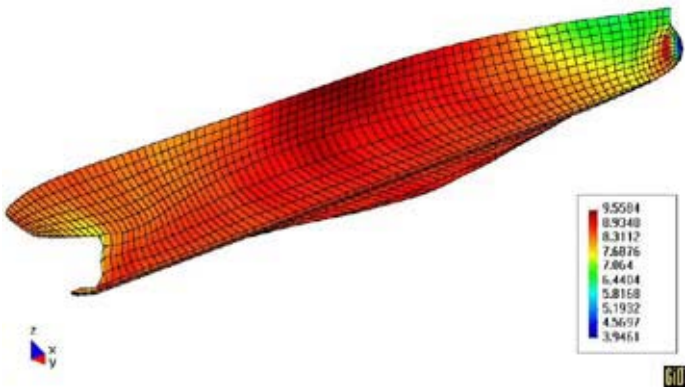
U.P.M. E.T.S.I.N.

BOUNDARY ELEMENT METHODS

&

ETSIN_CFD

(Hull shape optimization code)



Developed by the research team at CEHINAV, hydrodynamics testing facility.

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1. INTRODUCTION

Boundary element methods (BEM) are used to numerically solve boundary value problems through partial differential equations which can be reformulated as an integral equations problem. The unknown field can then be represented by the value of the function at the boundary. This way, the dimensionality of the problem is reduced. For instance, in 3D, instead of computing the solution in a 3D domain, the value of a function on a predefined surface constituting the boundary domain is enough to completely describe the solution. This means that BEM are extremely computationally efficient.

BEM are state of the art techniques for solving complex engineering problems, e.g., ship motions for which no other approach is viable.

This part of the course focuses on solving a Laplace equation in order to find a potential flow solution. This solution, considering some specific boundary conditions, represents quite accurately some free surface flows (figure 1). With this, the objective is that the students will have a basis in order to compare the power of these codes with full viscous flow solvers. The students will also get familiar with meshing basics.

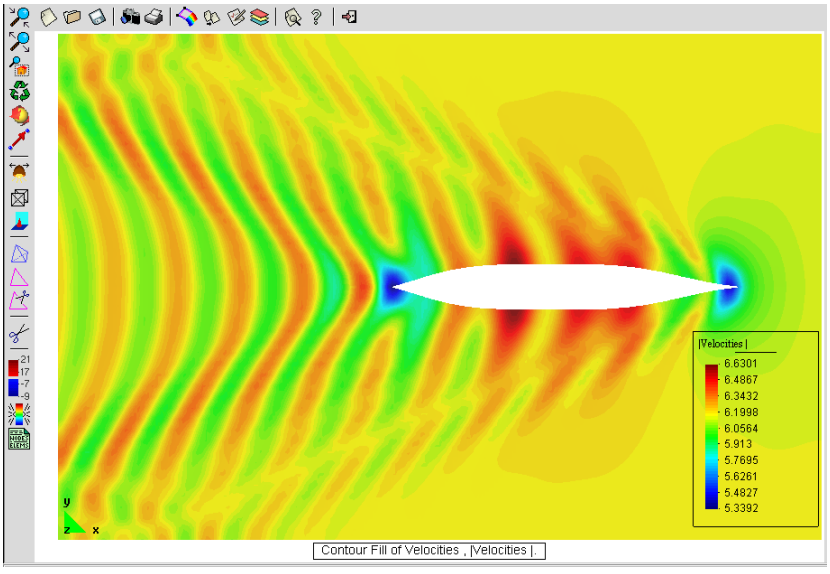

Figure 1: Velocity field at the free surface around a merchant vessel.

In order to achieve this target, a tutorial for the potential solution of free surface flows is provided. A few exercises are also provided, including some regarding the meshing and computing of potential flows around a sphere. The image of a solution to such an example is presented in figure 2.

