

1. Record Nr.	UNINA9910821647903321
Titolo	Cognitive communications : distributed artificial intelligence (DAI), regulatory policy & economics, implementation // editors David Grace, Honggang Zhang
Pubbl/distr/stampa	Chichester, West Sussex : , : Wiley, , 2012 [Piscataway, New Jersey] : , : IEEE Xplore, , [2012]
ISBN	1-118-36033-8 1-299-31471-6 1-118-36032-X 1-118-36031-1
Descrizione fisica	1 online resource (501 p.)
Classificazione	TEC041000
Altri autori (Persone)	GraceDavid <1970-> ZhangHonggang <1967->
Disciplina	621.384
Soggetti	Cognitive radio networks Distributed artificial intelligence Telecommunication policy
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Note generali	Description based upon print version of record.
Nota di bibliografia	Includes bibliographical references and index.
Nota di contenuto	-- List of Figures xiii -- List of Tables xxv -- About the Editors xxvii -- Preface xxix -- PART I INTRODUCTION -- 1 Introduction to Cognitive Communications 3 / David Grace -- 1.1 Introduction 3 -- 1.2 A New Way of Thinking 4 -- 1.3 History of Cognitive Communications 6 -- 1.4 Key Components of Cognitive Communications 8 -- 1.5 Overview of the Rest of the Book 9 -- 1.5.1 Part 2: Wireless Communications 10 -- 1.5.2 Part 3: Application of Distributed Artificial Intelligence 11 -- 1.5.3 Part 4: Regulatory Policy and Economics 12 -- 1.5.4 Part 5: Implementation 13 -- 1.6 Summary and Conclusion 14 -- References 14 -- PART II WIRELESS COMMUNICATIONS -- 2 Cognitive Radio and Networks for Heterogeneous Networking 19 / Haesik Kim and Aarne MEammelEa -- 2.1 Introduction 19 -- 2.1.1 Historical Sketch 19 -- 2.1.2 Cognitive Radio and Networks 21 -- 2.1.3 Heterogeneous Networks 22 -- 2.2 Cognitive Radio for Heterogeneous Networks 26 -- 2.2.1 Channel Sensing and Network Sensing 26 -- 2.2.2 Interference

Mitigation 27 -- 2.2.3 Power Control 31 -- 2.3 Applying Cognitive Networks to Heterogeneous Networks 37 -- 2.3.1 Network Policy for Coexistence of Different Networks 37 -- 2.3.2 Cooperation Mechanisms 39 -- 2.3.3 Network Resource Allocation 41 -- 2.3.4 Self-Organization Mechanisms 44 -- 2.3.5 Handover Mechanisms 45 -- 2.4 Performance Evaluation 47 -- 2.5 Conclusion 50 -- References 50 -- 3 Channel Assignment and Power Allocation Algorithms in Multi-Carrier-Based Cognitive Radio Environments 53 / Musbah Shaat and Faouzi Bader -- 3.1 Introduction 53 -- 3.2 The Orthogonal Frequency-Division Multiplexing (OFDM) Transmission Scheme 54 -- 3.2.1 Why OFDM is Appropriate for CR 55 -- 3.3 Resource Management in Non-Cognitive OFDM Environments 56 -- 3.3.1 Single User OFDM Systems 56 -- 3.3.2 Multiple User OFDM Systems (OFDMA) 57 -- 3.3.3 Resource Allocation Algorithms in Non-Cognitive OFDM Systems 58 -- 3.4 Resource Management in OFDM-Based Cognitive Radio Systems 58 -- 3.4.1 Algorithms Dealing with In-Band Interference 59. 3.4.2 Algorithms Dealing with Mutual Interference 60 -- 3.4.3 System Model 61 -- 3.4.4 Problem Formulation 63 -- 3.4.5 Resource Management in Downlink OFDM-Based CR Systems 64 -- 3.4.6 Resource Management in Uplink OFDM-Based CR Systems 76 -- 3.5 Conclusions 88 -- References 89 -- 4 Filter Bank Techniques for Multi-Carrier Cognitive Radio Systems 93 / Yun Cui, Zhifeng Zhao, Rongpeng Li, Guangchao Zhang and Honggang Zhang -- 4.1 Introduction 93 -- 4.2 Basic Features of Filter Banks-Based Multi-Carrier Techniques 94 -- 4.2.1 Introduction to the Filter Bank System 95 -- 4.2.2 The Polyphase Structure of Filter Banks 96 -- 4.2.3 Basic Structure of Filter Banks-Based Multi-Carrier Systems 97 -- 4.3 Adaptive Threshold Enhanced Filter Bank for Spectrum Detection in IEEE 802.22 98 -- 4.3.1 Multi-Stage Analysis Filter Banks for Spectrum Detection 99 -- 4.3.2 Complexity