# ANALISA LINEAR HYDRODYNAMIC DERIVATIVE MENGGUNAKAN VIRTUAL CAPTIVE MODEL PADA BERBAGAI KONDISI KEDALAMAN LAUT

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## ABSTRAK

Penelitian ini menganalisis derivatif hidrodinamik linear menggunakan model *virtual captive* berbasis *Computational Fluid Dynamics* (CFD) untuk menginvestigasi pengaruh kedalaman laut terhadap manuver kapal. Objek studi adalah model kapal kontainer KRISO Container Ship (KCS) skala 1:31.6. Metodologi mencakup simulasi *multi-phase* dengan model turbulensi k-ω SST. Variasi kedalaman laut direpresentasikan oleh rasio H/d (tinggi air/draft kapal) pada 1.2, 1.4, 1.6, 1.8, dan 4. *Drift angle* diuji dari 0 hingga 12 derajat, dengan kecepatan konstan 2.196 m/s. Validasi data menunjukkan deviasi di bawah 5% terhadap data eksperimental resistansi kapal KRISO. Studi independensi *mesh* memilih 2.6 juta sel untuk akurasi dan efisiensi. Hasil menunjukkan peningkatan gaya lateral (Y) dan momen oleng (N) seiring penurunan kedalaman air dan peningkatan *drift angle*. Ini disebabkan oleh menguatnya *blockage effect*. Derivatif hidrodinamik tidak menunjukkan tren linear; magnitudo mencapai puncak pada H/d = 1.4, lalu sedikit menurun pada H/d = 1.2 karena dominasi *cushioning effect*. Ini mengindikasikan kapal lebih stabil arah di perairan dangkal, namun juga lebih "kaku" dan "lamban" dalam bermanuver. Penelitian ini mengkonfirmasi validitas metode *virtual captive model* untuk ekstraksi derivatif hidrodinamik.

**Kata kunci:** *Hydrodynamic Derivative, CFD, Sway force, Yawing Moment*

# *ANALYZATION OF LINEAR HYDRODYNAMIC DERIVATIVE USING VIRTUAL CAPTIVE MODEL FOR VARIOUS SEA DEPTH*

**Ramadhan Farhan Fadillah**

## ABSTRACT

*This study analyses linear hydrodynamic derivatives using a virtual captive model based on Computational Fluid Dynamics (CFD) to investigate the effect of sea depth on ship manoeuvrings. The object of study is the 1:31.6 scale KRISO Container Ship (KCS) model. The methodology includes multi-phase simulations with the k-ω SST turbulence model. Sea depth variations were represented by the H/d (water height/draft of the ship) ratio at 1.2, 1.4, 1.6, 1.8, and 4. Drift angle was tested from 0 to 12 degrees, with a constant speed of 2.196 m/s. Data validation showed a deviation below 5% to the experimental data of KRISO ship resistance. The mesh independence study selected 2.6 million cells for accuracy and efficiency. Results show an increase in lateral force (Y) and overturning moment (N) as water depth decreases and drift angle increases. This is due to the strengthening of the blockage effect. The hydrodynamic derivatives do not show a linear trend; the magnitude peaks at H/d = 1.4, then decreases slightly at H/d = 1.2 due to the dominance of the cushioning effect. This indicates that the ship is more directionally stable in shallow water, but also more "stiff" and "sluggish" in manoeuvring. This study confirmed the validity of the virtual captive model method for hydrodynamic derivative extraction.*

***Keywords:*** *Hydrodynamic Derivative, CFD, Sway force, Yawing Moment*