ANALISIS *MANEUVERING* KAPAL MENGGUNAKAN *VIRTUAL CAPTIVE MODEL TEST* TERHADAP VARIASI *TRIM* DAN *SINK*

Audi Razif Santoso

ABSTRAK

Penelitian ini mengevaluasi pengaruh variasi *trim* dan *sinkage* terhadap karakteristik hidrodinamika kapal menggunakan *Virtual Captive Model Test* (VCMT) berbasis *Computational Fluid Dynamics* (CFD) pada model KRISO *Container Ship* (KCS). Simulasi dilakukan untuk variasi *sinkage* −0,00090; −0,00275; −0,00599 dan variasi *trim* 0,017°; 0,053°; 0,097°, pada rentang *drift angle* 2°–10° serta dua kondisi kecepatan yang direpresentasikan oleh *Froude number* 0,152 dan 0,163. Tujuan penelitian adalah menganalisis pengaruh *trim* dan *sinkage* terhadap gaya lateral (*sway force*) dan momen *yaw* (*yaw moment*) serta menentukan koefisien hidrodinamika menggunakan metode regresi *Least Square*. Hasil menunjukkan bahwa variasi *trim* dan *sinkage* memengaruhi nilai gaya lateral dan momen *yaw*, tetapi kontribusinya relatif lebih kecil dibandingkan pengaruh kecepatan dan *drift angle*. Peningkatan *sink*age cenderung meningkatkan gaya lateral dan momen *yaw* akibat peningkatan *wetted surface area* dan perubahan distribusi tekanan pada lambung, sementara perubahan memodifikasi distribusi tekanan sepanjang lambung dengan efek yang kurang signifikan pada rentang yang diteliti. Nilai maksimum nondimensional Y' dan N' tercatat pada Fr = 0,163 dan *drift angle* 10° (Y'_H = 0,206543; N'_H = 0,079192 untuk variasi *sinkage*; Y'_H = 0,202338; N'_H = 0,073965 untuk variasi *trim*). Data gaya dan momen dikonversi ke bentuk tak berdimensi menggunakan formulasi Yoshimura–Masumoto dan dianalisis melalui regresi Least Square, menghasilkan koefisien linier dan nonlinier untuk gaya lateral (a = 0,07643; b = 34,32566) serta momen *yaw* (a = 0,11545; b = 9,81361), yang konsisten dengan data simulasi. Kombinasi VCMT berbasis CFD dan metode *Least Square* terbukti efektif untuk memperoleh koefisien hidrodinamika sebagai alternatif identifikasi parameter manuver kapal.

Kata kunci: *Virtual Captive Model Test, Computational Fluid Dynamics, trim; sinkage, sway force, yaw moment, Least Square*, koefisien hidrodinamika.

SHIP MANEUVERING ANALYSIS USING VIRTUAL CAPTIVE MODEL TEST ON TRIM AND SINKAGE VARIATIONS

Audi Razif Santoso

ABSTRACT

This study evaluates the effect of trim and sinkage variations on ship hydrodynamic characteristics using the Virtual Captive Model Test (VCMT) based on Computational Fluid Dynamics (CFD) on the KRISO Container Ship (KCS) model. Simulations were performed for sinkage variations of −0.00090, −0.00275, and −0.00599 and trim variations of 0.017°, 0.053°, and 0.097°, over drift angles of 2°–10° and two speed conditions represented by Froude numbers 0.152 and 0.163. The objective is to analyze the influence of trim and sinkage on lateral force (sway) and yaw moment, and to determine hydrodynamic coefficients using the Least Squares regression method. Results indicate that trim and sinkage affect sway force and yaw moment, but their contributions are relatively smaller compared to the effects of speed and drift angle. Increased sinkage tends to raise sway and yaw due to larger wetted surface area and altered pressure distribution along the hull, while changes in trim modify pressure distribution longitudinally with less significant effects within the studied range. The maximum nondimensional Y′ and N′ occurred at Fr = 0.163 and drift angle 10° (Y′_H = 0.206543; N′_H = 0.079192 for sinkage variation; Y′_H = 0.202338; N′_H = 0.073965 for trim variation). Force and moment data were nondimensionalized using the Yoshimura–Masumoto formulation and analyzed via Least Squares regression, yielding linear and nonlinear coefficients for lateral force (a = 0.07643; b = 34.32566) and yaw moment (a = 0.11545; b = 9.81361), which show good agreement with the simulation data. The combination of VCMT-based CFD and Least Squares demonstrates an effective approach to obtain hydrodynamic coefficients as an alternative for identifying ship Maneuvering parameters.

Keywords: *Virtual Captive Model Test, Computational Fluid Dynamic, trim; sinkage; sway force; yaw moment; Least Squares; hydrodynamic coefficients.*