Name of organization Istanbul Technical University (ITU) Faculty of Naval Architecture and Ocean Engineering	**Year of information updating** 2025
Year established 1953	**Year of joining the ITTC** 1972
Istanbul Technical University Naval Architecture and Ocean Engineering Faculty Ayazaga Campus Sariyer/İstanbul Turkey	**Status in the ITTC** Member
Contact details (phone, fax, e-mail) +90 212 285 64 64 +90 532 498 68 71 +90 212 285 64 65 (fax) bulent.danisman@itu.edu.tr	**Website** atanutkulab.itu.edu.tr

Type of facility (experimental and/or computational) Experimental, Computational	**Year constructed/upgraded** 2019
Name of facility Ata Nutku Ship Model Testing Laboratory	**Location** (if different from the above address)

Main characteristics (dimensions of tank/basin/test section; for simulators: full mission, part task or desktop; for non-experimental services: Numerical services provided)

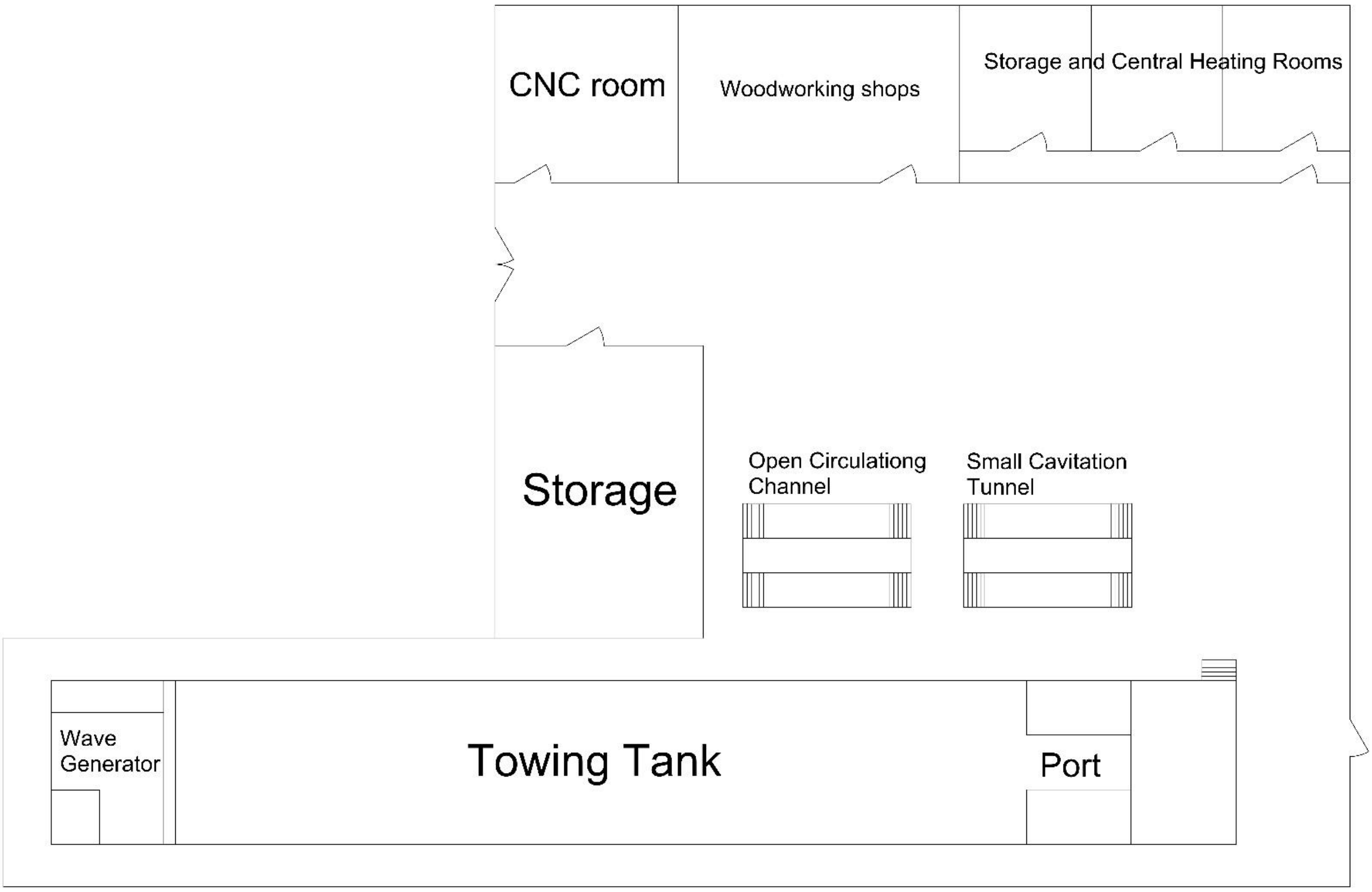
Founded by Ord. Prof. Ata Nutku, the Ship Model Test Laboratory began its construction in 1953, with model experiments commencing in 1956. Over the decades, the laboratory has continuously evolved through major infrastructural and technological upgrades. The towing tank length was extended from 80 m to 108 m in 1960, and in 1974–1975 the towing carriage, open-water propulsion dynamometer, and resistance dynamometer systems were fully renewed, reaching a maximum carriage speed of 6 m/s.

