Complex-Valued Neural Networks. Advances and Applications. IEEE Press Series on Computational Intelligence

Description: Presents the latest advances in complex-valued neural networks by demonstrating the theory in a wide range of applications.

Complex-valued neural networks is a rapidly developing neural network framework that utilizes complex arithmetic, exhibiting specific characteristics in its learning, self-organizing, and processing dynamics. They are highly suitable for processing complex amplitude, composed of amplitude and phase, which is one of the core concepts in physical systems to deal with electromagnetic, light, sonic/ultrasonic waves as well as quantum waves, namely, electron and superconducting waves. This fact is a critical advantage in practical applications in diverse fields of engineering, where signals are routinely analyzed and processed in time/space, frequency, and phase domains.

Complex-Valued Neural Networks: Advances and Applications covers cutting-edge topics and applications surrounding this timely subject. Demonstrating advanced theories with a wide range of applications, including communication systems, image processing systems, and brain-computer interfaces, this text offers comprehensive coverage of:

- Conventional complex-valued neural networks
- Quaternionic neural networks
- Clifford-algebraic neural networks

Presented by international experts in the field, Complex-Valued Neural Networks: Advances and Applications is ideal for advanced-level computational intelligence theorists, electromagnetic theorists, and mathematicians interested in computational intelligence, artificial intelligence, machine learning theories, and algorithms.

Contents:

Preface xv

1 Application Fields and Fundamental Merits 1
   Akira Hirose
   1.1 Introduction 1
   1.2 Applications of Complex-Valued Neural Networks 2
   1.3 What is a complex number? 5
   1.4 Complex numbers in feedforward neural networks 8
   1.5 Metric in complex domain 12
   1.6 Experiments to elucidate the generalization characteristics 16
   1.7 Conclusions 26

2 Neural System Learning on Complex-Valued Manifolds 33
   Simone Fiori
   2.1 Introduction 34
   2.2 Learning Averages over the Lie Group of Unitary Matrices 35
   2.3 Riemannian-Gradient-Based Learning on the Complex Matrix-Hypersphere 41
2.4 Complex ICA Applied to Telecommunications 49

2.5 Conclusion 53

3 N-Dimensional Vector Neuron and Its Application to the N-Bit Parity Problem 59
Tohru Nitta

3.1 Introduction 59

3.2 Neuron Models with High-Dimensional Parameters 60

3.3 N-Dimensional Vector Neuron 65

3.4 Discussion 69

3.5 Conclusion 70

4 Learning Algorithms in Complex-Valued Neural Networks using Wirtinger Calculus 75
Md. Faijul Amin and Kazuyuki Murase

4.1 Introduction 76

4.2 Derivatives in Wirtinger Calculus 78

4.3 Complex Gradient 80

4.4 Learning Algorithms for Feedforward CVNNs 82

4.5 Learning Algorithms for Recurrent CVNNs 91

4.6 Conclusion 99

5 Quaternionic Neural Networks for Associative Memories 103
Teijiro Isokawa, Haruhiko Nishimura, and Nobuyuki Matsui

5.1 Introduction 104

5.2 Quaternionic Algebra 105

5.3 Stability of Quaternionic Neural Networks 108

5.4 Learning Schemes for Embedding Patterns 124

5.5 Conclusion 128

6 Models of Recurrent Clifford Neural Networks and Their Dynamics 133
Yasuaki Kuroe

6.1 Introduction 134

6.2 Clifford Algebra 134

6.3 Hopfield-Type Neural Networks and Their Energy Functions 137

6.4 Models of Hopfield-Type Clifford Neural Networks 139

6.5 Definition of Energy Functions 140

6.6 Existence Conditions of Energy Functions 142

6.7 Conclusion 149

7 Meta-cognitive Complex-valued Relaxation Network and its Sequential Learning Algorithm 153
Ramasamy Savitha, Sundaram Suresh, and Narasimhan Sundararajan

7.1 Meta-cognition in Machine Learning 154
7.2 Meta-cognition in Complex-valued Neural Networks 156
7.3 Meta-cognitive Fully Complex-valued Relaxation Network 164
7.4 Performance Evaluation of McFCRN: Synthetic Complex-valued Function Approximation Problem 171
7.5 Performance Evaluation of McFCRN: Real-valued Classification Problems 172
7.6 Conclusion 178

8 Multilayer Feedforward Neural Network with Multi-Valued Neurons for Brain-Computer Interfacing 185
Nikolay V. Manyakov, Igor Aizenberg, Nikolay Chumerin, and Marc M. Van Hulle

