what are the trends in the stabiliser market? We'll look at all four categories, and get feedback from industry professionals:

THE FIN AND FOIL

"Stabilisation involves huge forces," says Ronny Skauen of Norwegian specialist Sidepower (Sleipner). "The mechanics have to be securely installed to be able to transfer the stabilising forces to the structure. This means that the area of the hull where you fit the fins must be strengthened. In new builds, this area can be prepared in advance, but in retrofits, hull strengthening and 'creating space' for the system is typically the majority of the work, and therefore the cost."

To help installers, stabiliser OEMs are usually able to offer a wide range of stabiliser systems aimed at specific sizes and types of vessels. Boatbuilders work with stabiliser companies to establish the ideal system for a particular model of boat, whilst the refit market is seeking models that are easy to fit, with 'plug and play' connectivity.

As seen with CMC Marine's Argo system, this connectivity is being expanded to link seamlessly with other underwater control surfaces, with a high level of automation to manage the ride via input from sensors.

For example, at a recent press gathering, Swedish manufacturer Humphree demonstrated its latest innovation, the customisable electric fin stabiliser. With fins built of carbon fibre and electrical power from a basic 24V battery system, the new product links electronically with Humphree's Interceptor trim tabs to combat pitch as well.

This combination approach made it the overall winner of the 2015 Dame Awards, but other OEMs are also harnessing processors into a stabiliser package to have greater control over pitch as well as roll.

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HERE ARE SOME OF THE GENERAL TRENDS FOR FIN-POWERED STABILISERS

TREND 1: More hydrodynamic design

A lot of effort has gone into the shape of the fin design, making full use of advanced hydrodynamic modelling and stress flow diagrams.

Sleipner, for example, said it focused on hydrodynamics as a priority when creating the curiously-curved Vector range of fins.

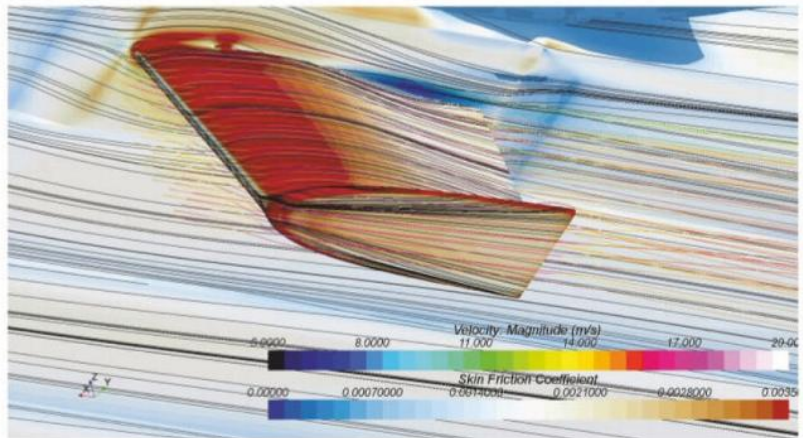
“They were designed for fast boats from the outset,” Sleipner’s Ronny Skauen said. “We have now launched the first size in the next generation of Vector fins. They have even ‘more vector’ to emphasise the lift aspect. This helps to offset the drag caused when any type of lift is added to the hull, and the shape allows us to mount them further aft. In this location, they can actually help to lift the stern and improve a yachts speed.”

TREND 2: Faster activation

Whilst hydraulic systems have improved greatly over the years, the surge of robotic assembly plants throughout the world has produced a new generation of fast acting servo motors to deliver high torque with absolute precision. These are ideal for stabiliser actuation. ➔



▲ CMC Marine’s hydrodynamic consultant Silverio Della Rosa poses with the company’s latest generation of Italian-made fins



▲ Whatever the underwater profile, advanced computer modelling is helping to confirm and improve on test tank results. Here are the flow dynamics of CMC Marine’s latest fin

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Hydraulic rams, as with Sidepower's Vector system, have improved greatly in recent years. They are increasingly more compact, self-contained and dependable

hydraulic components such as reservoirs, valves and coolers into one unit for easy installation, and others have followed. Advanced new electro-hydraulic systems can now apply large amounts of torque from a compact head unit to meet the massive cyclic loads on large fins.

TREND 3: Better sound damping

Off the back of a new generation of servos and high torque electric motors is the noise dividend. The last thing an owner wants to hear is the irregular working of the stabiliser actuators during a quiet night at anchor.

Sleipner's Ronny Skauen feels that noise should be reduced by good engineering and installation, rather than relying on additional insulation.

