Contents

Abstract	Ι
Resumen	V
Resum	IX
Acknowledgments	XV
Contents	XX
 Introduction Motivation and background Motivation and background Objectives Organization and development of the Thesis Fundamentals: wave equation and acoustic characterization 	1 3 4 5
2.1 Introduction	
2.2 Wave equation	$ \dots 14 \\ \dots 15 \\ \dots 18 $
2.3 One-dimensional acoustics of ducts	$ \dots $
2.4 Plane wave models. Matrix representation 2.4.1 Generalities 2.4.2 Transfer matrix of a duct 2.4.3 Transfer matrix at expansions and contractions	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$
 2.5.1 Characteristic impedance of a perforated surface 2.5.2 Characteristic impedance of microperforated surface 	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$
2.6 Absorbent materials	

		2.6.3 Additional considerations
	2.7	Silencers
		2.7.1 Reactive configurations
		2.7.2 Dissipative configurations
	2.8	Sound attenuation in silencers
		2.8.1 Energetic considerations
		2.8.2 Sound attenuation parameters in silencers
	2.9	Applications
		2.9.1 TL of a simple expansion chamber $\ldots \ldots \ldots$
		2.9.2 TL of perforated dissipative silencer $\ldots \ldots \ldots$
	2.10	Limitations
	2.11	Conclusions
0	D (
3	Exte	ended models for absorbent materials and sintered surfaces 61
	3.1	Introduction
	3.2	Models for the absorbent material with
		variable properties
	<u></u>	3.2.1 Absorbent material with neterogeneous bulk density 64
	3.3	Absorbent material with thermal-induced
		neterogeneity
	9.4	3.3.1 variation of the properties
	3.4	Sintered surface model
		3.4.1 Material characterization
		3.4.2 Sintered surface acoustic impedance
	25	3.4.3 Sintered surface acoustic model
	3.5	Applications
		3.5.1 Perforated dissipative silencers
	0.0	3.5.2 Silencers incorporating sintered ducts
	3.0	Conclusions
4	Adv	anced numerical techniques for the acoustic modelling of dissi-
	pati	ve silencers 97
	4.1	Introduction
	4.2	Application of the finite element method to the convective wave equation 101
		4.2.1 Pressure formulation
		4.2.2 Velocity potential formulation
	4.3	Coupled subdomains
		4.3.1 Pressure formulation
		4.3.2 Velocity potential formulation
	4.4	Configurations with absorbent material 122

	4.5	Finite element hybrid formulation. Variable properties of the propaga-	
		tion media	127
		4.5.1 Variable bulk density	128
		4.5.2 Non-uniform temperature field	133
	4.6	Shape optimization based on genetic algorithms	139
		4.6.1 MOGA-II description	140
		4.6.2 Variables, constraints and objective function of the problem	142
	4.7	Applications	144
		4.7.1 Perforated dissipative silencer with variable bulk density of the	
		absorbent material	144
		4.7.2 Perforated dissipative silencer subjected to thermal gradients .	150
		4.7.3 Shape optimization in multichamber silencers	160
		4.7.4 Comparison of surfaces	163
	4.8	Conclusions	166
5	Effi	cient numerical approaches. Point collocation technique	
-	and	mode-matching method	169
	5.1	Introduction	171
	5.2	Quadratic eigenvalue problem associated with the cross section of the	
		silencer	172
	5.3	Continuity of the acoustic fields	177
		5.3.1 Point collocation technique	177
		5.3.2 Mode-matching method	182
	5.4	Temperature variation	185
		5.4.1 Absorbent material	185
		5.4.2 Impedance of the perforated duct	186
	5.5	Application to axisymmetric perforated dissipative silencers	187
		5.5.1 Point collocation in nodes and Gauss points	188
		5.5.2 Mode-matching \ldots	189
		5.5.3 Study and comparison of the error convergence between the PC	
		technique and the MM approach	191
	5.6	Conclusions	196
6	Con	clusions and future works	197
	6.1	Conclusions	199
	6.2	Future works	202
Bi	ibliog	graphy	203
Li	st of	publications	219
	Inte	rnational journals	219
	Inte	rnational congresses	$\frac{-10}{220}$

Contents

National congresses.																											221
reactionar congresses .		•		•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	