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Chapter 1

Introduction

TERRIBLE WRITING WITH TONS OF ERRORS AND STUFF

introduction about fluid dynamics and the navier stokes euqations

Non-linearity of the navier stoks equations and some of the analytical solutions

computational fluid dynamics and introduction of the methods we are going to use

code and results

comparison and discussion

Chapter 2

Fluid Dynamics

The main concern of fluid dynamics is tracking and making predictable the motion of a fluid under different circumstances. This all seems easy and fun, but problems start to come out just by trying to define what actually a fluid is. As a matter of fact, the behaviour of a substance change regarding of the stresses applied to it and on the time scale. Some materials can act both like a fluid or a solid and it might be impossible to give an exact definition. Nevertheless, to keep things simple we might define a fluid as something that cannot sustain shear stresses. Easy as it is, we will take it for granted and we will not worry about weird behaviours typical of what we call non-Newtonian fluids.

Having said this, the first thing to decide before starting a more in-depth description is deciding what kind of approach we are going to use. There are two different approaches we can use: the Lagrangian approach and the Eulerian approach. The former involves taking a fluid element and tracking its movements, while the latter is basically based on observing the properties of the fluid going through a specific volume element. They are both valid and the choice of using on of them depends on the specific problem er are trying to tackle, on the available struments and on the performance we require.

Describing properly a fluid involves being consciuous of tons of different parameters that can change during the motion or just being constant. The most important ones are the velocity vectore, the pressure and the density, Known these five quantities we can give a full and clear description of the fluid we are observing. Most importantly, we can take into consideration fluids which have density constant throught the whole fluid. They are called incompressible fluids and their property simplifies the equations used to describe it, especially the continuity equation.

In addition to this, the flow of a fluid can be laminar or turbulent. The laminar flow in a flow constant in time and in which the fluid element paths do not mix with each other. On the other side, turbulent flow is highly chaotic and difficult to predict accurately.

2.1 Definition of fluid

2.2 Newtonian and non-Newtonian fluids

2.3 Compressible and incompressible fluids

2.4 Laminar and turbulent fluids

2.5 Lagrangian and Eulerian approach

Chapter 3

Governing equations

3.1 Conservation of mass

3.2 Conservation of momentum

3.3 Conservation of energy

3.4 Buckingham π theorem

Chapter 4

Partial Differential Equations

DA JOEL ETC. (UN LIBRO)

Quasi-linear second-order partial differential equations in two independent variables can be divided in three types depending on the characteristics: hyperbolic, parabolic and eliptic.

HYPERBOLIC -¿ the characteristics are real and distinct

PARABOLIC -¿ the characteristics degenerate to a single real set

ELLIPTIC -¿ there are no real characteristics. The two sets of characteristics are imaginary and distinct.

4.1 Navier-Stokes equations

The Navier-Stokes cannot be studied using the scheme above because we have four independent variables.

4.2 Hyperbolic flow

Unsteady inviscid compressible flow

steady compressible flow and SUPERSONIC

4.3 Parabolic flow

Boundary layer approximation leads to a set of equations that have parabolic character

specification of pressure obtained by solving a potential flow problem, elliptic nature

parabolic-elliptic problem

4.4 Elliptic flow

region of recirculation
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Computational Fluid Dynamics (CFD)

5.1 What is the scope of CFD?

5.2 Finite Difference Method (FDM)

5.3 Finite Element Method (FEM)

5.4 Finite Volume Method (FVM)

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6.2 Unstructured Grid

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Chapter 8

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8.2 SPH

Chapter 9

Application of FDM

9.1 Parameters...

9.2 Results

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