

ARTIFICIAL NEURAL NETWORKS FOR RENEWABLE ENERGY SYSTEMS AND REAL-WORLD APPLICATIONS

This page intentionally left blank

ARTIFICIAL NEURAL NETWORKS FOR RENEWABLE ENERGY SYSTEMS AND REAL-WORLD APPLICATIONS

Edited by

AMMAR H. ELSHEIKH

Production Engineering and Mechanical Design Department, Tanta University, Tanta, Egypt

MOHAMED ELASYED ABD ELAZIZ

Department of Mathematics, Faculty of Science, Zagazig University, Zagazig, Egypt



Academic Press is an imprint of Elsevier 125 London Wall, London EC2Y 5AS, United Kingdom 525 B Street, Suite 1650, San Diego, CA 92101, United States 50 Hampshire Street, 5th Floor, Cambridge, MA 02139, United States The Boulevard, Langford Lane, Kidlington, Oxford OX5 1GB, United Kingdom

Copyright © 2022 Elsevier Inc. All rights reserved.

No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or any information storage and retrieval system, without permission in writing from the publisher. Details on how to seek permission, further information about the Publisher's permissions policies and our arrangements with organizations such as the Copyright Clearance Center and the Copyright Licensing Agency, can be found at our website: www.elsevier.com/permissions.

This book and the individual contributions contained in it are protected under copyright by the Publisher (other than as may be noted herein).

MATLAB® is a trademark of The MathWorks, Inc. and is used with permission. The MathWorks does not warrant the accuracy of the text or exercises in this book. This book's use or discussion of MATLAB® software or related products does not constitute endorsement or sponsorship by The MathWorks of a particular pedagogical approach or particular use of the MATLAB® software.

Notices

Knowledge and best practice in this field are constantly changing. As new research and experience broaden our understanding, changes in research methods, professional practices, or medical treatment may become necessary.

Practitioners and researchers must always rely on their own experience and knowledge in evaluating and using any information, methods, compounds, or experiments described herein. In using such information or methods they should be mindful of their own safety and the safety of others, including parties for whom they have a professional responsibility.

To the fullest extent of the law, neither the Publisher nor the authors, contributors, or editors, assume any liability for any injury and/or damage to persons or property as a matter of products liability, negligence or otherwise, or from any use or operation of any methods, products, instructions, or ideas contained in the material herein.

ISBN: 978-0-12-820793-2

For Information on all Academic Press publications visit our website at https://www.elsevier.com/books-and-journals

Publisher: Charlotte Cockle Acquisitions Editor: Edward Payne Editorial Project Manager: Sara Valentino Production Project Manager: Anitha Sivaraj Cover Designer: Mark Rogers

Typeset by MPS Limited, Chennai, India



Contents

		ontribut		X	
ADO	out tr	ne edito	rs	XV	
1.	Basics of artificial neural networks Rehab Ali Ibrahim, Ammar H. Elsheikh, Mohamed Elasyed Abd Elaziz and Mohammed A.A. Al-qaness			1	
	1.1 Artificial neural networks				
	1.2	Types	of neural networks	2	
		1.2.1	Multilayer perceptron neural network	2	
		1.2.2	Wavelet neural networks	4	
		1.2.3	Radial basis function	5	
		1.2.4	Elman neural network	6	
		1.2.5	Statistical performance evaluation criteria	8	
		Concl		Ş	
	Refe	erences		10	
2.	Artificial neural network applied to the renewable energy				
	system performance				
	A. Parrales, E.D. Reyes-Téllez, W. Ajbar and J.A. Hernández				
	Nor	nenclat	rure	11	
	2.1 Introduction				
	2.2 Description of experimental equipment				
	2.3	Develo	opment of the neural network model	20	
	2.4 Neural network model				
	2.5	Conclu	ısions	39	
	Refe	erences		40	
3.	Applications of artificial neural networks in concentrating				
	solar power systems				
	Mohamed E. Zayed, Jun Zhao, Wenjia Li, S. Sadek and Ammar H. Elsheikh				
	3.1	3.1 Introduction			
	3.2	Conce	entrating solar collectors	48	
		3.2.1	Parabolic trough collector	48	
		3.2.2	Solar dish collector	49	

