

Contents

Title page	i
Certificate of approval	ii
Declaration	iii
Certificate from supervisors	iv
Acknowledgement	v
Dedication	vii
Nomenclature	viii
Greek Symbols	x
Abbreviations	xi
List of Figures	xii
List of Tables	xv
Abstract	xvii
Chapter 1 Introduction	1-16
1.1 Introduction to plasma spray coating process	1-3
1.2 Literature Review	4-13
1.2.1 Mathematical and thermal modeling based on experiments	4-6
1.2.2 Statistical regression analysis on plasma spray coating process	7-10
1.2.3 Soft computing-based modeling of plasma spray coating process	10-13
1.3 Gaps in the literature	13-14
1.4 Aims and Objectives	14
1.5 Contributions made by the scholar	15
1.6 Layout of the thesis	15-16

1.7 Summary	16
Chapter 2 Tools and techniques used	19-40
2.1 Statistical regression analysis	19-24
2.1.1 Overview and steps in statistical regression	19-21
2.1.2 Statistical design of experiments	21
2.1.3 Response surface methodology	21-22
2.1.4 Central composite design	23-24
2.2 Soft computing-based tools and techniques	24-40
2.2.1 Fuzzy sets and reasoning processes	25-28
2.2.2 Fuzzy clustering techniques	28-30
2.2.3 Artificial neural networks	30-34
2.2.4 Optimization tools	35-40
2.3 Summary	40
Chapter 3 Experiments on plasma spray coating	43-53
3.1 Selection of parameters and their ranges	43-44
3.2 Central composite design of experiments	44-45
3.3 Experimental set-up	46-48
3.4 Experimental procedure	48-50
3.4.1 Substrate preparation	49
3.4.2 Spraying: parameter details and procedure	50

3.5 Measurement of responses	50-53
3.5.1 Measurement of coating thickness	50
3.5.2 Preparation of coating cross-section	50-51
3.5.3 Measurement of porosity	52
3.5.4 Measurement of microhardness of coatings	52
3.6 Generation of test set samples	53
3.7 Summary	53
Chapter 4 Input-output modeling using statistical regression analysis	57-77
4.1 Forward modeling through statistical regression analysis	57-59
4.2 Effects and significance of input parameters on coating thickness	59-64
4.2.1 Effect of primary gas flow rate on coating thickness	61
4.2.2 Effect of stand-off distance on coating thickness	61
4.2.3 Effect of powder flow rate on coating thickness	62
4.2.4 Effect of arc current on coating thickness	62
4.3 Effects and significance of input parameters on porosity in coatings	64-69
4.3.1 Effect of primary gas flow rate on porosity	68
4.3.2 Effect of stand-off distance on porosity	68
4.3.3 Effect of powder flow rate on porosity	68
4.3.4 Effect of arc current on porosity	69

4.4 Effects and significance of input parameters on hardness of coatings	69-74
4.4.1 Effect of primary gas flow rate on microhardness	71
4.4.2 Effect of stand-off distance on microhardness	71
4.4.3 Effect of powder flow rate on microhardness	71
4.4.4 Effect of arc current on coating microhardness	72
4.5 Validation of regression models	74-76
4.6 Comparisons with others' studies	76
4.7 Summary	76-77
Chapter 5 ANFIS-based input-output modeling	81-97
5.1 Methodology adopted for predictions of the responses	81-82
5.2 Developed approaches for the prediction of outputs	83-84
5.3 Results and discussion	84-96
5.3.1 Prediction of coating thickness	84-90
5.3.2 Prediction of porosity in coatings	90-93
5.3.3 Prediction of microhardness of coatings	93-96
5.4 Comparisons with others' studies	97
5.5 Summary	97
Chapter 6 Input-output modeling using neural networks	101-121
6.1 Methodology adopted for the predictions of responses	101
6.2 Developed approaches for the prediction of outputs	101-108

6.3 Results and Discussion	108-121
6.3.1 Results of forward modeling	109-117
6.3.2 Results of reverse modeling	117-121
6.4 Comparisons with others' work	121
6.5 Summary	121
Chapter 7 Concluding remarks and scope for future study	125-127
7.1 Concluding remarks	125-126
7.2 Scope for future study	127
References	131-138
Appendix A	141-142
Appendix B	143
Appendix C	145
Appendix D	147
Appendix E	149-151
Appendix F	153-155
Appendix G	157-165
Appendix H	167-175