

# Contents

<b>Contents</b>	<b>xiii</b>
List of Figures . . . . .	xvi
List of Tables . . . . .	xxi
<b>Nomenclature</b>	<b>xxiii</b>
<b>1 Introduction</b>	<b>1</b>
1.1 Background . . . . .	2
1.2 Motivation . . . . .	4
1.3 Objectives . . . . .	5
1.4 Working plan . . . . .	6
1.5 Contents . . . . .	7
<b>2 Literature Review</b>	<b>9</b>
2.1 Introduction . . . . .	10
2.2 CFD modeling . . . . .	11
2.3 Flow through the stator . . . . .	12
2.4 Rotor-Stator interaction . . . . .	13
2.5 Tip leakage . . . . .	15
2.6 Effects of the geometry variation . . . . .	16
2.7 Entropy and exergy analysis in radial turbine . . . . .	17
2.8 References . . . . .	20
<b>3 CFD simulations setup</b>	<b>23</b>
3.1 Introduction . . . . .	25
3.2 Geometry Description . . . . .	25
3.3 Numerical Setup . . . . .	28
3.4 Summary . . . . .	35
3.5 References . . . . .	36
<b>4 Performance Characteristics</b>	<b>53</b>
4.1 Introduction . . . . .	55

---

## CONTENTS

---

4.2	Performance Characteristics . . . . .	55
4.3	Summary . . . . .	66
4.4	References . . . . .	67
<b>5</b>	<b>Stator Flow Characteristics</b>	<b>73</b>
5.1	Introduction . . . . .	74
5.2	Numerical Results . . . . .	74
5.3	Summary . . . . .	79
5.4	References . . . . .	80
<b>6</b>	<b>Flow characteristics through the vaneless space.</b>	<b>83</b>
6.1	Introduction . . . . .	85
6.2	Numerical Results . . . . .	85
6.3	Unsteady Rotor-Stator Interaction . . . . .	92
6.4	Summary . . . . .	99
6.5	References . . . . .	101
<b>7</b>	<b>Rotor Flow Characteristics</b>	<b>103</b>
7.1	Introduction . . . . .	105
7.2	Numerical Results . . . . .	105
7.3	Summary . . . . .	114
7.4	References . . . . .	115
<b>8</b>	<b>Exergy Analysis</b>	<b>117</b>
8.1	Introduction . . . . .	118
8.2	Numerical Results . . . . .	118
8.3	Summary . . . . .	122
8.4	References . . . . .	123
<b>9</b>	<b>Effects of the variation of the rotor tip gap at high pressure ratios reaching choked flow.</b>	<b>125</b>
9.1	Introduction . . . . .	128
9.2	Geometry description . . . . .	128
9.3	Performance characteristics . . . . .	129
9.4	Characteristics of flow through the tip gap . . . . .	133
9.5	Summary . . . . .	154
9.6	References . . . . .	157
<b>10</b>	<b>Grooved Stator Vanes</b>	<b>159</b>
10.1	Introduction . . . . .	161
10.2	Geometry Description . . . . .	161
10.3	Mesh analysis . . . . .	162
10.4	Performance Characteristics . . . . .	165

---

## Contents

10.5 Analysis of the stator flow behavior . . . . .	166
10.6 Summary . . . . .	181
10.7 References . . . . .	184
<b>11 Conclusions and future works</b>	<b>187</b>
11.1 Introduction . . . . .	189
11.2 Stator flow features . . . . .	189
11.3 Stator-Rotor interaction . . . . .	189
11.4 Rotor flow features . . . . .	190
11.5 Exergy analysis . . . . .	191
11.6 Effects of the geometry change . . . . .	192
11.7 Future works . . . . .	194
11.8 References . . . . .	203
<b>References</b>	<b>205</b>