vi Contents

		3.2.3	Linear Fresnel reflector	49		
		3.2.4	Central tower receiver	50		
	3.3	Artific	ial neural networks	50		
		3.3.1	Conceptual structure of artificial neural networks	50		
		3.3.2	Performance evaluation criteria of the artificial neural			
			network model	51		
	3.4	Artific	ial neural network applications in concentrating solar			
		power systems				
			ective and challenges	60		
			usions and future recommendations	61		
	Refe	erences		62		
4.	Ne	ural sii	mulation of a solar thermal system in low temperature	69		
			J. Diez, Leticia Chico-Santamarta, Adriana Correa-Guimaraes, artínez-Rodríguez and Luis M. Navas-Gracia			
	4.1	Introd	luction	69		
	4.2	Mater	ials and methods	74		
		4.2.1	Meteorological data	74		
		4.2.2	Solar thermal system	75		
		4.2.3	Artificial neural networks of the components of the			
			solar thermal system	77		
			Neural simulation of the solar thermal system	82		
	4.3	Result	-	85		
			Neural simulation during a day	86		
			Neural simulation during 2012	92		
			Neural simulation for 10 years	93		
			f-Chart method	94		
			Neural simulation versus f-chart method	99		
		Discu		104		
		Concl		107 108		
	Acknowledgments					
	References 109					
5.			ergy modelling and forecasting using artificial neural			
		networks: a review, a case study, and applications 113				
	You	ness E	l Mghouchi			
	5.1	Introd	luction	113		
	5.2		radiation modeling	116		
			Solar constant and extraterrestrial radiation	117		
		5.2.2	Instantaneous and hourly solar radiation models	118		

Contents vii

		5.2.3	Modeling of daily global solar radiation (DGSR) and monthly	110
		11	average global solar radiation (MAGSR) based on ANN techniques	118
	5.5		data and statistical analysis	121
			Local weather information	121
	- A		Statistical analysis	122
	5.4		ts and discussions	123
		5.4.1	Best combinations of inputs in modeling and forecasting of DGSR	123
		5.4.2	Best combinations of inputs in modeling and forecasting of MAGSR	126
	5.5	Solar	energy conversion systems: an overview	128
	5.6	Concl	usions	134
	App	endix		134
	Refe	rences		143
6.	_		vin predictive maintenance strategy based on	
			learning improving facility management in built	
	env	ironm	nent	149
	S. A	gostin	elli and A. Heydari	
	6.1	Introd	duction	149
	6.2	Case :	study	151
		6.2.1	Maintenance system	152
	6.3	Propo	osed predictive maintenance strategy	152
	6.4	Result	ts and discussions	154
		6.4.1	Digital twin for building management systems	155
	6.5	Concl	usions	156
	Refe	rences		156
7.	Arti	ficial	neural network and desalination systems	159
			sa, Mohamed Elasyed Abd Elaziz, S. Shanmugan and Elsheikh	
	7.1	Introd	luction	160
	7.2	Metho	ods of desalination	162
		7.2.1	Multistage flash distillation	162
		7.2.2	Multiple-effect distillation	164
		7.2.3	Vapor compression distillation	165
		7.2.4	Reverse osmosis	166
		7.2.5	Freezing	167
		7.2.6	Solar distillation	168
		7.2.7	Potabilization	168

viii Contents

	7.3 Economics related to desalination			169	
	7.4	4 Future expectance		170	
	7.5	5 Solar still			
	7.6	Types of solar still		172	
		7.6.1	Single-effect solar still	172	
		7.6.2	Multieffect solar still	175	
	7.7		ial neural network as a prediction method for the performance salination systems	177	
		7.7.1	Network architecture	179	
		7.7.2	Application of artificial neural networks in desalination systems	180	
	7.8	Concl	usions	183	
	Refe	erences		184	
8.	Art	ificial	neural networks for engineering applications:		
	a re	eview		189	
	Mohammad Shehab, Laith Abualigah, Mahmoud Omari, Mohd Khaled Yousef Shambour, Mohammad Alshinwan, Hayfa Y. Abuaddous and Ahmad M. Khasawneh				
	8.1	Introd	luction	189	
	8.2	Applio	cation of artificial neural networks in engineering fields	192	
		8.2.1	Chemical engineering	192	
		8.2.2	Civil engineering	193	
		8.2.3	Computer engineering	193	
		8.2.4	Power and energy engineering	194	
		8.2.5	Construction engineering	195	
		8.2.6	Mechanical engineering	196	
		8.2.7	Geotechnical engineering	201	
	8.3	Concl	usion	201	
	Con	flicts of	finterest	202	
	Refe	erences		202	
9.	Inc	remen	ntal deep learning model for plant leaf diseases		
	detection				
			adfel, Wafa Mousser, Ismail Ghoul and k Taleb-Ahmed		
	9.1	9.1 Introduction		207	
	9.2	.2 Related works		208	
	9.3	3 Proposed approach		209	
		9.3.1	The deep learning model	211	
		9.3.2	DataSelector and Memory	212	

