UNIVERSITY OF CALIFORNIA

Santa Barbara

Numerical Simulation of Transient Nonlinear Free-Surface Flows with Body Interaction

A Dissertation submitted in partial satisfaction

of the requirements for the degree of

Doctor of Philosophy

in

Mechanical and Environmental Engineering

by

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1990

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ACKNOWLEDGMENTS

This work is the result of research sponsored in part by NOAA, National Sea Grant College Program, Department of Commerce under grant number NA85AA-D-SG140, project number R/OE-6, through the California Sea Grant Program. The U.S. government is authorized to reproduce and distribute for governmental purposes.

The support of the Institut Mediterranéen de Technologie à Marseille, of Mr and Mrs F. Comemale, Mrs M. Saubestre, Mr and Mrs P. Saubestre, Mr and Mrs L. Doll is also gratefully acknowledged.

The College of Engineering at the University of California at Santa Barbara provided the computer time on the Convex without which this work would not have been possible. I am extremely grateful to Professor R. Mc Meeking for making this happen.

I wish to thank Professor J.L. Armand for having given me the opportunity to acquire and perfect, among other ventures, some dormant and unsuspected hydrodynamic skills in Santa Barbara. My thanks also go to Professors E. Bayo, H. Maruo , M. Tulin and Dr. T. Shugar who accepted to serve on my committee.

ABSTRACT

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Though well known, the complete equations describing the motion of free-surface flows are highly nonlinear and in general unsolvable analytically. Designers of ships and offshore structures have until the advent of powerful computing tools been limited to using theoretical analysis based on simplifying assumptions. This technique leads to a more tractable form of the equations and has been the focus of extensive research resulting in a large heritage of scientific knowledge on which to build.

Not all physical phenomenon may be predicted using these theories. Of interest to designer, are the transient hydrodynamic loadings which will affect the response of the structure in extreme cases when large deformation of the free-surface and/or large

amplitude motion are expected. With this in mind, the numerical code MEDUS was created to solve the fully nonlinear equations of motion within the framework of potential theory in two dimensions. It is based on a mixed Euler-Lagrange description of the flow field, and incorporates techniques to account for the simulation of a current, to model the forced or free motion of a submerged or water-piercing cylindrical section, and to overcome the difficulties associated with the finite extent of the numerical domain and the singular behavior at the body-fluid intersection. Classical potential, linear and second-order results are recovered and extended beyond the range of validity of these theories. The simulation of the motion of a water-piercing cylinder is also considered with an emphasis on horizontal displacement.