and Detection Precision Analysis 101 -- 4.3.3 Spectrum Detection in IEEE 802.22 103 -- 4.3.4 Power Estimation with Adaptive Threshold 106 -- 4.4 Transform Decomposition for Spectrum Interleaving in Multi-Carrier Cognitive Radio Systems 108 -- 4.4.1 FFT Pruning in Cognitive Radio Systems 108 -- 4.4.2 Transform Decomposition for General DFT 110 -- 4.4.3 Improved Transform Decomposition Method for DFT with Sparse Input Points 111 -- 4.4.4 Numerical Results and Computational Complexity Analysis 114 -- 4.5 Remaining Problems in Filter Banks-Based Multi-Carrier Systems 115 -- 4.6 Summary and Conclusion 117 -- References 117 -- 5 Distributed Clustering of Cognitive Radio Networks: A Message-Passing Approach 119 / Kareem E. Baddour, Oktay Ureten and Tricia J. Willink -- 5.1 Introduction 119 -- 5.1.1 Inter-Node Collaboration in Decentralized Cognitive Networks 119 -- 5.1.2 Scalability Issues and Overhead Costs 120 -- 5.1.3 Self-Organization Based on Distributed Clustering 120 -- 5.2 Clustering Techniques for Cognitive Radio Networks 122 -- 5.3 A Message-Passing Clustering Approach Based on Affinity Propagation 124 -- 5.4 Case Studies 126. 5.4.1 Clustering Based on Local Spectrum Availability 127 -- 5.4.2 Sensor Selection for Cooperative Spectrum Sensing 132 -- 5.5 Implementation Challenges 138 -- 5.6 Conclusions 140 -- References 140 -- PART III APPLICATION OF DISTRIBUTED ARTIFICIAL INTELLIGENCE -- 6 Machine Learning Applied to Cognitive Communications 145 / Aimilia Bantouna, Kostas Tsagkaris, Vera Stavroulaki, Panagiotis Demestichas and Giorgos Poullos -- 6.1 Introduction 145 -- 6.2 State of the Art 146 -- 6.3 Learning Techniques 148 -- 6.3.1 Bayesian Statistics 148 -- 6.3.2 Supervised Neural Networks (NNs) 150 -- 6.3.3 Self-Organizing Maps (SOMs): An Unsupervised Neural Network 153 -- 6.3.4 Reinforcement Learning

157 -- 6.4 Advantages and Disadvantages of Applying Machine Learning to Cognitive Radio Networks 158 -- 6.5 Conclusions 159 -- Acknowledgement 160 -- References 160 -- 7 Reinforcement Learning for Distributed Power Control and Channel Access in Cognitive Wireless Mesh Networks 163 / Xianfu Chen, Zhifeng Zhao and Honggang Zhang -- 7.1 Introduction 163 -- 7.2 Applying Reinforcement Learning to Distributed Power Control and Channel Access 165 -- 7.2.1 Conjecture-Based Multi-Agent Q-Learning for Distributed Power Control in CogMesh 165 -- 7.2.2 Learning with Dynamic Conjectures for Opportunistic Spectrum Access in CogMesh 176 -- 7.3 Future Challenges 191 -- 7.4 Conclusions 192 -- References 192 -- 8 Reinforcement Learning-Based Cognitive Radio for Open Spectrum Access 195 / Tao Jiang and David Grace -- 8.1 Open Spectrum Access 195 -- 8.2 Reinforcement Learning-Based Spectrum Sharing in Open Spectrum Bands 196 -- 8.2.1 Learning Model 196 -- 8.2.2 Basic Algorithms 200 -- 8.2.3 Performance 200 -- 8.3 Exploration Control and Efficient Exploration for Reinforcement Learning-Based Cognitive Radio 208 -- 8.3.1 Exploration Control Techniques for Cognitive Radios 208 -- 8.3.2 Efficient Exploration Techniques and Learning Efficiency for Cognitive Radios 218 -- 8.4 Conclusion 229 -- References 230 -- 9 Learning Techniques for Context Diagnosis and Prediction in Cognitive Communications 231 / Aimilia Bantouna, Kostas Tsagkaris, Vera Stavroulaki, Giorgos Poullos and Panagiotis Demestichas. 