

IMPLEMENTING IMPEDANCE – BASED HEALTH MONITORING

by

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ABSTRACT

This work is an experimental study of applying an impedance-based health monitoring technique to complex structures. The work is presented in three parts.

In the first part we consider effects of the following three factors on damage detection abilities: actuator excitation level, test wire length and ambient conditions (temperature, structural loading and vibration). It was concluded that increasing the applied voltage improves the signal to noise ratio and damage detection abilities. Test wire lengths under 30m do not affect damage detection abilities. The technique is able to distinguish and detect damage even with variations in temperature, structural loading and vibration.

In the second part we apply our health monitoring technique to a complex truss structure and a massive steel steam header. We discovered that with multiplexing (acquiring a single signal from distributed actuators) the actuators on the truss structure we could detect damage but with less location information. Damage detection on the steel pipe ended in inconclusive results. The use of this technique on massive structures needs further investigation.

Finally, we conducted a detailed experimental study of monitoring the integrity of composite-reinforced masonry structures. We developed a software package which enables even a casual user to determine if significant damage has occurred in these structures. The technique was successfully applied to detect damage (particularly due to

delamination) in these composite-concrete structures. Most significantly, the technique was also able to detect damage well in advance of actual failure.

This work relies mainly on frequency response plots and damage metric charts to present the data and to arrive at any conclusions. While frequency response plots give a qualitative approach to the analysis, damage metric charts attempt to quantify the data.

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TABLE OF CONTENTS

ABSTRACT.....	ii
ACKNOWLEDGEMENTS.....	iv
TABLE OF CONTENTS.....	v
LIST OF FIGURES.....	x
LIST OF TABLES.....	xv
CHAPTER 1: INTRODUCTION.....	1
1.1 BACKGROUND.....	1
1.2 PRINCIPLES OF THE IMPEDANCE-BASED HEALTH MONITORING TECHNIQUE.....	4
1.3 ELECTROMECHANICAL PRINCIPLES.....	5
1.4 RELATED PREVIOUS WORK.....	8
1.5 CONTRIBUTION AND GOALS OF THIS WORK.....	9
1.6 PARAMETERS IN THE IMPEDANCE BASED HEALTH MONITORING TECHNIQUE.....	12
1.6.1 LOCALIZATION OF SENSING AREA.....	12
1.6.2 FREQUENCY RANGE.....	12
1.7 FREQUENCY RESPONSE CHARTS.....	13
1.8 DAMAGE METRIC CHARTS.....	15
1.9 CONFIGURATION FOR DATA ACQUISITION.....	17
CHAPTER 2: EFFECTS OF VOLTAGE ON DAMAGE DETECTION.....	21
2.1 INTRODUCTION.....	21
2.2 EXPERIMENTAL SET-UP.....	21
2.3 RESULTS AND ANALYSIS.....	23
2.3.1 OBSERVATION 1: LOW VOLTAGE EFFECTS.....	23
2.3.2 OBSERVATION 2: ABILITY TO DETERMINE DAMAGE WITH VARYING VOLTAGES (WITH CONNECTING BOLTS TIGHT)	25

2.3.3 OBSERVATION 3: ABILITY TO DETERMINE DAMAGE WITH VARYING VOLTAGES (WITH CONNECTING BOLTS LOOSE)	26
2.3.4 OBSERVATION 4: DAMPING EFFECTS.....	28
2.3.5 OBSERVATION 5: ABILITY TO DETERMINE DAMAGE WITH VARYING VOLTAGES AND CHANGE IN DAMPING.....	29
2.4 SUMMARY.....	30
CHAPTER 3: EFFECT OF TEST WIRE LENGTH ON DAMAGE DETECTION.....	32
3.1 INTRODUCTION.....	32
3.2 EXPERIMENTAL SET-UP.	33
3.3 RESULTS AND ANALYSIS.....	34
3.3.1 OBSERVATION 1: EFFECTS OF TEST WIRE LENGTH ON FREQUENCY RESPONSE (R VS. FREQUENCY)	35
3.3.2 OBSERVATION 2: EFFECTS OF TEST WIRE LENGTH ON FREQUENCY RESPONSE (X VS. FREQUENCY)	36
3.3.3 OBSERVATION 3: DAMAGE METRICS FOR INCREASING TEST WIRE LENGTHS.....	38
3.4 SUMMARY.....	42
CHAPTER 4: DAMAGE DETECTION USING DISTRIBUTED SENSORS.....	44
4.1 INTRODUCTION.....	44
4.2 EXPERIMENTAL SET-UP.....	45
4.3 RESULTS AND ANALYSIS.....	48
4.3.1 OBSERVATION 1: FREQUENCY RESPONSE FOR MULTIPLEXED PZT'S.....	49
4.3.2 OBSERVATION 2: FREQUENCY RESPONSE FOR PZT 1.....	50
4.3.3 OBSERVATION 3: DAMAGE METRIC CHARTS.....	52
4.3.4 OBSERVATION 4: MATHEMATICAL AVERAGING VERSUS MULTIPLEXING...	56
4.4 SUMMARY.....	57
CHAPTER 5: EFFECTS OF BOUNDARY CONDITIONS AND AMBIENCE ON HEALTH MONITORING.....	59
5.1 INTRODUCTION.....	59
5.2 EXPERIMENTAL SET-UP.....	60
5.3 RESULTS AND ANALYSIS.....	64
5.3.1 OBSERVATION 1: VARIATION OF IMPEDANCE SIGNATURES ON A GIVEN DAY.....	64

