Fluid Mechanics Seminar 1997 - 98

Seung-Deog Yoo (Editor)

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Preface

This report consists of seminar presentations given by staff and visiting researchers at the Technical University of Hamburg-Harburg. The presentations were given at the weekly fluid mechanics seminar during the semesters Summer 97 to Winter 98. In general, the presentations in this seminar last about one hour including discussions. The purpose of the seminar is to report on the current state of on-going research or to present reviews of special topics in the fluid mechanics field without great formality. Especially the discussion is very lively and open.

The contents of the contributions cover a wide range of fluid mechanics topics, from marine hydrodynamics to metrological fluid problems. While the majority of the research reports deal with numerical simulations of the Navier Stokes equations, potential theoretical methods, which are still important for practical purposes in marine hydrodynamics, are also presented. In this report, only those contributions for which papers were provided are included. All the presentations held at the seminar are listed in the following.

I wish to thank Prof. H. Soeding of the TUHH for his support in organizing this seminar. I am grateful also to the staff researchers Mr. Zhou and Mr. Moctar for their assistance.

Seung-Deog Yoo (Editor)
List of Presentations at Fluid Mechanics Seminar 1997 - 98

Summer Semester 1997

14. Mai
Berechnung von Ruderkräften
Prof. H. Söding, IfS

21. Mai
Simulation des Abflusses in Verbindung mit einem globalen Klimamodell
Dipl.-Phy. S. Hagemann, MPI

28. Mai
Numerische Simulation der instationären Wirbelströmung
Dipl.-Ing. W. Fritz, DASA

18. Juni
Vergleich von Zweigleichungsturbulenzmodellen
Dipl.-Ing. M. Schmid, IfS

25. Juni
Panelmethode mit nichtlinearer Druckkorrektur für Seegangsbelastung von Schiffen
Dipl.-Ing. H. Rathje, GL

02. Juli
Stabilität von Schiffsbewegungen
Dipl.-Ing. M. Wendt, TUHH

09. Juli
Kintersicherheit von leckem Ro-Ro Schiff
Dipl.-Ing. B.-C. Chang, IfS

Winter Semester 1997

05. Nov. 97
Induced Internal Waves Influence on Drag Coefficient of Floating and Submerged Bodies in Fluids with Different Stratification Profiles
Dr. O.D. Shishkina, Russian Academy of Sciences

12. Nov. 97
Strömungsmodellrechnungen für Planktonfanggeräte
Dipl.-Ing. O.A.M. El Moctar, IfS

26. Nov. 97
Berechnung von Strömungen um Tragflügel unter freier Oberfläche
Dipl.-Ing. S.-D. Yoo, IfS
10. Dez. 97
Berechnung von Schiffsumströmungen mit einer VOF-Methode
Dipl.-Ing. C. Schumann, HSVa

14. Jan. 98
Numerische Bestimmung von Blasengrößenverteilungen mit Hilfe einer Fredholmischen Integralgleichung erster Art
Dipl.-Math. A. Diekmann, Mathematisches Seminar, Uni. Hamburg

Physikalische und mathematische Aspekte von Solitonen
Dr. U. Pollman, HSVa

28. Jan. 98
Application of Harmonic and Statistical Linearization to Calculation of Ship Motions in Frequency Domain
Prof. S. Sutulo, St. Petersburg State Marine Technical University

4. Febr. 98
Numerische Simulation der Kavitation
Dipl.-Phys. M. Krömer, IfS

Summer Semester 1998

27. Mai 98
Einführung der Längselastizität in die Analyse des dynamischen Verhaltens untergetauchter Schleppseile
Dipl.-Ing. F.-O. Albina, TUHH

3. Juni 98
Vergleich viskoser und potentialtheoretischer Verfahren zur hydrodynamischen Analyse von Propellern
Dr. H. Streckwall, HSVa

17. Juni 98
Turbulenzmodellierung für instationäre Strömungen um Turbinenschaufeln
Dr. F. Magagnato, TU Karlsruhe

24. Juni 98
Computation of 3-Dimensional Power-Augmented Ram Wing In Ground Effects
Prof. S.H. Kwag, Halla University, Korea

Winter Semester 1998

25. Nov. 98
Unstable behavior of surface waves generated by a hydrofoil
Dr. V.G. Shigunov, Maritime University of St.-Petersburg, Russia
02. Dez. 98
Grobstruktursimulation turbulenter Innen- und Außenströmungen
Dr. M. Meinke, RWTH Aachen

09. Dez. 98
Berechnung von Strömungen um einen oszillierenden Zylinder
Dr. S.-D. Yoo, TUHH

16. Dez. 98
Möglichkeiten und Grenzen der numerischen Simulation von Luftströmungen in der Gebäudetechnik - derzeitiger Stand und Zukunftsaussichten
Dr. B. Ochocinski, ROM

06. Jan. 99
Schwingungen von Balken in Flüssigkeiten
Prof. H. Söding, TUHH

27. Jan. 99
Determination of wave interactions between 3D bodies
Dr. G. Bannister, Marine Service
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Introduction of longitudinal elasticity in modeling dynamic behaviour of immersed tow cables

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Dynamic behaviour of immersed tow cables is of great importance in maritime design and applications. Therefore, tools have been developed for simulating and predicting this behaviour. They base mainly on a discretisation of the tow cable in a set of rigid bar elements connected together with a global joint. Equations of motion are then obtained with a Lagrangian formulation for rigid bodies. However, this formulation can not render some phenomena due to longitudinal elasticity. Therefore, an improved model which bases on a Lagrangian description of an elastic body and a finite-element like approach for displacements, is proposed. It has been applied to a two-dimensional case and the computed results thus obtained are compared to those of the perfect rigid cable.

Key words: tow cable, longitudinal elasticity, Lagrangian formulation, finite-elements

1 Introduction

Applications involving immersed tow cables are of great interest for the maritime industry as well as for military applications. They may be employed for passive or active sonar detection facilities, as communication, umbilical or trawl cables. In the last decades more and more interest has been shown to have a tool which could predict the approximate position of a tow cable. Some of them have been developed on the base of a Lagrangian description of the movement of a cable discretised in \( m \) rigid cylindrical articulated elements [1]. Each element is located in space by the only knowledge of its angles of incidence. This type of methods is very easy to develop on the one hand because of their simple formulation, on the other hand because the number of parameters is minimal. Besides, results [1] demonstrate that a precise description of the movement in space of a perfect rigid cable is obtained.

Unfortunately, some imprecisions may arise regarding the towing force or the position of cable end since a mechanical resonance for a real elastic cable is always possible. For this reason, a new model has to be developed to account for the behaviour of the real elastic cable. As a starting point, the previous Lagrangian formulation is conserved and the system of rigid cylindrical elements is replaced by a system of deformable ones. For this purpose, it will be shown in section 2 how it is possible in the most general case to become a Lagrangian formulation for the movement of an elastic body. This will then allow in section 3...