"Noise at anchor is very noticeable as the main engines are off," he said. "Our engineering has always been to eradicate noise in the first place. This is especially important for the gear that goes into – or underneath – the living space or is connected to the hull structure. We ensure that it is unable to transmit any hull-borne noise. For example, there are no audible 'hydraulic pulsations' as the actuators are silent and no rumble from the shaft bearings due to perfect tolerances within long-life components."

Similarly, Naiad Dynamics, whilst a major supplier to military and commercial operations, also provides a Quiet Powerpack option for yachts.

TREND 4: Lighter materials

The loading on a fin, especially at speed, can be heavy and cyclic, so manufacturers are turning to modern composites to produce lighter yet stronger fins.

Humphree, for example, use carbon fibre, and Naiad use an advanced composite construction that is galvanically inert, but which houses a stainless-steel insert with a self-locking keyless taper. This fin is designed to withstand damage, but also to 'yield safely' to major impacts without holing the hull.

Sleipner also adds layers of carbon to its larger fins, but this is less to do with weight, and more to do with reliability.

"The weight savings at this percentage are minimal in the overall picture of a powerboat," Skauen explains. "The

important thing is to get the engineering right for dependability when such big forces are at work."

TREND 5: Greater integration

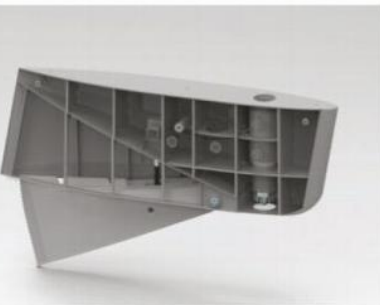
Quick reactions need quick thinking, and a joined-up approach with complimentary systems such as trim tabs and rudders. Most of the manufacturers we spoke to are using advanced control systems for instant response to data from sensors. In addition, algorithms are being used to not only react to movement, but to actually predict it too.

In 2014, US-based ABT:TRAC introduced TRAC.link, which uses a CANbus system to link all the hydraulic systems, including anchor windlasses and stabilisers into one control panel. Naiad currently uses a 'fully proportional automatic Angle-Velocity-Acceleration (AVA) closed loop control system for maximum control, and other OEMs also have their own proprietary electronics. These are presented to the boat owner in some stylish and futuristic interfaces. Whilst skippers may be tempted to constantly tweak the settings, a high degree of automation is there to encourage them to sit back and enjoy a well-managed, fuel-friendly ride instead.

TREND 6: Easier retrofit

As with all technology, the latest systems are being fitted by OEMs, whilst older units are being stripped out and upgraded by the retrofit sector.

"Development in this area should be considered with safety and reliability, not just ease of installation," Sleipner's Skauen advises. "Practically speaking, boats are hugely different and individual when it



Quantum's XT range provides an extending foil from within the fin to increase surface area when being used in 'zero speed' mode. This upgrade is backwards compatible

"We worked closely with industry leaders when we developed our new electric motors," said CMC Marine's Cappiello. "These were primarily Mitsubishi Electric for the actuators, Wittenstein for the motion control systems and Danfoss for the electronic controls. The result was a system that was incredibly fast to react. This is why we have switched away from hydraulic systems completely."

However, hydraulic systems have also been evolving fast. In 2007 ABT:TRAC was one of the first to 'pre-plumb' many



Fitting new and more powerful stabilisers, or adding them for the first time, can often mean major surgery on the hull, as seen on this superyacht refit in Florida.

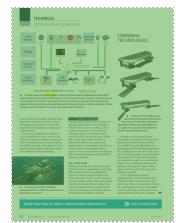
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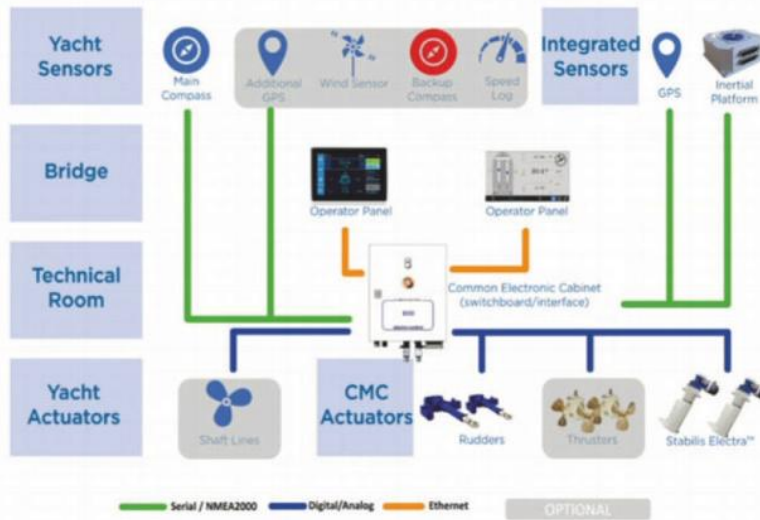
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▲ The Argo system from **CMC Marine** is reflecting the future path of stabilisation, where all the control surfaces interact automatically from a central computer to give a superior ride at speed, and a more gentle time at anchor. This graphic shows how the system, developed with hydrodynamic engineers Sirehna, provides continuous information between the sensors and the actuators. Custom settings can also be dialled in for use by more experienced helmsmen