5.3.2 OBSERVATION 2: COMPARISON OF EXTENT OF DAMAGE USING DAMAGE METRIC CHARTS.....	67
5.3.3 OBSERVATION 3: FREQUENCY RESPONSE PLOTS SHOWING VARIATION WITH TIME.....	72
5.3.4 OBSERVATION 4: DAMAGE METRIC CHART FOR VARIATION WITH TIME...	75
5.4 SUMMARY.....	77
CHAPTER 6: DAMAGE DETECTION ON A MASSIVE STEEL HEADER.....	80
6.1 INTRODUCTION.....	80
6.2 EXPERIMENTAL SET-UP.....	80
6.3 RESULTS AND ANALYSIS.....	83
6.3.1 OBSERVATION 1: FREQUENCY RESPONSE PLOTS FOR PZT 1.....	84
6.3.2 OBSERVATION 2: FREQUENCY RESPONSE PLOTS FOR PZT 2.....	87
6.3.3 OBSERVATION 3: DAMAGE METRIC CHARTS FOR PZT 1 AND 2.....	89
6.3.4 OBSERVATION 4: COMPARISON OF METRIC CHARTS FOR PZT 1 AND 2.....	91
6.4 SUMMARY.....	92
CHAPTER 7: REINFORCED STRUCTURE INTEGRITY MONITORING.....	94
7.1 OVERVIEW.....	94
7.2 OVERVIEW OF IMPEDANCE BASED QUALITATIVE HEALTH MONITORING..	98
7.2.1 BACKGROUND.....	98
7.2.2 THE ELECTRICAL IMPEDANCE APPROACH TO DAMAGE IDENTIFICATION	100
7.2.3 ADVANTAGES OF THE IMPEDANCE BASED HEALTH MONITORING TECHNIQUE.....	100
7.3 PROOF-OF-CONCEPT DEMONSTRATION.....	102
7.3.1 EXPERIMENTAL SETUP.....	102
7.3.2 ANALYSIS.....	104
7.3.3 OBSERVATIONS.....	112
7.4 DEMONSTRATION AND ANALYSIS OF COMPOSITE REINFORCED WALLS UNDER LOADING.....	113
7.4.1 EXPERIMENTAL SET-UP.....	113
7.4.2 PZT PATCH CONFIGURATION.....	114
7.4.3 LOADING CONFIGURATION.....	117
7.5 WALL 1.....	119
7.5.1 ANALYSIS.....	123
7.5.1.1 PZT 1.....	123

7.5.1.2 PZT 2.....	125
7.5.1.3 PZT 5.....	126
7.5.1.4 PZT 3.....	127
7.5.1.5 PZT 4.....	128
7.5.2 OBSERVATIONS.....	129
7.6 WALL 2.....	134
7.6.1 ANALYSIS.....	138
7.6.1.1 PZT 1.....	138
7.6.1.2 PZT 5.....	139
7.6.1.3 PZT 4.....	140
7.6.1.4 PZT 2.....	141
7.6.1.5 PZT 3.....	142
7.6.2 OBSERVATIONS.....	143
7.7 WALL 3.....	146
7.7.1 ANALYSIS.....	149
7.7.1.1 PZT 2.....	149
7.7.1.2 PZT 5.....	150
7.7.1.3 PZT 4.....	150
7.7.1.4 PZT 3.....	151
7.7.1.5 PZT 1.....	152
7.7.2 OBSERVATIONS.....	153
7.8 WALL 4.....	156
7.8.1 ANALYSIS.....	160
7.8.1.1 PZT 1.....	160
7.8.1.2 PZT 4.....	161
7.8.1.3 PZT 5.....	163
7.8.1.4 PZT 2.....	164
7.8.1.5 PZT 3.....	165
7.8.2 OBSERVATIONS.....	166
7.9 CONCLUSIONS AND RECOMMENDATION.....	168
CHAPTER 8: CONCLUSIONS AND RECOMMENDATIONS.....	172
REFERENCES.....	178

