PRESENTATION

Commercial finite volume software packages are the most commonly used in the aeronautical and automobile industries. The most important ones are FLUENT, ANSYS CFX and STAR-CCM+. STAR-CCM+ is offered to the end user as a Physics simulation integrated package. Much more than just a CFD solver, STAR-CCM+ aims at being an entire engineering computational procedure for solving problems involving flow (of fluids or solids), heat transfer and stress.

This material consists of a collection of exercises and tutorials used in the ATHENS course UPM41 CFD_WORKSHOP, which is given as well as the free configuration subject at the UPM, which has adopted STAR-CCM+ as the reference commercial package.

This course is organized around a set of tutorials through which the main capabilities of the software are demonstrated. These tutorials cover fundamental problems of fluid mechanics (viscous laminar flows, turbulent flows, free surface flows, etc…) as well as consolidating the more fundamental fluid Mechanics core knowledge.

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INTRODUCTION

In this course, we aim at providing an introduction to the use of CFD codes in Engineering. The specific objectives are:

1. Learn to use a finite volume method CFD.
    a) Physical Models (viscous and free surface flows)
    b) Meshing
    c) Execution
    d) Post-Processing.
2. Establish connections with Fluid Dynamics background.

In order to achieve these targets, this document is divided into five tutorials:

1) Tutorial 1: POISEUILLE FLOW

2) Tutorial 2: PLANE POISEUILLE WITH A TURBULENCE MODEL

3) Tutorial 3: FLOW PAST A CIRCULAR CYLINDER

4) Tutorial 4: DAM BREAK

Each tutorial describes in detail the steps to follow on how to appropriately solve the proposed problems thus making it much easier for the reader to follow. A great number of images have been used throughout these tutorials to further aid the reader in understanding the main aspects of the software interface. Once a tutorial has been completed, various similar unsolved exercises are proposed in order to complement and reinforce the recently acquired knowledge. Both the tutorials and exercises often require the use of certain CAD files, which are also provided. Furthermore, in order to carry out some comparisons with reference data, some MATLAB scripts are provided together with references to the scientific literature.

We hope these tutorials will be useful in familiarizing students with the software and its capabilities, but more importantly, helping them understand the nature of the problems as well as their underlying mechanics.