9.1 Introduction 231 -- 9.2 Prediction 232 -- 9.2.1 Building Knowledge: Learning Network Capabilities and User Preferences/ Behaviours 232 -- 9.2.2 Application to Context Diagnosis and Prediction: The Case of Congestion 248 -- 9.3 Future Problems 253 -- 9.4 Conclusions 254 -- References 255 -- 10 Social Behaviour in Cognitive Radio 257 / Husheng Li -- 10.1 Introduction 257 -- 10.2 Social Behaviour in Cognitive Radio 258 -- 10.2.1 Cooperation Formation 258 -- 10.2.2 Channel Recommendations 261 -- 10.3 Social Network Analysis 267 -- 10.3.1 Model of Recommendation Mechanism 267 -- 10.3.2 Interacting Particles 268 -- 10.3.3 Epidemic Propagation 273 -- 10.4 Conclusions 281 -- References 281 -- PART IV REGULATORY POLICY AND ECONOMICS -- 11 Regulatory Policy and Economics of Cognitive Radio for Secondary Spectrum Access 285 / Maziar Nekovee and Peter Anker -- 11.1 Introduction 285 -- 11.2 Spectrum Regulations: Why and How? 286 -- 11.3 Overview of Regulatory Bodies and Their Inter-Relation 287 -- 11.3.1 ITU 287 -- 11.3.2 CEPT/ECC 288 -- 11.3.3 European Union 289 -- 11.3.4 ETSI 290 -- 11.3.5 National Spectrum Management Authority 291 -- 11.4 Why Secondary Spectrum Access? 291 -- 11.5 Candidate Bands for Secondary Access 293 -- 11.5.1 Terrestrial Broadcasting Bands 294 -- 11.5.2 Radar Bands 294 -- 11.5.3 IMT Bands 295 -- 11.5.4 Military Bands 296 -- 11.6 Regulatory and Policy Issues 296 -- 11.6.1 UK Regulatory Environment 300 -- 11.6.2 US Regulatory Environment 301 -- 11.6.3 European Regulatory Environment 302 -- 11.6.4 Regulatory Environments Elsewhere 303 -- 11.7 Technology Enablers and Options for Secondary Sharing 304 -- 11.7.1 Cognitive Radio 304 -- 11.7.2 Technology Options for Secondary Access 306 -- 11.8 Economic Impact and Business Opportunities of SSA 308 -- 11.8.1 Stakeholders and Economic of SSA 309 -- 11.8.2 Use Cases and Business Models 310 -- 11.9 Outlook 313 -- 11.10 Conclusions 314 -- Acknowledgements 315 -- References 315 -- PART V IMPLEMENTATION -- 12 Cognitive Radio Networks in TV White Spaces 321 / Maziar Nekovee and Dave Wisely. 12.1 Introduction 321 -- 12.2 Research and Development Challenges

324 -- 12.2.1 Geolocation Databases 324 -- 12.2.2 Sensing 327 --
12.2.3 Beacons 330 -- 12.2.4 Physical Layer 330 -- 12.2.5 System
Issues 331 -- 12.2.6 Devices 335 -- 12.3 Regulation and
Standardization 335 -- 12.3.1 Regulation 335 -- 12.3.2
Standardization 338 -- 12.4 Quantifying Spectrum Opportunities 343
-- 12.5 Commercial Use Cases 346 -- 12.6 Conclusions 354 --
Acknowledgement 355 -- References 355 -- 13 Cognitive Femtocell
Networks 359 / Faisal Tariq and Laurence S. Dooley -- 13.1
Introduction 359 -- 13.2 Femtocell Network Architecture 361 -- 13.2.1
Underlay and Overlay Architectures for Femtocell Networks 362 --
13.2.2 Home Femtocell and Enterprise Femtocell 366 -- 13.2.3 Access
Mechanism: Closed, Open and Hybrid Access 369 -- 13.2.4 Possible
Operating Spectrum 371 -- 13.3 Interference Management Strategies
372 -- 13.3.1 Cross-Tier Interference Management 373 -- 13.3.2
Intra-Tier Interference Management 376 -- 13.4 Self Organized
Femtocell Networks (SOFN) 381 -- 13.4.1 Self-Configuration 383 --
13.4.2 Self-Optimization 383 -- 13.4.3 Self-Healing and Self-
Protection 388 -- 13.5 Future Research Directions 388 -- 13.5.1 Green
Femtocell Networks 388 -- 13.5.2 Communication Hub for Smart
Homes 389 -- 13.5.3 MIMO-Based Interference Alignment for
Femtocell Networks 389 -- 13.5.4 Enhanced FFR 390 -- 13.5.5 CoMP-
Based Femtocell Network 391 -- 13.5.6 Holistic Approach to SOFN 391
-- 13.6 Conclusion 391 -- References 391 -- 14 Cognitive Acoustics:
A Way to Extend the Lifetime of Underwater Acoustic Sensor Networks
395 / Lu Jin, Defeng (David) Huang, Lin Zou and Angela Ying Jun Zhang
-- 14.1 The Concept of Cognitive Acoustics 395 -- 14.2 Underwater
Acoustic Communication Channel 397 -- 14.2.1 Propagation Delay 397
-- 14.2.2 Severe Attenuation 397 -- 14.2.3 Ambient Noise 398 -- 14.3
Some Distinct Features of Cognitive Acoustics 401 -- 14.3.1 Purposes
of Deployment 401 -- 14.3.2 Grey Space 402 -- 14.3.3 Cost of Field
Measurement and System Deployment 402.