comes to the retrofit market. Installers often get into the situation where the choice of technology and sometimes even brand is dictated by the available space and location within the hull."

Key to any installation is to make it as easy as possible for the fitter, and here the OEMs are aiming for modular construction with the minimal amount of time required to assemble the units in situ. However, more powerful and responsive units often require some additional hull strengthening.



▲ In 'bow anchor mode', a Humphree-equipped yacht can 'paddle' its way forward as the anchor is recovered

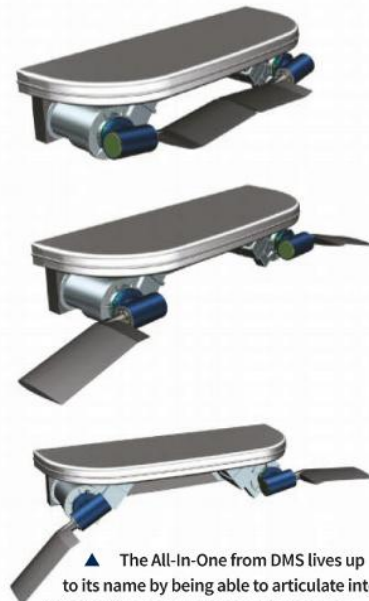
TREND 7: Greater articulation

The amount by which a fin can move will also lend itself to greater functionality, with the electric motor enabling a fin to rotate through 360°. This has allowed Humphree to give boat owners some unusual abilities when anchoring. Whilst able to move more widely than before, essential for effective zero speed work, modern fins are now designed to break away cleanly if they hit a submerged object at speed. This is to reduce the risk of holing the hull. But perhaps the greatest articulation is being seen with foils.

FOIL STABILISERS

Foiling technology has made its way into all kinds of marine applications, including RIBs, sailboats and even paddleboards, thanks to modern composite materials. These allow for very thin profiles that can withstand high loading, while maintaining a hydrodynamically-efficient shape. Foils can be articulated like an aircraft aileron, with the advantage of stowing flat against the hull when the vessel is moored.

COMBINING TECHNOLOGIES



▲ The All-In-One from DMS lives up to its name by being able to articulate into three main roles: Trim tabs at high speed, raked foils at medium speed and 'flappers' at zero speed. They can also retract behind the transom when the boat is moored

Perhaps one of the most striking innovations is the All-In-One from Dutch-based Diverse Marine Systems (DMS). In a collaboration with Rijksdienst voor Ondernemend (RVO) Brabant Engineering BV and Elling Yachts, the All-In-One uses a pair of articulating foils to counter dynamic roll and pitch. The really clever bit is that the articulation range is so varied that this system can cover all speeds from zero to planing, as the diagram explains. But, we asked, won't such a dynamic range prove difficult to operate?

"The engineering is relatively straightforward," says technical director Arnold van Aken. "It is the software that has to cope with so many variables. As such, the operating system has two basic modes – one for automatic, and the other for an experienced user. This is very common ➡"

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on advanced electronics, typified in modern 'semi-pro' cameras. You either let the kit do the job for you or play with the settings for custom effects. In each scenario, the All-In-One software protects against misuse and uses the CANopen system for quick response."

The system has taken nine months to get to the prototype stage and is now being successfully trialled by Elling Yachts. From early next year it should be available in two versions, one for full integration into a new build, and the other as a retrofit package.

