Operational Reinforcement of the Towing Tank of the Faculty of Naval Architecture from University „Dunarea de Jos" of Galati

1. Introduction

The existence of ship hydrodynamic laboratories is very important in the process of conceptual design of ships and floating marine structures. Due to the complexity of the hydrodynamic phenomena generated by the flow around the hull, theoretical models can not always provide satisfactory answers to the recent problems of design and need experimental validation of numerical solution.

The "Research Center of Hydrodynamics and Ship Structures" activates since 2001 at the Faculty of Naval Architecture of "Dunarea de Jos" University of Galati. The center has a homogeneous structure, created for developing scientifically fundamentals and support for optimum ship and marine structure design. The results of theoretical or numerical studies are validated by experimental tests in the Towing Tank and Cavitation Tunnel of the research center.

Do to the results of the researches and to the projects with industrial partners from Romania and Europe the Research Center activity is known at national and international level.

On the basis of a national program "PN II Capacities", financed in 2008, the operational reinforcement of the experimental capacities of the Towing Tank was performed. Modern experimental equipments with a high level of accuracy of the measurements, manufactured by Cussons Technology from U.K. were purchased.

The general strategic objective of this project was the development and the progress of experimental methodologies of the Towing Tank, with the purpose of increasing the international competitiveness of the Research Center.

The objective of the project is linked to the Romanian and European research and development strategies, regarding the sustained innovative solutions in transportation and shipbuilding area.

The achievement of the general objective of the project has favorable consequences on the ship hydrodynamic research and applicative activities, in Galati area.

The reinforcement of the Towing Tank leads to increase the variety of the experimental tests. By promoting the following directions, the optimization of the lines form of the hull can be achieved:

- solving the complex hydrodynamic problems, with theoretical model not enough developed, on the basis of experimental methodologies (for example, wave interference influence on multi-hull ship resistance);

- validating the physical parameters describing the ship hydrodynamics performance (ship resistance, wake, thrust, torque and propeller efficiency).

2. Towing tank experimental equipments

The towing tank with the main dimensions of 45x4x3 m is depicted in Figure 1. Didactic and applicative research activities have developed since 1962.

The towing tank is equipped with a new automatic carriage developed by Cussons Technology Ltd. A constant towing speed up to 4 m/s can be obtained for a model with maximum length of 4 m and maximum mass of 200 kg.

The automatic towing carriage includes the following systems:

- control of movement and speed (Figure 2);

- acceleration and deceleration (1 m/s^2);

- emergency braking (that operates up to 3 m/s^2);

- experimental data acquisition (Figure 3).

A hydraulic wave generator system is used to induce regular waves (Figure 4) with the circular frequency of 0.4-0.9 Hz.

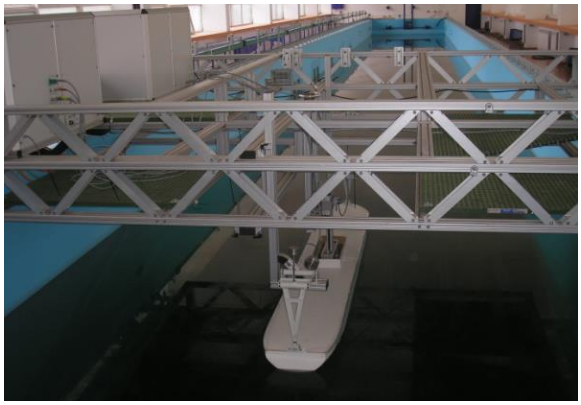

Figure 1. Towing tank of the Naval Architecture Faculty

Figure 2. Control system of the carriage movement and speed

The new equipments developed by Cussons Technology Ltd. will be employed in order to perform: resistance and self-propulsion tests, open water propeller tests, wake tests and wave measurements.

The experimental equipment for resistance tests includes: the R35e resistance dynamometer fitted with a coupling arm to the towing carriage (Figure 5), the guidance system for the movement of the model (Figure 6) which ensures maintenance on the advance direction, as well as freedom of heave and pitch motions and the stand for static calibration of the resistance dynamometer (Figure 7).

Technical performances of the resistance dynamometer are as follows:

- measures values of resistance up to 200 N;

- measurement error is 0.2 %;

- capacity of overloaded up to 500 N.

Figure 3. Data acquisition system

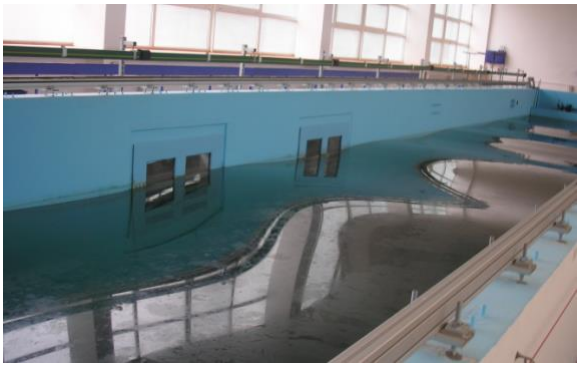

Figure 4. Hydraulic waves generation

Figure 5. Resistance dynamometer and coupling arm to the towing carriage

Figure 6. Guidance system for the movement of the experimental model

Figure 7. Stand for static calibration of the resistance dynamometer

The experimental equipment for resistance tests allows the measurement of the trim and sinkage of the model at given speed, in still water, as well as the heave (max. 0.3 m.) and pitch (max. 21deg.) motion amplitudes in incident waves.