APPENDIX A: REINFORCED STRUCTURE INTEGRITY MONITORING (RSIM)	
USER'S MANUAL.....	181
A.1 INTRODUCTION.....	181
A.2 HARDWARE AND SOFTWARE REQUIREMENTS.....	181
A.3 FILE STRUCTURE.....	182
A.4 GENERAL DESCRIPTION OF FILES: PZT-1 THROUGH 5.....	183
A.4.1 'SETTINGS' SHEET.....	183
A.4.2 'COPY1' SHEET.....	186
A.4.3 'Data(A)' SHEET.....	187
A.4.4 'Data(B)' SHEET.....	187
A.4.5 'Metric-FUNC' SHEET.....	188
A.4.6 'A Vs. Freq.' SHEET.....	188
A.4.7 'B Vs. Freq.' SHEET.....	189
A.4.8 'Metric-ASD' SHEET.....	189
A.4.9 'Metric-CORR' SHEET.....	190
A.5 GENERAL DESCRIPTION OF FILE: PZT-ALL.....	190
A.5.1 'PZT-Program' SHEET.....	191
A.5.2 'CERL' SHEET.....	191
A.5.3 'COMBINE' SHEET.....	191
A.5.4 'CLEAR' SHEET.....	192
A.5.5 'SET-ALL' SHEET.....	192
A.5.6 'Data-Copy' SHEET.....	194
A.5.7 'ALL-CORR' SHEET.....	194
A.5.8 'ALL-ASD' SHEET.....	194
A.6 STEP-BY-STEP INSTRUCTIONS FOR THE RSIM SOFTWARE.....	195
APPENDIX B: 'PZT' PROGRAM.....	198
APPENDIX C: 'CERL' PROGRAM.....	207
APPENDIX D: 'COMBINE' PROGRAM.....	216
APPENDIX E: 'CLEARPZT' PROGRAM.....	221
APPENDIX F: 'CLEARALL' PROGRAM.....	223
VITA.....	225

LIST OF FIGURES

1.1	1-D model used to represent a PZT-driven dynamic structural system...	6
1.2a	General configuration of test set-up and instrumentation using the HP 4194A impedance analyzer.....	18
1.2b	General configuration of test set-up and instrumentation using the HP 4192A impedance analyzer.....	19
2.1	Experimental set-up to determine effect of voltage change on damage detection.....	22
2.2	‘R vs. Frequency’ chart; the two connecting bolts are tight with the screw in place, at 0.01 V and at 1.0 V.....	24
2.3	Damage Metric chart; connecting bolts are tight, baseline readings are taken with screw and compared to the case when screw is removed.....	25
2.4	Damage Metric; connecting bolts are loose, baseline readings are taken with screw and compared to the case when screw is removed.....	27
2.5	‘R vs. Frequency’ chart; voltage is constant, screw is in place. Two readings are taken, one with the connecting bolts tight, and then with them loose.....	28
2.6	Damage Metric chart; comparison between the case when screw is removed and connecting bolts are tight, and, screw removed and connecting bolts are loose.....	29
3.1	Experimental set-up to determine effect of test wire length.....	34
3.2	‘R vs. Frequency’ chart; variation of the curves with increasing wire length, all readings shown are taken with undamaged structure (both screws in place).....	36
3.3	‘X vs. Frequency’ chart; variation of the curves with increasing wire length, all readings shown are taken with undamaged structure (both screws in place).....	37