THE ROTOR

The rotor stabiliser uses the Magnus Effect to generate lift, with surprising results. The technology is being pioneered for smaller craft by RotorSwing, a Dutch specialist catering for motoryachts and sportsfishers of all sizes. "Theo Koop invented the Magnus Effect stabiliser back in 1970," says Rien van den Bergh, RotorSwing's office manager. "But it wasn't until about 10 years ago that the technical limitations were resolved. By collaborating with Quantum Controls Engineering, we now have RotorSwing's highly versatile and retractable stabiliser system."

Van den Bergh explained that the system was originally designed for displacement vessels and proved very effective. Unfortunately, the perpendicular deployment could cut nearly a knot off the top speed. The solution was to 'adaptively

▼ Other OEMs have discovered the benefits of the Magnus Effect. This version from Quantum has found favour in military vessels as well as superyachts, as it can be retracted when not needed, and gives a stable platform at rest for sunbathing – or live firing



▲ This is the smallest of the units made by US-based Seakeeper, seen here as a boat show demonstrator in an 8m (24ft) sportsboat. IBI tried this unit, the 12V Seakeeper 2, for ourselves, and were impressed with its ease of use and strong damping effect

and proportionally' rake the rotors aft for high speeds (up to 25kt) a bit like the wing on a fighter jet.

Later innovations allowed the motors powering the rake to be used for zero speed stabilisation by swinging the cylinders back and forth to generate lift, but without any 'sculling' effect. The system can also be engaged when going slowly astern, ideal for fishermen hauling their catch.

"The rake function provides an extremely efficient multi-function roll damping system for vessels of up to 35m," Van den Bergh said. "This has opened another large market for fast cruising with RotorSwing."

Meanwhile, US-based Quantum has developed the MAG-Lift system, which is finding favour in the commercial market. The speed of rotation combined with the angle of the rake is said to give an 'instantaneous' reaction, allowing for a steady working platform. Quantum's figures suggest that its smallest model, the ML200 with a rotor of 1540mm by 220mm, is equivalent to a fin of 1.9m² at 8kt.

THE GYRO

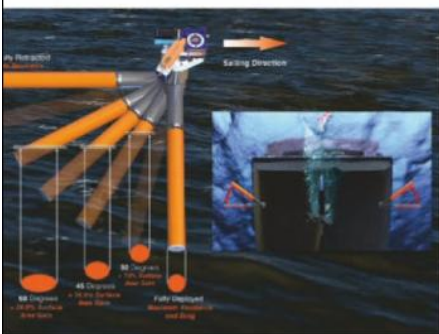
Several marine companies have successfully harnessed the damping effect of gyroscopic 'inertia' to provide a powerful counterforce to the roll of a boat. The self-righting tumble of the gyro transforms the roll into a bobbing motion instead. IBI was invited for a demonstration in two different boats, one stabilised by US-based Seakeeper, and another by Australia-based VEEM, to witness just how effective the gyro

can be. The engineering of a marine gyro for stabilisation is much the same in each brand – a steel flywheel is spun by an electric motor in a spherical chamber. The chamber maintains a near vacuum to eliminate air resistance and corrosion, allowing the flywheel to be made lighter, but still able to reach speeds in excess of 9,700rpm. The unit can take several minutes to reach operating speed, and when deployed its unique movement known as 'precession' is harnessed by hydraulic rams attached to the structure. These forces are transferred immediately to balance the boat from wave to wave. When disconnected it sits in its frame with no effect on the hull. After use, the gyro is switched off and winds down, with even a small unit taking around six hours to slow to a halt. The owner doesn't need to be aboard for this – the units take care of themselves.

All gyro stabilisers need a cooling system, either fresh water, sea water or forced air.

DEVELOPMENTS IN THE GYRO

"We have spent a great deal of effort in refining our four models of gyro stabiliser," says VEEM's Luca Signorini. As the company's southern Europe development manager, he hosted IBI's ride on the Viking 64 demo boat. These refinements have obviously paid off, as the VEEM Gyro 260SD won a special mention in the 2018 DAME Design Awards at METSTRADE. The judges described it as "beautifully engineered, and designed to work as a single installation on ships of up to 250 tonnes".



▲ Whilst some drag is experienced when the rotors are perpendicular, this is greatly reduced as they are moved aft. The system can also be used in reverse, providing stabilisation as sea anglers reel in their catch

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QUIET RUNNING

"The units are very quiet, which makes them ideal for use overnight at anchor," Signorini says. "They operate at just 57db, whereas the average speaking voice is 83db. The gyro can also be operated from any onboard control station and is very easy to install. Another advantage is that there are no flapping fins involved, so there are no concerns about swimmers alongside."

