

Contents

	page
Abstract	v
Acknowledgments	vii
Contents	ix
List of Figures	xi
List of Tables	xiii
List of Symbols	xv
List of Abbreviations	xvi
List of Symbols	xv
List of Abbreviations	xvii
Chapter 1: Introduction	1
1.1 Motivation	1
1.2 Problem Formulation	2
1.3 Contributions	3
Chapter 2: Signal Model and Literature Survey	5
2.1 Introduction	5
2.1.1 Signal Model in AWGN channel	5
2.1.2 Signal in Fading channel	6
2.1.3 Signal model for Gaussian Mixture Model	7
2.2 Review of existing Classifiers	7
2.2.1 Likelihood-based Classifiers	7
2.2.2 Feature Based Classification	9
2.2.3 Machine Learning based classifiers	13
Chapter 3: Modulation Classification using Curve Fitting to Constellation	15
3.1 Introduction	15
3.2 carrier frequency offset estimation and correction	15
3.3 symbol rate estimation	15
3.4 Proposed modulation classification algorithm	16
3.4.1 Linear Regression	17
3.4.2 Circle Fitting	18
3.5 simulation results	20
Chapter 4: Symmetric Dot Pattern based Modulation Classification	23
4.1 Introduction	23
4.2 System Model	23
4.3 Symmetric dot pattern	23
4.3.1 SDP formation	24
4.3.2 Gray-scale image formation	25
4.3.3 Color image generation using ALPLT	25
4.3.4 Selection of parameters ($\Psi_0, \mathcal{L}, \mathcal{G}$)	26
4.3.5 Optimum \mathcal{L} and \mathcal{G} estimation ($\mathcal{L}_{opt}, \mathcal{G}_{opt}$)	27
4.4 Model architectures of classification methods	28
4.4.1 Deep residual network	29
4.4.2 ResNet-50	30
4.4.3 Inception ResNet V2	33
4.4.4 Training of network	36
4.5 Experiments and results	37
4.5.1 System implementation	37
4.5.2 Performance of classification method	37
4.5.3 Comparison with existing work	37
Chapter 5: Constellation Density based Modulation Classification	43
5.1 Introduction	43

5.2	Deep Learning for Modulation Classification	43
5.2.1	ResNet-50	43
5.2.2	Inception ResNet V2	45
5.3	Data Pre-processing and Training	45
5.3.1	Color Image Formation using CDM	45
5.3.2	Classification Strategy	45
5.3.3	Model Implementation and Training	47
5.4	Results and Discussion	47
Chapter 6: 2D-FFT based Modulation Classification		49
6.1	Introduction	49
6.2	DCNN-based classifier	49
6.2.1	Signal pre-processing and 2D-FFT matrix generation	49
6.2.2	DCNN architecture	50
6.2.3	Implementation and training	53
6.3	simulation results	55
6.4	Comparison with existing work	56
Chapter 7: AMC using Constellation Analysis with Oversampling Factor Alteration		57
7.1	Introduction	57
7.2	System and Signal Model	57
7.3	Modulation Classification Algorithm	58
7.3.1	Preprocessing for constellation extraction	58
7.3.2	Modulation scheme detection	60
7.4	FPGA implementation of Algorithm	62
7.4.1	LabVIEW FlexRIO communication architecture	62
7.4.2	Data Acquisition	62
7.4.3	Modulation scheme detection and symbol rate estimation	63
7.5	Performance Evaluation	64
7.5.1	Optimization of results for α	65
7.5.2	Experimental Outcomes	66
7.5.3	Classification against CFO	67
7.5.4	Comparison with related works	69
Chapter 8: Conclusion and Future Scope		71
References		75