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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

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1 Aim

The main objective of this paper is to study the simulation of the fundamental equations of fluid dynamics and mass and heat transfer. A second objective would be to apply the developed and verified codes in a practical engineering case.

2 Scope

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.

Finally, a second part 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 research of the state of the art.
- Theoretical approach of the fluid dynamics behind all the cases and study 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.
- Application of the developed simulation codes to an specific system and possible optimization of this system through them.
- Analysis of the obtained results.
- Conclusions

3 Requirements

The main requirement is to obtain accurate and realistic numerical results 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.

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.

5 Calendar