Shanghai Jiao Tong University
2nd Semester, Academic Year 2008-2009

Summary of Ship Manoeuvring for Review

Prof. Dr.-Ing. Zou Zaojian

May 5, 2009

Outline

- Brief Introduction
- Evaluation of Ship Manoeuvrability
- Prediction of Ship Manoeuvrability
- Linear Equations of Ship Manoeuvring Motion
- Control Devices
- Measures to Improve Ship Manoeuvrability
- Some Remarks on the Examination

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Brief Introduction

- **Ship Manoeuvrability and Its Contents**

  — **Ship Manoeuvrability: The ability of a ship to keep or change its state of motion under the control actions.**

  Ship manoeuvrability includes: (definition !)

  - **Inherent dynamic stability (straight line stability)**
  - **Course-keeping ability (directional stability)**
  - **Initial turning/course-changing ability**
  - **Yaw-checking ability**
  - **Turning ability**

Brief Introduction

- **Importance of Ship Manoeuvrability**

  — **Navigation safety**

  — **Navigation economy**

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- **Importance of Ship Manoeuvrability**
  - Navigation safety
  - Navigation economy

Evaluation of Ship Manoeuvrability

- **Standard manoeuvres (tests) and the parameters to be used to evaluate ship manoeuvrability**
  - How to conduct these manoeuvres?
  - The parameters obtained from these manoeuvres?
  - How can these parameters be used to evaluate ship manoeuvrability?
    - Turning test
    - Zig-zag test
    - Stopping test
    - Spiral test (direct spiral and reverse spiral test)

Evaluation of Ship Manoeuvrability

- **IMO Standards for Ship Manoeuvrability**
  - Turning ability (by turning test)
  - Initial turning ability (by zig-zag test)
  - Yaw-checking and course-keeping abilities (by zig-zag test)
  - Stopping ability (by stopping test)

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    - Pull-out test

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Prediction of Ship Manoeuvrability

- The conventional methods which can be used to predict ship manoeuvrability at the ship design stage:
  - Free-running model tests (by conducting the standard manoeuvres with ship model)
  - Mathematical model (Equations of ship manoeuvring motion)+ computer simulation

Prediction of Ship Manoeuvrability

- Mathematical model (Equations of ship manoeuvring motion)
  - Coordinate systems
    (1) earth-fixed coordinate system
    (2) body-fixed coordinate system with the origin lying on the center of gravity of the ship
    (3) body-fixed coordinate system with the origin lying on the mid-ship point
  - How to derive the equations of ship manoeuvring motion in these coordinate systems?

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Prediction of Ship Manoeuvrability

- Expressions of the hydrodynamic forces
  - — Abkowitz model (whole-ship model)
    (1) The hydrodynamic force (and moment) acting on hull-propeller-rudder system as a whole
    (2) The hydrodynamic force (and moment) are expressed by Taylor expansion, with the steady forward motion state as the expansion point
  - — MMG model (modular model)
    The hydrodynamic force (and moment) are divided into three parts: on hull, on propeller and on rudder

Prediction of Ship Manoeuvrability

- Methods for determining the hydrodynamic forces
  - — Captive model tests
    (1) Oblique-towing test
    (2) Rotating-arm test
    (3) PMM test (pure sway, pure yaw tests)
    (4) Circular motion test
  - — System identification method
  - — Semi-empirical method (database etc.)
  - — Numerical method (CFD method)

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以上内容仅为本文档的试下载部分，为可阅读页数的一半内容。如要下载或阅读全文，请访问：https://d.book118.com/206054224034010045