3.4	Damage metric chart based on ‘R vs. Frequency’. Metrics for damage 1 (when screw #1 is removed) and damage 2 (when screw # 1 and #2 are removed).....	39
3.5	Damage metric chart based on ‘X vs. Frequency’. Metrics for damage 1 (when screw #1 is removed) and damage 2 (when screw #1 and #2 are removed).....	40
3.6	Line plot for damage metric values versus test wire length, variations of ‘R’ and ‘X’ functions with damage 1 and damage 2.....	41
4.1	Photographs (2 angles) of the aluminum truss.....	46
4.2	Close-up photograph of the PZT bonded onto the Derlin ball.....	47
4.3	‘Cs vs. Frequency’ chart; all 4 PZT’s multiplexed, variation of the signature pattern with increasing damage is shown.....	49
4.4	‘Rs vs. Frequency’ chart; all 4 PZT’s multiplexed, variation of the signature pattern with increasing damage is shown.....	50
4.5	‘Cs vs. Frequency’ chart for PZT 1 when it is interrogated individually	51
4.6	‘Rs vs. Frequency’ chart for PZT 1 when it is interrogated individually	52
4.7	Damage Metric chart (1 – Correlation) based on the ‘Cs vs. Frequency’ plot.....	53
4.8	Damage Metric chart (1 – Correlation) based on the ‘Rs vs. Frequency’ plot.....	55
4.9	Damage metric chart, based on the ‘Rs vs. Frequency’ plot. Comparison of metric values from the ‘Multiplexing’ versus the ‘Mathematical Averaging’ case.....	57
5.1	Photographs (2 angles) of the aluminum truss structure.....	61
5.2 a	‘R vs. Frequency’ plot for PZT 1, Day 1.....	65
5.2 b	‘R vs. Frequency’ plot for PZT 2, Day 1.....	65
5.2 c	‘R vs. Frequency’ plot for PZT 3, Day 1.....	66
5.2 d	‘R vs. Frequency’ plot for PZT 4, Day 1.....	66

5.3 a	Damage metric chart for PZT 2. Comparison of metric values for the ambient conditions over 7 days.....	68
5.3 b	Damage metric chart for PZT 2. The metric values are averaged (from <i>figure 5.3 a</i>) and serve as a comparison of the ‘damaged’ versus the ‘undamaged’ case.....	69
5.3 c	Damage metric values for all 4 PZT’s; values averaged over the first 4 days (structure undamaged) and the last 3 days (structure damaged)....	70
5.3 d	Damage metric chart; metrics averaged for all 4 PZT’s over the first 4 days (‘Undamaged’) and the last three days (‘Damaged’)......	71
5.4 a	‘R vs. Frequency’ plot for PZT 2, ‘Baseline’ readings on the 7 days are shown.....	72
5.4 b	‘R vs. Frequency’ plot for PZT 2, ‘Weight 1’ readings on the 7 days are shown.....	73
5.4 c	‘R vs. Frequency’ plot for PZT 2, ‘Weight 2’ readings on the 7 days are shown.....	73
5.4 d	‘R vs. Frequency’ plot for PZT 2, ‘Vibration’ readings on the 7 days are shown.....	74
5.4 e	‘R vs. Frequency’ plot for PZT 2, ‘Heat’ readings on the 7 days are shown.....	74
5.5	Damage metric for PZT 2; metric values are calculated over time to determine the extent of damage (or variation) with time.....	76
6.1	Enhanced photograph of the circular steel steam header; position of PZT’s 1 and 2 and location of the hole (on the flat face) is shown.....	81
6.2	‘Rs vs. Frequency’ chart for PZT 1, at 50-52 kHz.....	85
6.3	‘Rs vs. Frequency’ plot for PZT1, at 300-302 kHz.....	85
6.4	‘Rs vs. Frequency’ plot for PZT 2, at 50-52 kHz.....	87
6.5	‘Rs vs. Frequency’ plot for PZT 2, at 300-302 kHz.....	88
6.6	Damage metric chart for PZT 1, based on the ‘Rs vs. Frequency’ plot..	89
6.7	Damage metric chart for PZT 2, based on the ‘Rs vs. Frequency’ plot..	90

