Building better ships

THE EU'S SATURN PROJECT AIMS TO REDUCE UNDERWATER NOISE FROM SHIPPING

Shipping   Underwater noise

Innovating for a better future

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> Innovating for a better future

The global maritime industry is working on new technologies to reduce underwater radiated noise from shipping through a project known as SATURN (Developing Solutions for Underwater Radiated Noise). The project's marine biologists are investigating how marine mammals, fish and invertebrates respond to various sound levels and frequencies and defining criteria to assess the impact. At the same time, acousticians are developing standards for terminology, impact assessments and underwater noise measurements. These studies support the EU Marine Strategy Framework Directive (see box below). **JOHAN BOSSCHERS** explains how several emerging technologies could help to quiet commercial ships—including some that were once top secret and used only by military vessels.

The EU Marine Strategy Framework Directive aims to protect marine ecosystems and biodiversity. It requires EU member states to take an ecosystem-based approach to managing human activities and maintain a "Good Environmental Status."

Next to machinery noise, ships' propellers are the dominant source of noise on most ships. As a result, many of the noise-reduction technologies being studied today focus on these. Cavitation—the formation and implosion of small bubbles on propellers as they rotate—causes vibration and significant underwater noise that can radiate across large distances.

Various organizations are exploring potential retrofits to replace the propellers on a twin-screw ferry. (A twin-screw ship has two screw propellers, which usually revolve in opposite directions.)

For example, CETENA, an Italian research and consultancy firm, is studying a pump-jet propulsor—a special combination of propeller and duct that can be used on submarines to make the propeller quieter. The design is nearing completion and will be tested by the Italian Institute of Marine Engineering at the end of this year.

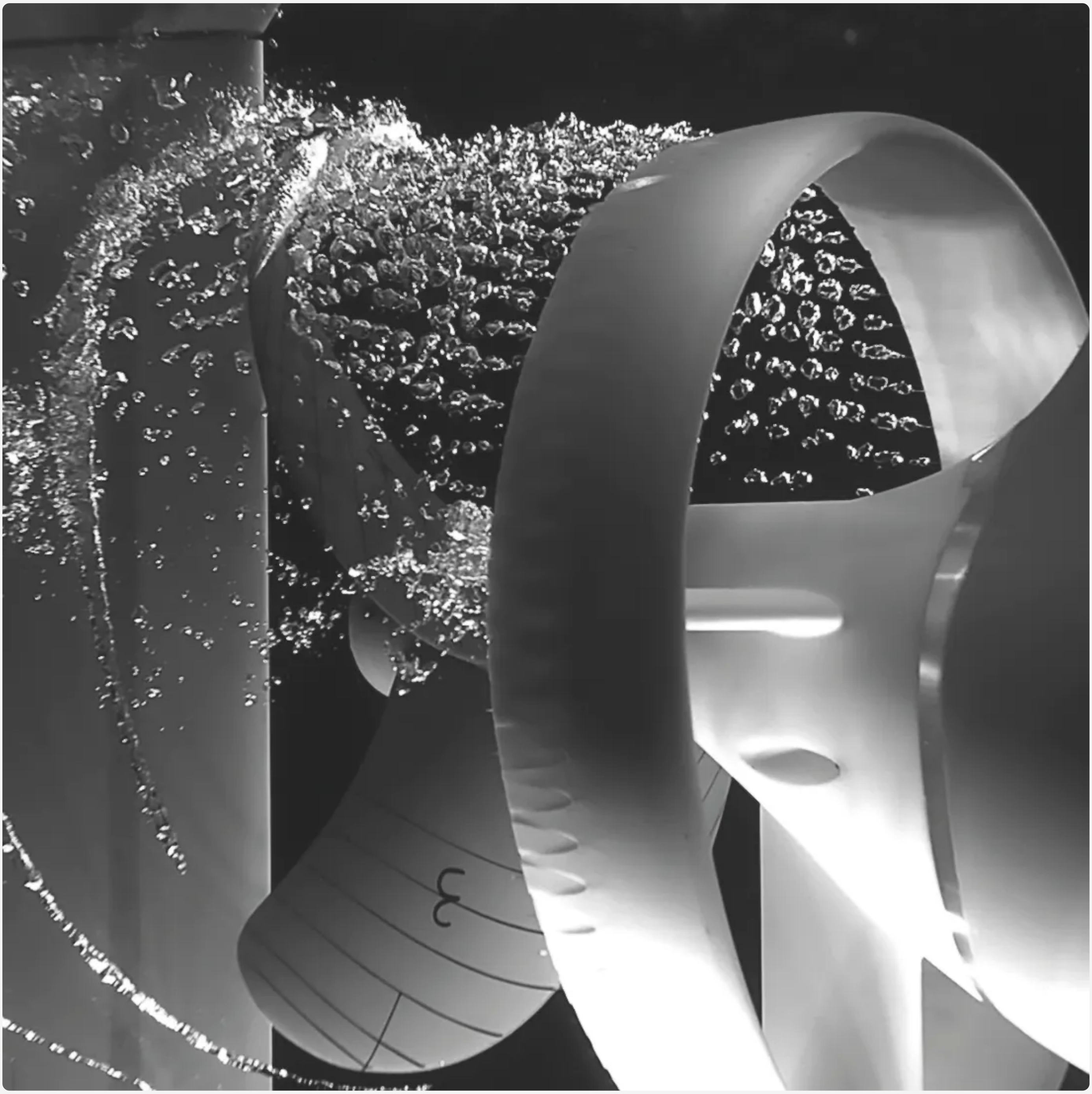
Meanwhile, Sirehna, a subsidiary of Naval Group, the French naval shipyard, has been developing a trochoidal propeller whose blade motion resembles that of whale's tail, and recently tested it on a French lake. And two Netherlands firms, MARIN and Wärtsilä, are designing a new propeller that uses modern automated design techniques to reduce noise.