8.1 Brain-Computer Interface (BCI) 185
8.2 BCI Based on Steady-State Visual Evoked Potentials 188
8.3 EEG Signal Preprocessing 192
8.4 Decoding Based on MLMVN for Phase-Coded SSVEP BCI 196
8.5 System Validation 201
8.6 Discussion 203

9 Complex-Valued B-Spline Neural Networks for Modeling and Inverse of Wiener Systems 209
Xia Hong, Sheng Chen and Chris J. Harris

9.1 Introduction 210
9.2 Identification and Inverse of Complex-Valued Wiener Systems 211
9.3 Application to Digital Predistorter Design 222
9.4 Conclusions 229

10 Quaternionic Fuzzy Neural Network for View-invariant Color Face Image Recognition 235
Wai Kit Wong, Gin Chong Lee, Chu Kiong Loo, Way Soong Lim, and Raymond Lock

10.1 Introduction 236
10.2 Face Recognition System 238
10.3 Quaternion-Based View-invariant Color Face Image Recognition 244
10.4 Enrollment Stage and Recognition Stage for Quaternion-Based Color Face Image Correlator 255
10.5 Max-Product Fuzzy Neural Network Classifier 260
10.6 Experimental Results 266
10.7 Conclusion and Future Research Directions 274

References 274

Index 279
Ordering:

Order Online - http://www.researchandmarkets.com/reports/2330279/

Order by Fax - using the form below

Order by Post - print the order form below and send to

Research and Markets,
Guinness Centre,
Taylors Lane,
Dublin 8,
Ireland.
Fax Order Form
To place an order via fax simply print this form, fill in the information below and fax the completed form to 646-607-1907 (from USA) or +353-1-481-1716 (from Rest of World). If you have any questions please visit http://www.researchandmarkets.com/contact/

Order Information
Please verify that the product information is correct.

<table>
<thead>
<tr>
<th>Product Name:</th>
<th>Complex-Valued Neural Networks. Advances and Applications. IEEE Press Series on Computational Intelligence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web Address:</td>
<td><a href="http://www.researchandmarkets.com/reports/2330279/">http://www.researchandmarkets.com/reports/2330279/</a></td>
</tr>
<tr>
<td>Office Code:</td>
<td>SCAV8FA5</td>
</tr>
</tbody>
</table>

Product Format
Please select the product format and quantity you require:

- **Quantity**
  - Hard Copy (Hard Back): [ ] USD 131 + USD 28 Shipping/Handling

* Shipping/Handling is only charged once per order.

Contact Information
Please enter all the information below in BLOCK CAPITALS

<table>
<thead>
<tr>
<th>Title:</th>
<th>Mr [ ] Mrs [ ] Dr [ ] Miss [ ] Ms [ ] Prof [ ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Name:</td>
<td></td>
</tr>
<tr>
<td>Last Name:</td>
<td></td>
</tr>
<tr>
<td>Email Address: *</td>
<td></td>
</tr>
<tr>
<td>Job Title:</td>
<td></td>
</tr>
<tr>
<td>Organisation:</td>
<td></td>
</tr>
<tr>
<td>Address:</td>
<td></td>
</tr>
<tr>
<td>City:</td>
<td></td>
</tr>
<tr>
<td>Postal / Zip Code:</td>
<td></td>
</tr>
<tr>
<td>Country:</td>
<td></td>
</tr>
<tr>
<td>Phone Number:</td>
<td></td>
</tr>
<tr>
<td>Fax Number:</td>
<td></td>
</tr>
</tbody>
</table>

* Please refrain from using free email accounts when ordering (e.g. Yahoo, Hotmail, AOL)
Payment Information

Please indicate the payment method you would like to use by selecting the appropriate box.

☐ Pay by credit card: You will receive an email with a link to a secure webpage to enter your credit card details.

☐ Pay by check: Please post the check, accompanied by this form, to:

Research and Markets,
Guinness Center,
Taylors Lane,
Dublin 8,
Ireland.

☐ Pay by wire transfer: Please transfer funds to:

Account number 833 130 83
Sort code 98-53-30
Swift code ULSBIE2D
IBAN number IE78ULSB98533083313083
Bank Address Ulster Bank,
27-35 Main Street,
Blackrock,
Co. Dublin,
Ireland.

If you have a Marketing Code please enter it below:

Marketing Code: ____________________________

Please note that by ordering from Research and Markets you are agreeing to our Terms and Conditions at http://www.researchandmarkets.com/info/terms.asp

Please fax this form to:
(646) 607-1907 or (646) 964-6609 - From USA
+353-1-481-1716 or +353-1-653-1571 - From Rest of World