

Imperial Prize and Japan Academy Prize to:

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for “Studies on Nonlinear Ship Wave”

***Outline of the work:***

Waves are generated about a ship advancing steadily, and this phenomenon gives resistance to the ship. Called wave resistance, a lot of research work has been concentrated on this theme of waves and resistance. Until 1979, it was based on the assumption that ship waves are typically linear dispersive in form.

Through a long series of systematic experiments, Prof. Hideaki Miyata revealed and demonstrated that waves in the near-field of ships have nonlinear dissipative characteristics, and that they have common characteristics with supersonic shock waves. In 1979, he founded a nonlinear ship wave system and named it “Free Surface Shock Wave.”

This scientifically sound understanding of the ship wave mechanism exerted an important influence on the design of ship hull configuration. He, then, invented a “thin long-protrudent ship bow” design, which was first applied to a bulk carrier in 1983. As this design reduced wave resistance by about 20% in its first application, its use prevailed throughout the world in the 1980s.

Since the effectiveness of heuristic design methods was clearly limited, Prof. Miyata started to develop numerical models to solve nonlinear wave phenomena in 1979. In parallel with progress being made in computer technology, his first numerical model, including computer software, was completed in 1983 and released to major ship-building companies in Japan. In the 1980s, this technology spread around the world, and almost all merchant ships were designed both with an understanding of the occurrence of “Free Surface Shock Wave” and using the new design method aided technologically by computational fluid dynamics.

Research on ship waves has evolved through three eras. In the first era of experimentation (up to 1960s), measuring forces was the only way to support hull form design. In the second era of linear dispersive waves (up to 1979), a lot of theoretical models were proposed. However, these research results were only used very limitedly in hull form design, simply because they could not explain the occurrence of “Free Surface Shock Wave.” The designers still had to rely upon force measurement as well as wave pattern analyses in that era. The third era of nonlinear ship waves was opened by Prof. Miyata in 1979 when he discovered “Free Surface Shock Wave” and new numerical design methods were developed by his team with the aid of advances in computer technology.

The era of nonlinear ship waves was successfully established through collaboration between scientific researchers and engineers. From the 1980s, the design method of ship hull form was gone through evolutionary advances, resulting in an average reduction of about 20% in wave resistance in ships all over the world, which has contributed to both economic and environmental improvements.

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