REDUCING BOTH NOISE AND FUEL USE: A WIN-WIN

Using the Depressurized Wave Basin, a unique research facility for testing ships and offshore structures in realistic operational conditions, MARIN has also experimented with two solutions that use air-bubble injection.

Air bubble injection below a ship’s hull to lessen machinery noise, known as the Masker system, has been used on military naval vessels before. There is no quantitative information in the open literature about the resulting noise reduction, but this solution is still an interesting possibility for ships equipped with two-stroke diesel engines because there are currently no other promising noise mitigation measures available for these.

In addition, more and more ships are now equipped with air lubrication systems that can reduce their hulls’ frictional resistance, cutting down on both fuel use and carbon emissions.



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TAKING A SECOND LOOK AT THE MASKER AND PRAIRIE SYSTEMS

Combining the two approaches—air bubble injection and air lubrication systems—may produce a win-win situation when it comes to fuel efficiency and underwater noise. MARIN has evaluated the Masker system for a one-propeller tanker known as the Streamline. A metal midsection has been designed, manufactured and tested using a shaker to mimic machinery vibrations, and porous hoses have been mounted on the ship's hull upstream of the metal midsection to inject air. Preliminary results indicate that the noise reduction may be more than 20 decibels.

Air bubbles can also be used to reduce cavitation noise: if the cavity contains a sufficient quantity of air, it collapses more slowly, reducing the volume of radiated noise. In what is known as the Prairie system, the bubbles are injected in the flow-through holes in the propeller blade.

However, manufacturing such a propeller blade is challenging and, as a result, expensive. An alternative approach is to inject air bubbles from the hull upstream of the propeller. This idea has been evaluated before and shown some potential, which is why MARIN assessed it for the Streamline tanker. Preliminary results have shown that it's possible to achieve significant noise reduction. But there is an increase in noise levels at very low frequencies, most likely due to the increase in cavity volume.

Once considered top secret, the Masker and Prairie ship noise reduction systems were originally designed to prevent a hostile vessel, such as a submarine, from classifying or identifying a warship's acoustic signature.

The Masker portion of the system is installed on the hull of a vessel, usually near its machinery spaces. The Prairie portion is designed to silence its propellers.

MORE STUDIES AHEAD

Ultimately, all noise-reduction technologies will be evaluated by CETENA and DNV, a Norwegian classification society. These organizations will look at capital investment costs, operational costs, and outcomes related to the International Maritime Organization's Energy Efficiency eXisting ship Index (EEXI), a measure introduced to reduce ships' greenhouse gas emissions. At the same time, the approach to studying the resulting impacts on marine life is being explored with support from JASCO Applied Sciences Germany and Aarhus University in Denmark.

The result will be a comprehensive overview of the effectiveness of all these new ship noise mitigation technologies—and, hopefully, a quieter environment for marine life soon.

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