Contents ix

9.4	Experimental results		216
	9.4.1 Plant diseases d	ataset	216
	9.4.2 The model's arc	hitecture	216
	9.4.3 Hyperparameter	rs and evaluation	217
	9.4.4 Influence of me	mory size and batches	218
	9.4.5 Comparison wit	h iCaRL	220
9.5	Conclusion		221
Refe	rences		221
	-	convolutional neural networks in	
	nformatics		223
Waf	a Mousser, Salima Oua	dfel and Abdelmalik Taleb-Ahmed	
10.1	Introduction		223
	10.1.1 Replay-based	methods	225
	10.1.2 Regularization	n-based methods	225
	10.1.3 Parameter iso	lation-based methods	225
10.2	Incremental learning	of convolutional neural networks	226
	10.2.1 iCaRL: increm	ental classifier and representation learning	226
	10.2.2 LwF: learning	without forgetting	228
	10.2.3 Tree-CNN: tre	e convolutional neural networks	230
10.3	Incremental learning of bioinformatics	of convolutional neural networks in	231
		novel incremental learning framework blearning and support data	231
	10.3.2 Continual class	ss incremental learning for computerized	
	tomography ((CT) thoracic segmentation	233
	Discussion		235
	Conclusion		235
Refe	rences		237
11 Hvk	rid Arabic classifica	tion techniques based on naïve	
-		ultidisciplinary applications	239
	•	Zacout, Laith Abualigah and Mahmoud Omari	
11.1	Introduction		239
11.2	Related works		241
	11.2.1 Data mining		241
	11.2.2 Text classifica	tion	242
	11.2.3 Previous stud	ies	246
11.3	The proposed method	d	248

		11.3.1	Collecting information	248
		11.3.2	Obtaining datasets	250
		11.3.3	Preprocessing	251
		11.3.4	The classification process	252
		11.3.5	Evaluation	255
	11.4	Results	and discussion	256
		11.4.1	Results	257
	11.5	Conclu	sion and future work	261
References				262
Ina	index			

List of contributors

Hayfa Y. Abuaddous

Department of Scientific Information and Services, Umm Al-Qura University, Mecca, Saudi Arabia

Laith Abualigah

Faculty of Computer Sciences and Informatics, Amman Arab University, Amman, Jordan; Hourani Center for Applied Scientific Research, Al-Ahliyya Amman University, Amman, Jordan; Faculty of Information Technology, Middle East University, Amman, Jordan; School of Computer Sciences, Universiti Sains Malaysia, Pulau Pinang, Malaysia; Department of Scientific Information and Services, Unim Al-Qura University, Mecca, Saudi Arabia

S. Agostinelli

Department of Astronautics, Electrical and Energy Engineering, Sapienza University of Rome, Rome, Italy

W. Ajbar

Centro de Investigación en Ingeniería y Ciencias Aplicadas (CIICAp), Universidad Autónoma del Estado de Morelos (UAEM), Cuernavaca, Morelos, México

Mohammed A.A. Al-ganess

State Key Laboratory for Information Engineering in Surveying, Mapping and Remote Sensing, Wuhan University, Wuhan, P.R. China

Mohammad Alshinwan

Department of Scientific Information and Services, Umm Al-Qura University, Mecca, Saudi Arabia

Leticia Chico-Santamarta

Harper Adams University, Newport, Shropshire, United Kingdom

Adriana Correa-Guimaraes

University of Valladolid, Department of Agricultural and Forestry Engineering, University of Valladolid, Palencia, Castile and León, Spain

Francisco J. Diez

University of Valladolid, Department of Agricultural and Forestry Engineering, University of Valladolid, Palencia, Castile and León, Spain

Youness El Mghouchi

Moulay Ismail University, National School of Arts and Crafts (ENSAM), Meknes, Morocco