6.8	Damage metric chart based on the ‘Rs vs. Frequency’ plot for PZT’s 1 and 2.....	91
7.1	Experimental set-up for proof-of-concept demonstration.....	103
7.2	‘R Vs. Frequency’ plot for PZT 1, under loading.....	105
7.3	‘R Vs. Frequency’ plot for PZT 2, under loading.....	106
7.4	Damage metric (1 – correlation) for PZT’s 1 and 2 under loading.....	107
7.5	‘R Vs. Frequency’ for PZT 1 for delamination.....	109
7.6	‘R Vs. Frequency’ plot for PZT 2 for delamination.....	110
7.7	Damage Metric for PZT’s 1 and 2, under the effects of artificial delamination.....	111
7.8	Photograph showing PZT patch configuration.....	115
7.9	Loading configuration used for the testing of the wall specimens; diagonal loading is employed to promote early failure.....	118
7.10	Placement and numbering of the PZT’s on Wall 1. Failure occurred in two stages: TOP and CENTERLINE crack.....	122
7.11	‘R Vs. Frequency’ chart for PZT 1, Wall 1.....	123
7.12	‘R Vs. Frequency’ chart for PZT 2, Wall 1.....	125
7.13	‘R Vs. Frequency’ chart for PZT 5, Wall 1.....	126
7.14	‘R Vs. Frequency’ chart for PZT 3, Wall 1.....	127
7.15	‘R Vs. Frequency’ chart for PZT 4, Wall 1.....	128
7.16	Damage metric (1 – Correlation), for PZT’s 1 through 5, of Wall 1.....	130
7.17	Photograph of concrete face of Wall 1 (Reichold) after fracture.....	133
7.18	Placement and numbering of PZT’s on Wall 2. Position of the crack is also shown.....	137
7.19	‘R Vs. Frequency’ chart for PZT 1, Wall 2.....	138
7.20	‘R Vs. Frequency’ chart for PZT 5, Wall 2.....	139
7.21	‘R Vs. Frequency’ chart for PZT 4, Wall 2.....	140
7.22	‘R Vs. Frequency’ chart for PZT 2, Wall 2.....	141
7.23	‘R Vs. Frequency’ chart for PZT 3, Wall 2.....	142

7.24	Damage metric (1 – Correlation), for PZT’s 1 through 5, of Wall 2.....	143
7.25	Photograph of composite side and concrete side of Wall 2 (TONEN) after fracture.....	145
7.26	Placement and numbering of PZT’s on Wall 3. Position of the crack is also shown.....	148
7.27	‘R Vs. Frequency’ chart for PZT 2, Wall 3.....	149
7.28	‘R Vs. Frequency’ chart for PZT 5, Wall 3.....	150
7.29	‘R Vs. Frequency’ chart for PZT 4, Wall 3.....	151
7.30	‘R Vs. frequency’ chart for PZT 3, Wall 3.....	152
7.31	‘R Vs. Frequency’ chart for PZT 1, Wall 3.....	153
7.32	Damage metric (1 – Correlation), for PZT’s 1 through 5, of Wall 3.....	154
7.33	Placement and numbering of PZT’s on Wall 4. Position of the crack is also shown.....	159
7.34	‘R Vs. frequency’ chart for PZT 1, Wall 4.....	160
7.35	‘R Vs. Frequency’ chart for PZT 4, Wall 4.....	162
7.36	‘R Vs. frequency’ chart for PZT 5, Wall 4.....	163
7.37	‘R Vs. Frequency’ chart for PZT 2, Wall 4.....	164
7.38	‘R Vs. Frequency’ chart for PZT 3, Wall 4.....	165
7.39	‘Damage Metric chart for PZT’s 1 through 5, Wall 4 (1 – Correlation)’	166
A1	Structure of files in the RSIM software.....	182
A2	‘Settings’ Sheet.....	184
A3	‘COPY1’ Sheet.....	187
A4	Function to calculate the Average Square Difference Damage Metric...	188
A5	‘SET-ALL’ Sheet.....	193

LIST OF TABLES

1.1	Comparison of conventional NDE versus sensor systems.....	2
1.2	Comparison of strain gauges versus sensors.....	3
5.1	Summary of the readings taken from the 4 PZT's over the 7 days.....	63
7.1	Summary of the composite reinforcement materials used for the four walls. The method of failure and the percentage load increase is also noted.....	97
7.2	Summary of the composite reinforcement materials used for the four walls.....	113
7.3	Loading history for Wall 1 (Reichold). Failure along top length was observed at 50,000 lbs. Loading was finally stopped at 60,000 lbs.....	119
7.4	Loading history for Wall 2 (TONEN). A centerline fracture occurred early in the test (at 12,000 lbs), loading was eventually stopped at 45,000 lbs at which stage the fracture became more pronounced.....	134
7.5	Loading history for Wall 3 (Hexcel-Fyfe). The structure was loaded in stages to 49,000 lbs, at which point failure occurred.....	146
7.6	Loading history for Wall 4 (Owens Corning). Failure along the centerline of the structure was observed initially at 45,000 lbs. A top crack appeared at 55,000 lbs, the bottom corner crumbled at 58,000 lbs, the loading was stopped at 58,000 lbs.....	156
7.7	Summary of the composite reinforcement materials used for the four walls. The method of failure and the percentage load increase is also noted.....	170