

Contents

1	Introduction	1
1.1	Statistical Pattern Recognition	4
1.1.1	Density Estimation	7
1.1.2	Semi-Supervised Learning	10
1.1.3	Hierarchical Clustering	11
1.1.4	Non-Linear Dynamic Modelling	14
1.2	Scope	16
1.3	Contributions	17
1.3.1	ICA Mixture Modelling	17
1.3.2	Learning Hierarchies from ICA Mixtures	19
1.3.3	New Applications of ICA and ICAMM	20
1.4	Overview	22
	References	24
2	ICA and ICAMM Methods	29
2.1	Introduction	29
2.2	Standard ICA Methods	32
2.2.1	InfoMax	34
2.2.2	JADE	35
2.2.3	FastIca	36
2.2.4	TDSEP	38
2.3	Non-Parametric ICA	39
2.3.1	Npica	40
2.3.2	Radical	41
2.3.3	Kernel-ICA	42
2.4	ICA Mixture Modelling	44
2.4.1	Unsupervised Classification Using ICAMM	45
2.4.2	β -Divergence Method Applied to ICAMM	47
2.4.3	Variational Mixture of Bayesian ICAs	48

2.5	Conclusions	50
	References	52
3	Learning Mixtures of Independent Component Analysers	57
3.1	The Model and the Definition of the Problem.	59
3.2	Iterative Solutions	60
3.3	A General Procedure for ICAMM	60
3.3.1	Non-Parametric Estimation of the Source pdf's	60
3.3.2	Unsupervised–Supervised Learning	62
3.3.3	Using Any ICA Algorithm.	63
3.3.4	Correction of the Conditioned Class-Probability After Convergence	63
3.3.5	Discussion	65
3.4	Simulations.	67
3.4.1	Performance in BSS	68
3.4.2	Classification of ICA Mixtures	71
3.4.3	Convergence Properties	72
3.4.4	Classification of ICA Mixtures with Nonlinear Dependencies	75
3.4.5	Semi-supervised Learning	77
3.5	Conclusions	80
	References	81
4	Hierarchical Clustering from ICA Mixtures	83
4.1	Introduction	83
4.2	Problem Statement and Distance Between ICA Clusters.	86
4.3	Merging ICA Clusters with Kernel-Based Source Densities	86
4.3.1	ICAMM-Based Hierarchical Clustering Algorithm	90
4.4	Simulations.	90
4.5	Real Data Analysis: Image Processing	95
4.5.1	Real Object Recognition	96
4.5.2	Image Segmentation	98
4.6	Conclusions	100
	References	101
5	Application of ICAMM to Impact-Echo Testing	105
5.1	Introduction	105
5.2	Impact-Echo Measurements	107
5.2.1	Simulated Signals	107
5.2.2	Experimental Signals.	109
5.3	ICAMM for Learning Material Defect Patterns	110
5.3.1	ICA Mixture Statement of the Problem	112
5.3.2	Classification Procedure.	117
5.3.3	Patterns Detected in ICA Mixtures	121

5.3.4	Results	123
5.4	Conclusions	125
	References	127
6	Cultural Heritage Applications: Archaeological Ceramics and Building Restoration	129
6.1	Chronological Classification of Archaeological Ceramics	130
6.1.1	Introduction	130
6.1.2	Through-Transmission Model and Feature Definition	131
6.1.3	Motivation for an ICAMM Application	133
6.1.4	Experiments and Results	134
6.1.5	Discussion	138
6.2	Consolidation Diagnosis and Layer Determination in Heritage Building Restoration	144
6.2.1	Introduction	144
6.2.2	ICA Statement of the Problem	145
6.2.3	Diagnosis of the Material Consolidation Status	147
6.2.4	Thickness Material Layer Profile	149
6.3	Conclusions	151
	References	152
7	Other Applications: Sequential Dependence Modelling and Data Mining	155
7.1	Including Sequential Dependence in ICAMM	156
7.1.1	Introduction	156
7.1.2	Sequential ICAMM	157
7.1.3	Simulations	158
7.1.4	Analysis of Hypnograms	159
7.2	Webmining Application for Detecting Learning Styles in Virtual Education	161
7.2.1	Introduction	161
7.2.2	ICA Statement of the Problem	163
7.2.3	Results and Discussion	164
7.3	Conclusions	169
	References	170
8	Conclusions	173
8.1	Summary	173
8.2	Contribution to Knowledge	175
8.3	Future Work	179
8.3.1	Improvement of ICAMM Extensions	179
8.3.2	Extension of Mixca to Other Methods	180
8.3.3	Other Applications	180

Appendix: One-ICA Version of the Mixca Algorithm	181
Curriculum Vitae	185

<http://www.springer.com/978-3-642-30751-5>

On Statistical Pattern Recognition in Independent
Component Analysis Mixture Modelling

Salazar, A.

2013, XXII, 186 p., Hardcover

ISBN: 978-3-642-30751-5