In 1988, the laboratory was relocated to the ITU Ayazağa Campus, where it attained its current dimensions of 160 m × 6 m × 3.4 m. The adoption of CNC technology in 2009 significantly enhanced model manufacturing precision and efficiency, while in 2019 the wave generator system was fully renewed and computerized. From 1956 to 2024, the laboratory has continuously expanded its capabilities by integrating advanced experimental techniques and state-of-the-art measurement systems.

Today, the laboratory is equipped with single-, three-, and six-component electronic resistance dynamometers; propulsion dynamometers for single- and twin-propeller configurations; and a comprehensive stock of propeller models with various diameters and pitches. Advanced facilities include a 3D track measuring system for propeller-plane velocity components, a wave generator capable of producing regular and irregular sea states based on specified spectra, a circulation channel for detailed flow visualization, and specialized dynamometers for rudder force measurements.

For maneuvering and seakeeping studies, the laboratory operates both Planar Motion Mechanism (PMM) and Vertical Planar Motion Mechanism (VPMM) systems, enabling the determination of horizontal and vertical maneuvering derivatives. A wide range of sensors—such as ultrasonic position meters, accelerometers, and load cells—supports customized experimental setups. Together with CNC-based model manufacturing, these facilities position the laboratory as a comprehensive and continuously advancing center for experimental hydrodynamics and ship performance testing..

Drawings of facility



- **Detailed characteristics** (carriages, wave/current/wind generators, instrumentations, etc. or for numerical services: CFD codes and overall principles (RANS, Potential Flow etc.) and computational resources
- Resistance dynamometers: Single-, three-, or six-component electronic dynamometers.
- Propulsion dynamometers and stock propellers: Single- or twin-propeller systems. The laboratory inventory includes propeller models of various diameters and pitches, manufactured to represent a wide range of ship types.
- 3D wake survey device: Automatically measures the nominal velocity components on the propeller plane.
- Wave generator: Generates regular and irregular waves and can reproduce specified wave spectra.
- Circulating channel: Used to monitor flow quality around ship models and their appendages.
- Rudder dynamometer: Measures forces and moments acting on rudders at different deflection angles.
- Planar Motion Mechanism (PMM) – maneuvering dynamometer: Measures the forces and moments required to determine the maneuvering derivatives of ships.
- Vertical Planar Motion Mechanism (VPMM) – maneuvering dynamometer: Measures the forces and moments required to determine the vertical maneuvering derivatives of underwater objects.
- Measurement of motions, accelerations, and forces: A wide range of devices, including ultrasonic position sensors, accelerometers, and load cells, are available to support the design of customized experimental setups.
- CNC model manufacturing milling machine: Reduces model fabrication time while increasing manufacturing precision.

Applications (Tests performed / numerical services provided)

The Ata Nutku Ship Model Testing Laboratory provides comprehensive experimental and numerical capabilities for the hydrodynamic assessment of marine vehicles. The laboratory integrates advanced model-scale testing with computer-aided flow and resistance analyses to support ship performance evaluation and design optimization. All numerical analyses and hull form optimization studies are carried out using in-house computational tools developed by the laboratory's researchers and validated through systematic experimental testing.

