



## CONTENTS

Abstract	iii
Contents	xi
List of Symbols	xv
1 Introduction	1
1.1 Research objectives . . . . .	3
1.2 Thesis outline . . . . .	4
2 State Of Art	7
2.1 State of Art CFD . . . . .	7
3 Governing Equations	19
3.1 Introduction . . . . .	19
3.2 Single-phase conservation equations . . . . .	24
3.3 Single-phase closure equations . . . . .	27

3.4 Two-phase flow conservation equations . . . . .	32
3.5 Solid conduction equation . . . . .	41
3.6 Two-phase closure models . . . . .	42
3.7 Interfacial momentum transfer . . . . .	45
3.8 Interfacial heat transfer . . . . .	57
3.9 Interfacial mass transfer . . . . .	60
3.10 Two-phase wall friction model. . . . .	62
3.11 Two-phase wall heat transfer model . . . . .	63
3.12 Subcooled boiling model . . . . .	64
<b>4 Methodology (I): OpenFOAM<sup>®</sup>, Utilities and External Applications</b>	<b>69</b>
4.1 Introduction to OpenFOAM . . . . .	69
4.2 Finite Volume Method . . . . .	73
4.3 Boundary conditions . . . . .	78
4.4 Solution algorithms: SIMPLE, PISO and PIMPLE. . . . .	82
4.5 Short introduction about OpenFOAM <sup>®</sup> programming . . . . .	86
4.6 Conjugate Heat Transfer . . . . .	90
4.7 Thermophysical models . . . . .	93
<b>5 Methodology (II): One-dimensional Solver Development</b>	<b>103</b>
5.1 Introduction . . . . .	103
5.2 Single-phase flow solver . . . . .	104
5.3 Solid mesh implementation . . . . .	109
5.4 Two-phase flow solver . . . . .	117
<b>6 Application and results</b>	<b>135</b>
6.1 Introduction . . . . .	135
6.2 Single-phase flows simulations . . . . .	138
6.3 Two-phase flow simulations . . . . .	144

<b>7 Conclusions</b>	<b>171</b>
7.1 Conclusions . . . . .	171
7.2 Future work . . . . .	174
<b>Bibliography</b>	<b>179</b>