The experimental equipment for self-propulsion tests (in twin screw arrangements) includes the R31 self-propulsion dynamometer and a dummy (non measuring) propeller dynamometer, with the following accessories: stern tube and propeller shafts with universal joint for coupling the dynamometers, telescopic shafts with universal joint for the connection of the dynamometers to a standard distribution gearbox and a H75E drive motor. The main components of the experimental equipment for self-propulsion tests are depicted in Figure 8.

The stand for static calibration of the self-propulsion dynamometer is presented in Figure 9. The self-propulsion will be rated for thrust measurements up to 200 N and torque measurements up to 4 Nm at 1500 rpm.

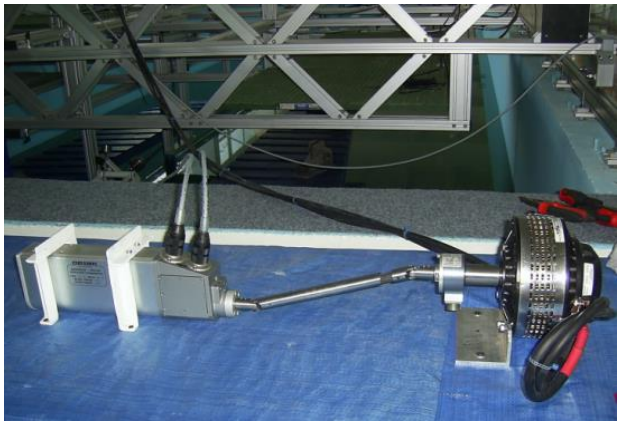

Figure 8. Components of the experimental equipment for self-propulsion tests

Figure 9. Stand for static calibration of the self-propulsion dynamometer

The experimental equipment for open water propeller tests (Figure 10) includes the H75e open water propeller dynamometer, which will be rated for thrust measurements up to 250 N, and torque measurements up to 10 Nm at 2010 rpm.

Figure 10. Open water propeller dynamometer

In order to measure the 2D wake profile in the propeller disc of the experimental model, the N10e wake rake was purchased. The 2D wake rake has four Pitot static tubes connected directly to pressure transducers and is depicted in Figure 11.

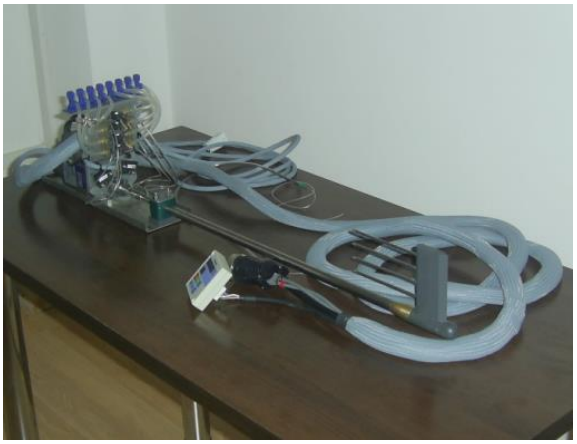

Figure 11. Wake rake with four Pitot static tubes

The experimental equipment includes a carriage mounted R23e wave probe (Figure 12) for measuring the waves generated in the towing tank, with the maximum height of 0.25 m.

The existence of the new experimental equipments for resistance and propulsion tests in the Towing Tank will increase the scientific potential and the visibility of the "Research Centre of Hydrodynamics and Ship Structures" from the Faculty of Naval Architecture of "Dunarea de Jos" University of Galati.

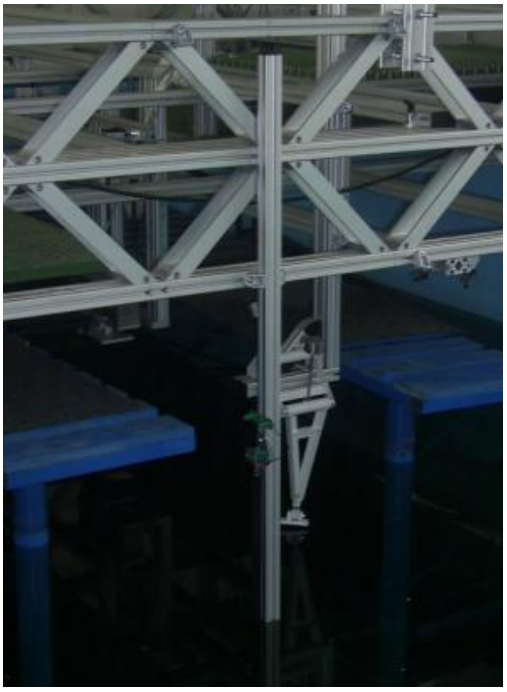

Figure 12. Wave probe

Prof. DAN OBREJA
Faculty of Naval Architecture
University "Dunarea de Jos" of Galati