1. Resistance and Performance Tests
   - Bare-hull resistance tests in the towing tank
   - Resistance measurements under different trim and displacement conditions
   - Determination of speed–resistance and speed–power characteristics
   - Investigation of frictional, wave, and form resistance components
   - Added resistance tests due to waves, wind, and appendages
2. Propulsion and Propeller Tests
   - Open-water propeller tests
   - Self-propulsion tests
   - Performance evaluation of single- and twin-propeller propulsion systems
   - Measurement of thrust and torque and analysis of hull–propeller interaction
   - Determination of propeller efficiency and wake characteristics
3. Maneuvering Tests
   - Determination of maneuvering derivatives using the Planar Motion Mechanism (PMM)
   - Pure sway, pure yaw, and combined motion tests
   - Free-running maneuvering tests (turning circle, zig-zag, and spiral tests)
   - Measurement of rudder forces and moments
   - Assessment of course-keeping and directional stability
4. Wave and Seakeeping Tests
   - Regular and irregular wave tests
   - Measurement of ship motions and response amplitude operators (RAOs)
   - Evaluation of heave, pitch, and roll motions
   - Added resistance tests in waves
   - Performance assessment in head, following, and beam seas
5. Flow and Hydrodynamic Investigation Tests
   - Flow quality and flow structure investigations in the open circulating channel
   - Measurement of velocity fields at the propeller plane
   - Analysis of flow interaction around hulls and appendages
   - Performance evaluation of energy-saving devices (e.g., rudder bulbs, hull vanes)
6. Computational Hydrodynamics and Hull Form Optimization
   - Computer-aided flow and resistance analyses using numerical hydrodynamics methods
   - Hull form optimization studies aimed at minimizing resistance and/or improving seakeeping performance
   - Parametric and data-driven hull form modification and comparison studies
   - Use of in-house computational tools and analysis codes developed by laboratory researchers
   - Experimental validation of numerical results through towing tank and maneuvering tests

Published description (Publications on this facility)

Goren, O., Calisal, S.M. & Bulent Danisman, D. Mathematical programming basis for ship resistance reduction through the optimization of design waterline. J Mar Sci Technol 22, 772–783 (2017). https://doi.org/10.1007/s00773-017-0447-9

Çelik, C., et al. "On the evaluation of the model test extrapolation by sea trial measurements." 7th International Conference on Advanced Model Measurement Technology for the Maritime Industry. Istanbul, Türkiye. 2023.

Usta, Onur and Koksal, Cagatay Sabri and Korkut, Emin, A Systematic Study into the Cavitation Erosion Test for Marine Propeller Materials by Cavitating Jet Technique. Available at SSRN: https://ssrn.com/abstract=4437083 or http://dx.doi.org/10.2139/ssrn.4437083

Kinaci, O. K., Delen, C., & Kara, E. (2024). Predicting practical ship powering and speed loss in waves using added resistance test results. *Ships and Offshore Structures*, 1–10. https://doi.org/10.1080/17445302.2024.2415415

Çelik, C., Özsayan, S., Köksal, Ç. S., Danışman, D. B., Atlar, M., & Korkut, E. (2025). Powering extrapolation approaches of ship model tests with the gate rudder system. Ocean Engineering, 304, 118134. https://doi.org/10.1016/j.oceaneng.2024.118134

Karabulut, U. C., & Barlas, B. (2025). A novel approach to full-scale ship resistance predictions: Experimental and numerical study of a high-speed planing hull. Journal of Marine Science and Technology. Advance online publication. https://doi.org/10.1007/s00773-025-00989-x

Delen, C., & Bal, Ş. (2015). Uncertainty analysis of resistance tests in Ata Nutku Ship Model Testing Laboratory of Istanbul Technical University. Turkish Journal of Maritime and Marine Sciences, 1(1), 1–14.

Karabulut, U. C., Barlas, B., Helvacıoğlu, Ş., & Baykal, M. A. (2025). Investigation of the underwater hydrodynamics of a hybrid autonomous military platform capable of surface and underwater navigation. Journal of Intelligent & Autonomous Systems in Maritime Applications, 3(1), 1–15.
Ozbulut, M., Ramezanzadeh, S., Yildiz, M., & Goren, O. (2020). Modelling of wave generation in a numerical tank by SPH method. Journal of Ocean Engineering and Marine Energy, 6(2), 121–136.