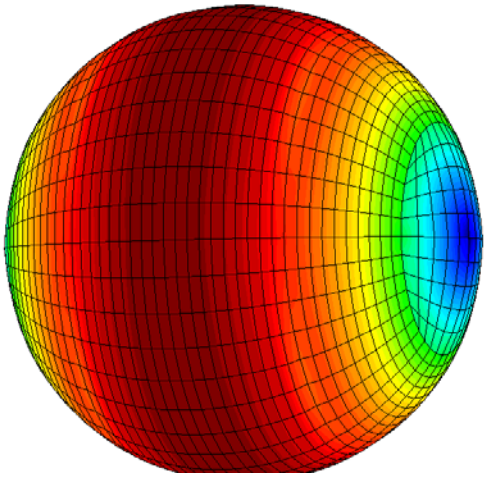

Figure 2: Velocity field around a sphere computed with the Laplace BEM solver from this course.

2. SOFTWARE INSTALLATION

2.1. General

In order to run the BEM codes, GiD pre and post processing software should have been previously installed. GiD is proprietary software but temporary licences, with a long enough life to run the course, can easily be obtained.

2.2. GiD

GiD is available for download from the following link. Once installed, a one month activation key is also available online. This key is renewable up to three times.

To obtain it, first launch the installed program. Then, go to Help>Register (figure 2) where the provided information will be necessary to obtain the key. With this information, go online to the key obtention page where you will have

to fill in the previously given information. After that, a key will be provided which you will have to enter in the GiD registration window.

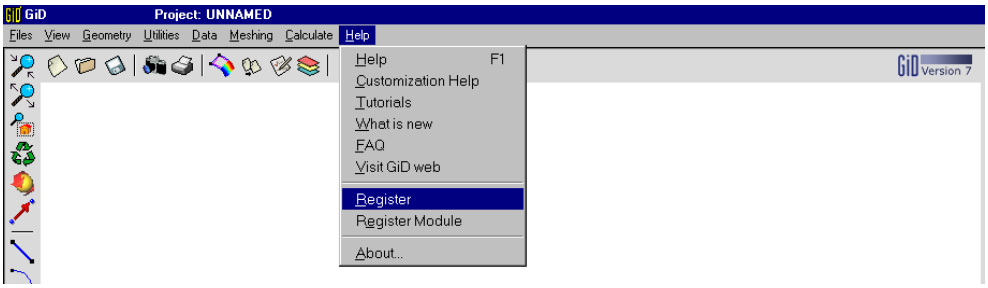

Figura 3

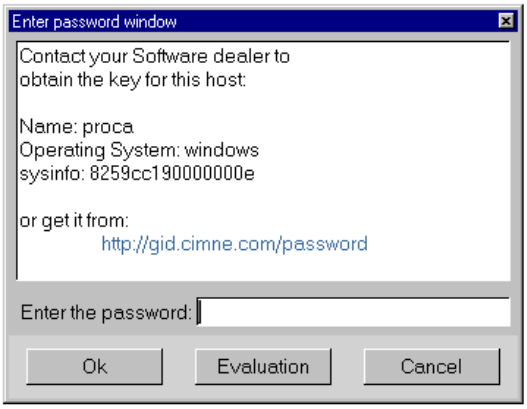

Figura 4

By clicking OK, the program should be activated for one month.

2.3. ETSIN_CFD & HESS3D

The software can be obtained as part of the course materials. In particular ETSIN_CFD can also be downloaded from:

http://canal.etsin.upm.es/ftp/ETSINCFD.rar

In any case, they have to be decompressed in the "problem types" folder of your GiD directory. This directory depends on where the GiD software was installed. Use the *extract here* option in WINRAR (or equivalent).

C:\GiD\GiD7.4.9b\problemtypes

C:\Archivos de programa\GiD\GiD7.4.9b\problemtypes

The directory might slightly vary depending on the GiD version installed. To check if the software has been correctly installed and the files properly unzipped, the folder *ETSIN_CFD.gid* should appear in the *problemtypes* folder mentioned above.

A tutorial is available in the course as well as some examples. They can also be downloaded from

http://canal.etsin.upm.es/ftp/ETSINCFDexamples.rar

This file should be unzipped in what will be the active folder of the user. The specified folder location can also be changed by the user.