

Contents

1	Introduction	1
1.1	General approach	1
1.2	Objectives and Structure	4
2	Frequency sweep ultrasonics: Case on bending test monitoring on Glass-fiber Reinforced Cement	7
2.1	Ultrasonic characterization of GRC with high percentage of fly ash substitution ¹	9
2.1.1	Introduction	9
2.1.2	Experimental	11
2.1.3	Results and discussion	17
2.1.4	Conclusions	24
2.2	Ultrasonic monitoring on glass-fiber reinforced cement (GRC) bending test ²	30
2.2.1	Introduction	30
2.2.2	Experimental	31
2.2.3	Results and discussion	35
2.2.4	Conclusions	39
2.3	Optimized ultrasonic attenuation measures for non-homogeneous materials ³	41
2.3.1	Introduction	41
2.3.2	Experimental	43
2.3.3	Mathematical background	44
2.3.4	Results and discussion	52
2.3.5	Conclusions	58
2.4	Ultrasonic broadband signals monitoring of glass-fiber reinforced cement (GRC) bending tests ⁴	61
2.4.1	Introduction	61
2.4.2	Experimental	63
2.4.3	Results and discussion	67

2.4.4 Conclusions	72
3 Non-linear acoustic spectroscopy: Cases on chemical and thermal damages in mortar	81
3.1 Multimodal analysis of GRC ageing process using Non-linear Impact Resonance Acoustic Spectroscopy ⁵	83
3.1.1 Introduction	83
3.1.2 Experiment	84
3.1.3 Results and discussion	88
3.1.4 Conclusions	97
3.2 Ultrasonic and impact spectroscopy monitoring on internal sulphate attack of cement-based materials ⁶	101
3.2.1 Introduction	101
3.2.2 Experimental	103
3.2.3 Results and discussion	111
3.2.4 Conclusions	121
3.3 Non-linear acoustic spectroscopy and frequency sweep ultrasonics: Case on thermal damage assessment in concrete ⁷	125
3.3.1 Introduction	125
3.3.2 Experimental	128
3.3.3 Results	135
3.3.4 Conclusions	142
3.4 Effects of slow dynamics and conditioning on non-linear hysteretic material evaluation ⁸	146
3.4.1 Introduction	146
3.4.2 Mathematical background	148
3.4.3 Experimental	151
3.4.4 Results and discussion	153
3.4.5 Conclusions	161
4 Conclusions and future research	165
4.1 Conclusions	165
4.2 Future research	167
5 Publications and developed activities	169
5.1 Peer review ISI Journals	169
5.2 International Conferences	170
5.3 National Conferences	171
5.4 Patents	171
5.5 Institutional acknowledgements	172
Bibliography	173
Epilogue	175

List of Figures	177
List of Tables	185