



MECHANICAL ENGINEERING MSc SEMINAR (30 min.)

Monday, July 13 2026 at 15:00-15:30, Lady Davis Building, Room 640

Analysis of Toroidal and Conventional Propellers for Fast Patrol Craft: Comparative Sea Trial Results

Liran Malka

Adviser: Prof. Morel Groper

Toroidal propellers, distinguished by their closed-loop blade geometry, have attracted growing interest in the marine propulsion community owing to claims of reduced tip-vortex losses, improved mid-range efficiency, and lower vibration signatures. Despite this interest, rigorous comparative data obtained under controlled operational conditions remain scarce in the open literature [1-3]. The present work forms part of a comprehensive research program undertaken at the Technion Tribomechanics Laboratory, in cooperation with the Navy, to characterize the hydrodynamic performance of toroidal propellers relative to conventional open-blade designs. The program comprises two complementary efforts: (i) a computational fluid dynamics (CFD) investigation, in which both propeller geometries are modeled from CMM scans and analyzed using RANS simulations in Ansys FLUENT to generate open-water performance curves and, (ii) instrumented operational sea trials providing direct empirical comparison under representative service conditions.

This presentation reports the sea trial component. Two back-to-back trials were conducted on a 7.2-ton Defender-class fast patrol boat equipped with three 300 HP outboard engines, the first with the standard OEM conventional propellers and the second with Sharrow toroidal propellers. Vessel displacement was verified by crane weighing before each trial, and the test protocol, instrumentation, and environmental conditions were kept consistent across both configurations.

The presentation will report the complete sea trial results, including steady-state speed and slip across the full RPM range, fuel consumption comparison, dynamic manoeuvring performance comprising acceleration, deceleration, and turning characteristics, as well as vibration spectral analysis. A detailed comparison between the two propeller configurations will be presented for each of these performance domains, identifying the operational regimes in which each design holds an advantage. The complementary CFD results, to be presented separately, will provide additional mechanistic insight into the flow phenomena underlying the empirical observations.