Mohamed Elasyed Abd Elaziz

Department of Mathematics, Faculty of Science, Zagazig University, Zagazig, Egypt

Ammar H. Elsheikh

Production Engineering and Mechanical Design Department, Tanta University, Tanta, Egypt

xii List of contributors

Fadl A. Essa

Mechanical Engineering Department, Faculty of Engineering, Kafrelsheikh University, Kafrelsheikh, Egypt

Ismail Ghoul

Department of Computer Sciences and Applications, New Information and Communication Technologies Faculty, Laboratory of Complex Systems' Modeling and Implementation, Abdelhamid Mehri Constantine 2 University, Constantine, Algeria

J.A. Hernández

Centro de Investigación en Ingeniería y Ciencias Aplicadas (CIICAp), Universidad Autónoma del Estado de Morelos (UAEM), Cuernavaca, Morelos, México

A. Heydari

CITERA Interdepartmental Centre, Sapienza University of Rome, Rome, Italy

Rehab Ali Ibrahim

Department of Mathematics, Faculty of Science, Zagazig University, Zagazig, Egypt

Ahmad M. Khasawneh

Department of Scientific Information and Services, Umm Al-Qura University, Mecca, Saudi Arabia

Wenjia Li

Key Laboratory of Efficient Utilization of Low and Medium Grade Energy, MOE, Tianjin University, Tianjin, P.R. China

Andrés Martínez-Rodríguez

University of Valladolid, Department of Agricultural and Forestry Engineering, University of Valladolid, Palencia, Castile and León, Spain

Wafa Mousser

Department of Computer Sciences and Applications, New Information and Communication Technologies Faculty, Laboratory of Complex Systems' Modeling and Implementation, Abdelhamid Mehri Constantine 2 University, National Biotechnology Research Center, Constantine, Algeria

Luis M. Navas-Gracia

University of Valladolid, Department of Agricultural and Forestry Engineering, University of Valladolid, Palencia, Castile and León, Spain

Mahmoud Omari

Faculty of Computer Sciences and Informatics, Amman Arab University, Amman, Jordan; Department of Scientific Information and Services, Umm Al-Qura University, Mecca, Saudi Arabia

Mohammed Otair

Faculty of Computer Sciences and Informatics, Amman Arab University, Amman, Jordan

Salima Ouadfel

Department of Computer Sciences and Applications, New Information and Communication Technologies Faculty, Abdelhamid Mehri Constantine 2 University, Constantine, Algeria

List of contributors Xiii

A. Parrales

Centro de Investigación en Ingeniería y Ciencias Aplicadas (CIICAp), Universidad Autónoma del Estado de Morelos (UAEM), Cuernavaca, Morelos, México

E.D. Reyes-Téllez

Centro de Investigación en Ingeniería y Ciencias Aplicadas (CIICAp), Universidad Autónoma del Estado de Morelos (UAEM), Cuernavaca, Morelos, México

S. Sadek

Key Laboratory of Efficient Utilization of Low and Medium Grade Energy, MOE, Tianjin University, Tianjin, P.R. China

Mohd Khaled Yousef Shambour

Faculty of Information Technology, Middle East University, Amman, Jordan

S. Shanmugan

Research Centre for Solar Energy, Department of Engineering Physics, College of Engineering, Koneru Lakshmaiah Education Foundation, Guntur, Andra Pradesh, India

Mohammad Shehab

Information Technology, The World Islamic Sciences and Education University, Amman, Jordan; Faculty of Computer Sciences and Informatics, Amman Arab University, Amman, Jordan

Abdelmalik Taleb-Ahmed

Institut d'Electronique de Microélectronique et de Nanotechnologie (IEMN), UMR 8520, Université Polytechnique Hauts de France, Université de Lille, CNRS, Valenciennes, France

Somaya Zacout

Faculty of Computer Sciences and Informatics, Amman Arab University, Amman, Jordan

Mohamed E. Zayed

Key Laboratory of Efficient Utilization of Low and Medium Grade Energy, MOE, Tianjin University, Tianjin, P.R. China; Mechanical Power Engineering Department, Faculty of Engineering, Tanta University, Tanta, Egypt

Jun Zhao

Key Laboratory of Efficient Utilization of Low and Medium Grade Energy, MOE, Tianjin University, Tianjin, P.R. China

This page intentionally left blank