SISTEM PENGUKURAN *THRUST* DAN *VELOCITY* BERBASIS MEKANISME UJI TARIK SKALA TERBATAS UNTUK PENGUJIAN KAPAL MODEL

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ABSTRAK

Pengujian hidrodinamika kapal model secara konvensional umumnya bergantung pada fasilitas towing tank berskala besar yang mahal dan sulit diakses. Penelitian ini mengembangkan sistem pengukuran *thrust* dan *velocity* berbasis mekanisme uji tarik (pull test) skala terbatas untuk pengujian kapal model di perairan terbuka. Sistem yang dikembangkan terdiri atas subsistem penarik (motor DC RS795, drum, wire rope), subsistem akuisisi data *thrust* (load cell, modul HX711, dan mikrokontroler ESP32 dengan komunikasi WiFi), serta subsistem akuisisi data *velocity* berbasis *video tracking*. Pengujian dilakukan pada kombinasi tiga variasi putaran motor (300, 600, dan 1000 RPM) dan tiga variasi pembebanan (tanpa beban, 3 kg, dan 5 kg) di Waduk Brigif, Depok. Hasil pengujian menunjukkan bahwa peningkatan RPM meningkatkan nilai *thrust* dan *velocity* pada seluruh kondisi pembebanan, sedangkan peningkatan pembebanan meningkatkan *thrust* namun menurunkan *velocity* akibat bertambahnya tahanan hidrodinamika. Evaluasi rasio kedalaman perairan terhadap draft (h/T) pada zona pengambilan data menunjukkan seluruh pengujian memenuhi kriteria air dalam sesuai st*and*ar ITTC. Analisis *Repeatability* dan sensitivitas sistem menunjukkan bahwa sistem yang dirancang mampu menghasilkan data yang konsisten dan peka terhadap perubahan kondisi pengujian, sehingga berpotensi menjadi alternatif pengukuran *thrust* dan *velocity* kapal model yang lebih terjangkau.

Kata Kunci: Kapal Model, Uji Tarik, *Thrust*, *Velocity*, Skala Terbatas

THRUST AND VELOCITY MEASUREMENT SYSTEM BASED ON LIMITED-SCALE PULL TEST MECHANISM FOR MODEL SHIP TESTING

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ABSTRACT

Conventional ship model hydrodynamic testing generally relies on large-scale towing tank facilities that are costly and difficult to access. This study develops a thrust and velocity measurement system based on a limited-scale pull-test towing mechanism for ship model testing in open water. The system consists of a pulling subsystem (RS795 DC motor, drum, wire rope), a thrust acquisition subsystem (load cell, HX711 module, and ESP32 microcontroller with WiFi communication), and a video-tracking-based velocity acquisition subsystem. Tests were conducted across combinations of three motor speed levels (300, 600, and 1000 RPM) and three loading conditions (no load, 3 kg, and 5 kg) at Brigif Reservoir, Depok. Results show that increasing RPM increases both thrust and velocity across all loading conditions, while increasing load raises thrust but reduces velocity due to greater hydrodynamic resistance. Evaluation of the water-depth-to-draft ratio (h/T) at the data collection zone confirms that all tests satisfy the ITTC deep-water criterion. Repeatability and sensitivity analyses show that the developed system produces consistent data and remains responsive to changes in test conditions, making it a potentially more affordable alternative for measuring ship model thrust and velocity.

***Keywords**: Ship Model, Pull Test, Thrust, Velocity, Limited Scale*