The Seakeeper IBI tried out was also remarkably quiet. The unit was the Seakeeper 2, the smallest in the range and able to run off a 12V battery system. "Noise output is around 68db," explains Seakeeper's communications manager Kelsey Albina. "That is pretty minimal, and even the largest units run very quietly."

EASE OF INSTALLATION

Gyros can be effective when located almost anywhere on board but are usually housed in the engine room to take advantage of load-bearing frames and access to power and cooling. They are also placed along the centerline to prevent damage from hard wave impacts. The Seakeeper 2 and 3 models can even be mounted beneath the helmsman's seat and act on a vertical pillar.

Another DAME mention was the MC² X 7k gyro stabiliser from Italy-based Quick SpA, mainly for the simplicity of its set-up. The design is very compact, but the element that sets it apart from the competitors is the horizontal axis gyro. This is said to minimise vertical compression loads on the lower bearings, give a faster spool up time

and remove the need for water cooling. The judges remarked that they "admired many design details of this model, including the user interface."

REMOTE OPERATION

With the gyro systems, care has been taken to ensure that the controls are very easy to understand. Normally it is a question of spool up, engage as required, and then put it into a spool-down mode when the boat is left. Mobile apps can also be used to monitor a system remotely via a phone app, so the gyro performance can be checked underway. Whilst the gyro is a passive system, all the models from Gyromarine can be actively 'driven' to greatly enhance the damping effect.

THE ROLE OF TRIM TABS

An increasing trend is for stabilisers to work hand-in-hand with trim tabs or interceptors, with automatic control of the boats stability via an integrated system of sensors. A good example is the Zipwake system, which is described as an 'automatic, full-control trim system for semi-planing or planing boats of between 7m-18m (20ft-60ft).

Zipwake takes advantage of the quick deployment of its own design of interceptor blade, said to be just 1.5 seconds from zero to 30mm (1.2ins). This allows the pitch and roll dampening of a fast boat to be controlled automatically, with a manual over-ride if preferred. Designed and built in Sweden, Zipwake uses information from a GPS, 3D-gyro and 3D accelerometer to automatically compensate for big seas and

hard turns, giving a much smoother ride and claiming savings of up to 20% in fuel.

The system is very much plug and play, with easy installation on the external transom by a yard or experienced DIY enthusiast and has been developed almost exclusively with retrofit in mind.


In an interview for US-based *Yachting* magazine, Zipwake's design engineer Axel Lindholm said: "We wanted to make sure the system compensates properly when the boat turns or rolls. Just as important is ending that roll when the boat straightens up again."

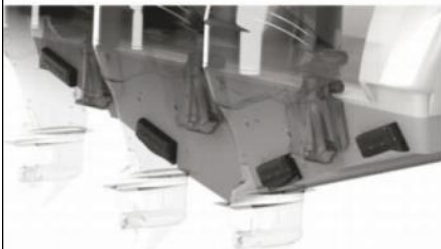
Taking stabilisation to the final degree of simplicity with a static system is Hull Vane, a fixed hydrofoil system that won the 2018 Technology Award from the International Superyacht Society. Hull Vane is a submerged 'wing' that improves the performance of displacement vessels by converting the energy in the stern wave into forward thrust. Apart from saving between 10% to 29% in fuel, Hull Vane also claims a stabilisation bonus. The wing dampens the yacht's motion in a seaway, whilst also reducing noise from the smaller stern wave.

THE FUTURE

There is no doubt that powerful and quick moving actuators combined with lightning-fast processing are making boating far more stable, and even much smaller craft can now extend their cruising into seas they would normally avoid. The advance of connectivity and automation of all the underwater control surfaces will make a big difference to performance and economy.

However, as Sleipner's Ronny Skauen explains, there is still some confusion as to how to compare different stabiliser systems and their actual force capabilities. "These can be easily calculated from basic mathematics," he says. "Some manufacturers talk about peak force capabilities available for a fraction of a second, while others quote the total force available for the whole roll period. Currently, there is no standard allowing a fair comparison, but perhaps the industry can agree on a common standard."

Meanwhile, if you don't believe how good stabilisation can be, get out on a test boat on a windswept day and see for yourself. 



▲ Trim has a big role to play, and these interceptors from Swedish manufacturers Zipwake work with sensors to not only stabilise a boat automatically underway but also manage quick recovery from tight turns

► The advance of connectivity means that stabilisation can be monitored remotely.

Quick Marine's MC² X app allows management of its full range of MC gyro stabilisers, including recording of performance during sea trials



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