14.4 Fundamentals of Reinforcement Learning 402 -- 14.4.1 Markov
Decision Process 402 -- 14.4.2 Reinforcement Learning 403 -- 14.4.3
Q-Learning 403 -- 14.5 An Application Scenario: Underwater Acoustic
Sensor Networks 404 -- 14.5.1 System Description 404 -- 14.5.2 State
Space, Action Set and Transition Probabilities 406 -- 14.5.3 Reward
Function 407 -- 14.5.4 Routing Protocol Discussion 409 -- 14.6
Numerical Results 410 -- 14.7 Conclusion 414 -- Acknowledgements
414 -- References 414 -- 15 CMOS RF Transceiver Considerations for
DSA 417 / Mark S. Oude Alink, Eric A.M. Klumperink, Andre B.J.
Kokkeler, Gerard J.M. Smit and Bram Nauta -- 15.1 Introduction 417 --
15.1.1 Terminology 418 -- 15.1.2 Transceivers for DSA: More than an
ADC and DAC 420 -- 15.1.3 Flexible Software-Defined Transceiver 421
-- 15.1.4 Why CMOS Transceivers? 421 -- 15.2 DSATransceiver
Requirements 421 -- 15.3 Mathematical Abstraction 423 -- 15.4
Filters 426 -- 15.4.1 Integrated Filters 426 -- 15.4.2 External Filters
427 -- 15.5 Receiver Considerations and Implementation 428 --
15.5.1 Sub-Sampling Receiver 429 -- 15.5.2 Heterodyne Receivers 430
-- 15.5.3 Direct-Conversion Receivers 432 -- 15.6 Cognitive Radio
Receivers 436 -- 15.6.1 Wideband RF-Section 436 -- 15.6.2 No
External RF-Filterbank 437 -- 15.6.3 Wideband Frequency Generation
447 -- 15.7 Transmitter Considerations and Implementation 449 --
15.8 Cognitive Radio Transmitters 451 -- 15.8.1 Improving
Transmitter Linearity 451 -- 15.8.2 Reducing Harmonic Components
452 -- 15.8.3 The Polyphase Multipath Technique 453 -- 15.9
Spectrum Sensing 456 -- 15.9.1 Analogue Windowing 458 -- 15.9.2
Channelized Receiver 459 -- 15.9.3 Crosscorrelation Spectrum Sensing
459 -- 15.9.4 Improved Image and Harmonic Rejection Using

Sommario/riassunto

"This book discusses in-depth the concept of distributed artificial intelligence (DAI) and its application to cognitive communications. In this book, the authors present an overview of cognitive communications, encompassing both cognitive radio and cognitive networks, and also other application areas such as cognitive acoustics. The book also explains the specific rationale for the integration of different forms of distributed artificial intelligence into cognitive communications, something which is often neglected in many forms of technical contributions available today. Furthermore, the chapters are divided into four disciplines: wireless communications, distributed artificial intelligence, regulatory policy and economics and implementation. The book contains contributions from leading experts (academia and industry) in the field. Key Features: Covers the broader field of cognitive communications as a whole, addressing application to communication systems in general (e.g. cognitive acoustics and Distributed Artificial Intelligence (DAI)) Illustrates how different DAI based techniques can be used to self-organise the radio spectrum Explores the regulatory, policy and economic issues of cognitive communications in the context of secondary spectrum access Discusses application and implementation of cognitive communications techniques in different application areas (e.g. Cognitive Femtocell Networks (CFN)) Written by experts in the field from both academia and industry Cognitive Communications will be an invaluable guide for research community (PhD students, researchers) in the areas of wireless communications, and development engineers involved in the design and development of mobile, portable and fixed wireless systems., wireless network design engineer. Undergraduate and postgraduate students on elective courses in electronic engineering or computer science, and the research and engineering community will also find this book of interest. "--