

Contents

Foreword by Gildas Avoine	xi
Foreword by Cédric Richard	xiii
Preface	xv
William PUECH	
Chapter 1. Biometrics and Applications	1
Christophe CHARRIER, Christophe ROSENBERGER and Amine NAIT-ALI	
1.1. Introduction	1
1.2. History of biometrics	3
1.3. The foundations of biometrics	6
1.3.1. Uses of biometrics	7
1.3.2. Definitions	7
1.3.3. Biometric modalities	8
1.4. Scientific issues	10
1.4.1. Presentation attacks	10
1.4.2. Acquisition of new biometric data or hidden biometrics	12
1.4.3. Quality of biometric data	14
1.4.4. Efficient representation of biometric data	19
1.4.5. Protecting biometric data	22
1.4.6. Aging biometric data	24
1.5. Conclusion	25
1.6. References	26

Chapter 2. Protecting Documents Using Printed Anticopy Elements	31
Iuliia TKACHENKO, Alain TREMEAU and Thierry FOURNEL	
2.1. Introduction	31
2.2. Document authentication approaches: an overview	33
2.3. Print test shapes	35
2.3.1. Print test signatures	36
2.3.2. Glyphs	38
2.3.3. Guilloches	39
2.4. Copy-sensitive graphical codes	41
2.4.1. Copy detection pattern	42
2.4.2. Two-level barcodes	44
2.4.3. Watermarked barcodes	47
2.4.4. Performance of CSGC authentication	48
2.5. Conclusion	52
2.6. References	52
Chapter 3. Verifying Document Integrity	59
Petra GOMEZ-KRÄMER	
3.1. Introduction	59
3.2. Fraudulent manipulation of document images	62
3.2.1. Imitation	62
3.2.2. Copy-and-paste of a region from the same document	62
3.2.3. Copy-and-paste of a region from another document	63
3.2.4. Deleting information	63
3.3. Degradation in printed and re-scanned documents	64
3.3.1. Degradations linked to the print process	65
3.3.2. Degradations linked to scanning	66
3.3.3. Degradation models	67
3.4. Active approaches: protection by extrinsic fingerprints	68
3.4.1. Watermarking a document	68
3.4.2. Digital signatures	73
3.5. Passive approaches: detecting intrinsic characteristics	76
3.5.1. Printer identification	77
3.5.2. Detecting graphical clues	80
3.5.3. Other approaches	81
3.6. Conclusion	82
3.7. References	82

Chapter 4. Image Crypto-Compression	91
Vincent ITIER, Pauline PUTEAUX and William PUECH	
4.1. Introduction	91
4.2. Preliminary notions	93
4.2.1. The JPEG image format	93
4.2.2. Introduction to cryptography	96
4.3. Image encryption	100
4.3.1. Naive methods	102
4.3.2. Chaos-based methods	104
4.3.3. Encryption-then-compression	105
4.4. Different classes of crypto-compression for images	106
4.4.1. Substitution-based crypto-compression	108
4.4.2. Shuffle-based crypto-compression	108
4.4.3. Hybrid crypto-compression	110
4.5. Recompressing crypto-compressed JPEG images	113
4.5.1. A crypto-compression approach robust to recompression	114
4.5.2. Recompression of a crypto-compressed image	117
4.5.3. Decoding a recompressed version of a crypto-compressed JPEG image	119
4.5.4. Illustration of the method	122
4.6. Conclusion	124
4.7. References	124
Chapter 5. Crypto-Compression of Videos	129
Cyril BERGERON, Wassim HAMIDOUCHE and Olivier DÉFORGES	
5.1. Introduction	129
5.1.1. Background	129
5.1.2. Video compression	130
5.1.3. Video security	131
5.2. State of the art	131
5.2.1. Naive encryption	132
5.2.2. Partial encryption	133
5.2.3. Perceptual encryption	134
5.2.4. Crypto-compression methods	134
5.2.5. Selective encryption methods	135
5.3. Format-compliant selective encryption	136
5.3.1. Properties	136
5.3.2. Constant bitrate format compliant selective encryption	139
5.3.3. Standardized selective encryption	140
5.3.4. Locally applied selective encryption	143
5.3.5. Decrypting selective encryption	149
5.4. Image and video quality	150

5.4.1. Experiments on encryption solutions	151
5.4.2. Video quality: experimental results	154
5.4.3. CSE: a complete real-time solution	162
5.5. Perspectives and directions for future research	163
5.5.1. Versatile Video Coding	163
5.5.2. Immersive and omnidirectional video	164
5.6. Conclusion	165
5.7. References	166
Chapter 6. Processing Encrypted Multimedia Data Using Homomorphic Encryption	173
Sébastien CANARD, Sergiu CARPOV, Caroline FONTAINE and Renaud SIRDEY	
6.1. Context	173
6.2. Different classes of homomorphic encryption systems	176
6.2.1. Partial solutions in classic cryptography	176
6.2.2. Complete solutions in cryptography using Euclidean networks	178
6.3. From theory to practice	181
6.3.1. Algorithmics	183
6.3.2. Implementation and optimization	183
6.3.3. Managing and reducing the size of encrypted elements	189
6.3.4. Security	191
6.4. Proofs of concept and applications	193
6.4.1. Facial recognition	193
6.4.2. Classification	196
6.4.3. RLE and image compression	201
6.5. Conclusion	207
6.6. Acknowledgments	207
6.7. References	207
Chapter 7. Data Hiding in the Encrypted Domain	215
Pauline PUTEAUX and William PUECH	
7.1. Introduction: processing multimedia data in the encrypted domain	215
7.1.1. Applications: visual secret sharing	216
7.1.2. Applications: searching and indexing in encrypted image databases	217
7.1.3. Applications: data hiding in the encrypted domain	218
7.2. Main aims	219
7.2.1. Digital rights management	220
7.2.2. Cloud storage	220
7.2.3. Preserving patient confidentiality	220
7.2.4. Classified data	220
7.2.5. Journalism	220
7.2.6. Video surveillance	221

7.2.7. Data analysis	221
7.3. Classes and characteristics	221
7.3.1. Properties	221
7.3.2. Classic approaches to encryption	223
7.3.3. Evaluation criteria	227
7.4. Principal methods	231
7.4.1. Image partitioning	231
7.4.2. Histogram shifting	232
7.4.3. Encoding	234
7.4.4. Prediction	235
7.4.5. Public key encryption	237
7.5. Comparison and discussion	237
7.6. A high-capacity data hiding approach based on MSB prediction	239
7.6.1. General description of the method	239
7.6.2. The CPE-HCRDH approach	243
7.6.3. The EPE-HCRDH approach	245
7.6.4. Experimental results for both approaches	249
7.7. Conclusion	253
7.8. References	253
Chapter 8. Sharing Secret Images and 3D Objects	259
Sébastien BEUGNON, Pauline PUTEAUX and William PUECH	
8.1. Introduction	259
8.2. Secret sharing	261
8.2.1. Classic methods	262
8.2.2. Hierarchical aspects	264
8.3. Secret image sharing	272
8.3.1. Principle	272
8.3.2. Visual cryptography	273
8.3.3. Secret image sharing (polynomial-based)	274
8.3.4. Properties	275
8.4. 3D object sharing	276
8.4.1. Principle	276
8.4.2. Methods without format preservation	276
8.4.3. Methods with format preservation	277
8.5. Applications for social media	280
8.6. Conclusion	287
8.7. References	288
List of Authors	293
Index	295