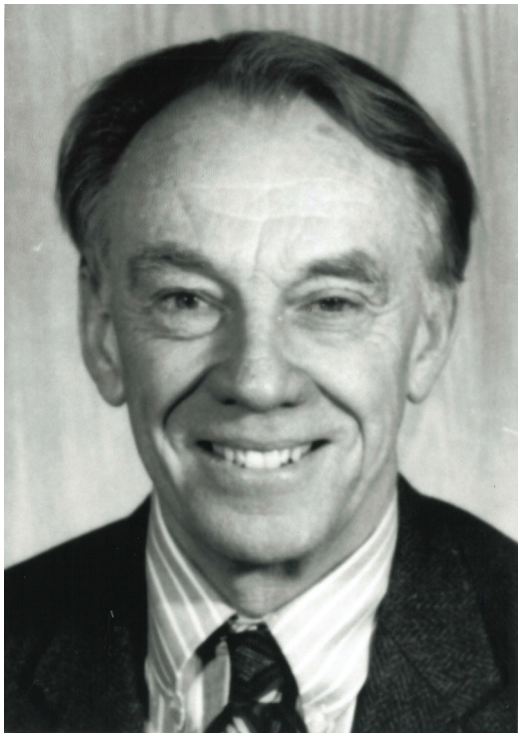

JUSTIN E. KERWIN

1931–2021

Elected in 2000

"For research and development of computational methods used in propeller design and in the prediction of sailing yacht performance."

BY DAVID S. GREELEY, SPYROS A. KINNAS, AND J. NICHOLAS NEWMAN

JUSTIN ELLIOT KERWIN, emeritus professor of naval architecture at the Massachusetts Institute of Technology and a pioneer in the development of computational methods, died at his home in Rockport, Massachusetts, on May 23, 2021. He was 90.

Known as Jake to his friends, colleagues, and students, he was born in New York City on March 24, 1931. His father, Matthew Kerwin, was an executive in the Standard Fruit and Steamship Company and his mother, Carlotta (Service) Kerwin, was a homemaker. The family lived in the Hague and London before World War II and then returned to the New York area. His uncle also worked in the shipping industry and owned a small schooner that Jake sailed on when he was young, inspiring his choice of a career in naval architecture.

He received his SB degree in 1953 from MIT, where he was a member of the varsity sailing team. This required a substantial commitment of time sailing on the Charles River and at other colleges and universities, but he was an outstanding student. He stayed for another year to get his master's degree, followed by a year as a Fulbright scholar at Delft University of Technology. After serving for 2 years as an officer in the Air Force, overseeing the design and construction of rescue boats, he returned to MIT as an instructor and part-time graduate student.

His return to MIT in 1957 coincided with the installation of an IBM 704, a mainframe computer given to MIT for general use. This was also when the first Fortran compiler was released, making it much easier to develop programs for engineering applications. After a short programming course Jake became one of the first users of the 704 and one of the first naval architects to take advantage of programmable computation. In addition to applying this technology in his research, he developed and taught a new subject devoted to numerical analysis and programming in the Department of Naval Architecture and Marine Engineering.

Jake received his PhD in 1961, with his thesis on "The solution of propeller lifting surface problems by vortex lattice methods."[1] Most of his subsequent research focused on propeller hydrodynamics, including analytical, experimental, and numerical aspects.

The blades of marine propellers are lifting surfaces with moderate aspect ratios and complex geometry. They rotate in nonuniform inflow fields, resulting in substantial unsteady effects, often accompanied by intermittent cavitation. These complications were included by Jake as his theories and programs evolved. He was the first to analyze them in a general unsteady manner in the time domain. In later work he treated more complex propulsors, including contrarotating propellers, stator/rotor combinations, ducted propellers, and waterjets.

He supervised innovative experiments in the MIT Marine Hydrodynamics Water Tunnel to guide and confirm theoretical and numerical developments. Measurements of the flow around propellers were made using laser Doppler velocimetry and led to better understanding of the trailing wake behind propellers and improved predictions of performance at off-design conditions. Studies of the flow around a stator/rotor combination confirmed the greater efficiency of this arrangement. In a "flapping foil" experiment measurements were made of the unsteady field around a stationary foil that was subject to the time-varying flow caused by two smaller flapping

[1] Available at https://apps.dtic.mil/sti/pdfs/AD0262648.pdf.

foils upstream. The latter results were used by several research groups to validate their computational techniques.

Jake and his students became the principal developers of propeller design and analysis techniques and related software, with funding from the Navy and other organizations. Their work provided computational solutions to practical problems that hitherto could only be analyzed based on physical experiments and measurements. The codes they developed are known for their robustness, accuracy, and computational efficiency and are used for propeller designs by the US Navy and industries worldwide.

He also applied his computational expertise to other problems in the field of naval architecture. One of his first papers was on the use of bivariate polynomials to represent the geometry of ship hulls.[2] Later he made extensive use of B-splines, not only for the geometry but also to represent the fluid velocity field; the resulting programs were more accurate and efficient, and better suited to integration with commercial CAD/CAM codes.

Jake was a partner in a small consulting company that developed software and performed routine hydrostatic calculations for naval architects and shipyards, before the time when they acquired their own computers.

In the 1970s he collaborated with one of us (JNN) on a research project to improve the handicap systems for sailing yachts in ocean races. One of the principal accomplishments was a velocity prediction program (VPP), in which the hydrodynamic forces on the hull and aerodynamic forces on the sails are balanced to predict the yacht's performance for a given wind velocity and direction. This requires a multidimensional optimization of the sails and orientation of the boat to maximize the velocity in the prescribed direction. In this program Jake was able to apply his sailing experience as well as his expertise in lifting surfaces and computing. The VPP revolutionized both the handicap systems used for

[2] Kerwin JE. 1960. Polynomial surface representation of arbitrary ship forms. *Journal of Ship Research* 4(1):12–21.

ocean races and the optimization of sailboat designs by naval architects.

Jake served on the faculty at MIT for 41 years, teaching and mentoring numerous students and postdocs. Many are now leaders in their field in the United States and other countries. He retired as professor emeritus in 2001 but remained an active consultant to the Navy until 2017.

He was honored with the David W. Taylor Medal from the Society of Naval Architects and Marine Engineers (1992) "for notable achievements in naval architecture" and the Gibbs Brothers Medal (1998) from the National Academy of Sciences "for his outstanding contributions in the field of naval architecture, including the development of computational methods used worldwide in propeller design."

His keen interest in sailing continued throughout his life. His first boat was a 24-foot sloop that he assembled from a kit and raced in southern Massachusetts. His crew usually included graduate students. Later he bought a larger boat, which he owned for 50 years, racing and cruising with his family and students. He applied his engineering knowledge and craftsmanship to many boat projects.

Jake married Marilyn Peterson in 1969. Their daughter Melinda is a social worker and musician. Their son John is a systems engineer working on the development of medical devices. After Jake retired, he and Marilyn started a Dixieland jazz group with other retired MIT colleagues in ocean engineering, he on the piano and she on bass. The Ancient Mariners, as the group was called, played gigs throughout New England and as far away as Austin, Texas, often accompanied by Melinda on the fiddle. Sadly, and unexpectedly, Marilyn died less than a month after Jake.