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Study and development of a solidification model using CFD

MASTER FINAL THESIS

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UNIVERSITAT POLITÈCNICA DE CATALUNYA

MASTER THESIS

Study and development of a solidification model using CFD

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April 20, 2022

Declaration of Authorship

I, Aitor BAZÁN ESCODA, declare that this thesis titled, "Study and development of a solidification model using CFD" and the work presented in it are my own. I confirm that:

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- Where I have consulted the published work of others, this is always clearly attributed.
- Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work.
- I have acknowledged all main sources of help.
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Abstract

Faculty Name
Escola Tècnica Superior d'Enginyeria de Camins, Canals i Ports de Barcelona

Master Thesis

Study and development of a solidification model using CFD

by Aitor BAZÁN ESCODA

Phase-changes, but specifically solidification processes are of great interest in automotive industry for the windshield washer tank design. This Master thesis will produce a comprehensive state of the art of current used methods to effectively represent solidification processes.
The content of this thesis is organized in the following way: the

Acknowledgements

The acknowledgments and the people to thank go here, don't forget to include your project advisor...

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List of Abbreviations

LAH	**L**ist **A**bbreviations **H**ere
WSF	**W**hat (it) **S**tands **F**or

Physical Constants

Speed of Light $\quad c_0 = 2.997\,924\,58 \times 10^8\,\mathrm{m\,s^{-1}}$ (exact)

List of Symbols

a	distance	m
P	power	W ($\mathrm{J\,s^{-1}}$)
ω	angular frequency	rad

Chapter 1

Introduction

1.1 Thesis Statement

Enthalpy-porosity for modeling the melting process and UDF (user defined function) to describe the expansion of PCM (phase-change material) as a result of the variation between the solid and liquid density.

Numerical modeling of a solid-liquid phase change in a closed 2D cavity with density change, elastic wall and natural convection.

1.2 Phase-Change Process

1.2.1 Freezing Phenomena

LaTeX is not a WYSIWYG (What You See is What You Get) program, unlike word processors such as Microsoft Word or Apple's Pages. Instead, a document written for LaTeX is actually a simple, plain text file that contains *no formatting*. You tell LaTeX how you want the formatting in the finished document by writing in simple commands amongst the text, for example, if I want to use *italic text for emphasis*, I write the `\emph{text}` command and put the text I want in italics in between the curly braces. This means that LaTeX is a "mark-up" language, very much like HTML.

1.2.2 State of Art. Numerical Methods

1.2.3 Stefan Problem

1.3 Conjugate Heat Transfer

1.3.1 Mechanisms of Heat Transfer

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4.2.2 Governing Equations of the Fluid Region

4.2.2.1 Momentum Equation

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4.2.4 Case Setup

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Chapter 5

Conclusions

Chapter 6

Future Works

Appendix A

Frequently Asked Questions

A.1 How do I change the colors of links?

The color of links can be changed to your liking using:

`\hypersetup{urlcolor=red}`, or
`\hypersetup{citecolor=green}`, or
`\hypersetup{allcolor=blue}`.

If you want to completely hide the links, you can use:

`\hypersetup{allcolors=.}`, or even better:
`\hypersetup{hidelinks}`.

If you want to have obvious links in the PDF but not the printed text, use:

`\hypersetup{colorlinks=false}`.