

Feasibility of Active Noise Control on Marine Gensets: Concept Testing on Everllence 175D

Autors: **Dipl.-Ing. (FH) Ricardo Hermann (Everllence SE), Dipl.-Phys. Roger Wimmel (ERAS GmbH)**

A major challenge in shipbuilding remains the constant improvement of passengers' and crew comfort and the reduction of underwater radiated noise in the context of environmental protection as well as related to the noise signatures of naval vessels.

Several sources on board contribute to noise generation, with marine engines used as propulsion engines for mechanical as well as electric propulsion or auxiliary gensets for power generation being among the most significant. One of the main tasks in this context is to reduce the dynamic forces induced in the ship structure, especially for ship types with increased requirements in this regard, such as pleasure crafts, research vessels, or naval ships. The reduction of structure-borne noise excitation conflicts with recent efforts to reduce the ecological footprint from these engines.

Nowadays, electric propulsion systems with DC net and variable-speed generators allow engines to operate at an optimized speed, maximizing efficiency and minimizing fuel consumption based on the current load conditions. Usually, single- or, in case of increased requirements, two-stage elastic mountings are used to isolate the structure-borne noise mainly excited by the operational vibration of the combustion engines. This effectively reduces the dynamic forces transmitted to the machinery foundation and hence vibrational excitation of the attached structures. However, the isolation capacity of these mounting systems depends largely on the excitation frequencies.

Conventional passive isolation systems, while very effective at higher frequencies, can be less effective in the low- to mid-frequency range. Resonance effects of the mounting system, within the mount itself but also in structural parts (e.g., the above-mentioned intermediate frame), lead to a reduction of vibration isolation. For challenging applications, double-resiliently mounted systems often require a very heavy and stiff intermediate frame construction to ensure sufficient isolation quality. Due to local and global effects on the engine's operational vibration behaviour, structure-borne noise excitation often exhibits elevated levels within certain speed ranges, for example at higher part-load operating points. Operating a variable-speed genset at unpreferred speed can lead to increased structural excitation and vibration response in the vessel. The effects listed above cannot be completely eliminated in real-world applications, but they are typically taken into account during the layout phase of conventional fixed-speed designs.

Active Noise Control (ANC) offers a promising solution by introducing counteracting forces in critical frequencies directly at interfacing points to reduce dynamic loads transmitted to the hull. High vibration isolation can be maintained even at critical operating points, reducing the need for extensive optimization of the mounting system and frame structure. In another case, complex two-stage systems may no longer be necessary for specific vessel types with increased noise & vibration requirements if ANC systems with increased actuator power can be implemented directly on the vessel foundation.

Everllence SE and ERAS GmbH have jointly performed conceptual tests in that regard. This paper presents a feasibility study of an ANC system with a limited number of actuators applied to a high-speed marine genset (Everllence 175D series) with a double-resilient mounting arrangement. The approach integrates voice-coil actuators at the intermediate frame's mount points to generate counteracting forces in the dominant vertical and transverse directions, governed by a real-time adaptive control system. Sensor feedback and shaft trigger signals enable precise force application in the engine harmonic frequencies. An excitation analysis assessing actuator characteristics—particularly the required force—demonstrates that the targeted vibration reduction at dominant frequencies, such as rotational and engine firing, can be achieved with a compact solution. Depending on the overall reduction target and focused frequency range, significant reductions are already possible with quite a limited setup. Finally, the principle system capability is verified by implementing a complete control loop with a limited actuator setup. The achieved reduction of 5 dB in averaged structure-borne noise levels at the intermediate frame genset clearly demonstrates the capabilities of ANC for marine gensets, especially for applications with variable speed. Furthermore, it indicates considerable potential for reducing structure-borne noise beyond the limits of pure passive isolation.