UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH
Escola Superior d'Enginyeries Industrial,
Aeroespacial i Audiovisual de Terrassa

ESEIAAT

Study for the computational resolution of conservation equations of mass, momentum and energy. Possible application to different aeronautical and industrial engineering problems: Case 1B

Project Charter

Author: Laura Pla Olea
Director: Carlos David Perez Segarra
Co-Director: Asensio Oliva Llena
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1 Aim of the project

The main objective of this study is to study the simulation of the fundamental equations of fluid dynamics and mass and heat transfer, and to apply the developed codes in a practical engineering case.

2 Scope of the project

The main objective of this study is to develop different simulation codes to find numerical computational solutions to solve different cases in which the equations of mass, momentum and energy are applied.
The first step will be to solve some basic cases in order to learn the fundamentals of the mathematical formulation and the computational and programming techniques that are going to be needed to develop the whole study. With the help of these cases, some simulation codes are going to be developed, to ensure the correct programming of these basic problems. Finally, the aim of this study will be to apply the knowledge acquired to a practical case, that may be an engineering system or any other physical system.

In order to accomplish the objectives mentioned above, these are the following tasks to be developed:

- Previous analysis of the current methods of computational analysis and state of the art.
- Study of the physical phenomenon behind all the cases and of the mathematical formulation that should be applied.
- Development of the necessary numerical simulation tools. All the codes will need to be validated to ensure they are correct.
- Analysis of the obtained results.
- Application of the developed simulation codes to an specific system and possible optimization of this system through them.

3 Basic requirements of the project

The main requirement of this study is to get the numerical results as accurate as possible in all the simulation cases. However, to obtain these results, a knowledge in fluid mechanics is necessary to understand the physics behind each case, as well as some basic programming skills to correctly develop the simulation codes. Finally, there are no economical or legal

requirements because the software used for this study is completely open source. However, the electrical consumption of the computers used to develop and run the simulations may be taken into account.

4 Justification

Conservation equations of mass, momentum and energy are necessary to solve thermal and engineering problems. However, they usually do not have an analytical solution, so a computational approach is often necessary. A huge amount of cases have been solved in the recent years, but there are still other problems that need to be studied and developed, in particular some practical applications.

The main advantage of the approach explained in the scope is that the study of the computational resolution is started from basic cases and its difficulty is upgraded with every case of fluid dynamics that is proposed. That way, the comprehension on the developed simulations is higher and the codes are more reliable. As previously mentioned, the simulation codes are being developed from zero. This is an advantage because no previous errors are going to be introduced on the program, but it is also a disadvantage because its development could take some time.

Anyhow, this project can be useful in the study of new engineering and thermal problems that need to be solved using the conservation equations of mass, momentum and energy; and can lead to other new studies of computational resolution of these equations.