Handbook of Research on Modeling, Analysis, and Application of Nature-Inspired Metaheuristic Algorithms

Sujata Dash
North Orissa University, India

B.K. Tripathy
VIT University, India

Atta ur Rahman
University of Dammam, Saudi Arabia

A volume in the Advances in Computational Intelligence and Robotics (ACIR) Book Series

IGI Global
DISSEMINATOR OF KNOWLEDGE

Published in the United States of America by
IGI Global
Engineering Science Reference (an imprint of IGI Global)
701 E. Chocolate Avenue
Hershey PA, USA 17033
Tel: 717-533-8845
Fax: 717-533-8661
E-mail: cust@igi-global.com
Web site: http://www.igi-global.com

Copyright © 2018 by IGI Global. All rights reserved. No part of this publication may be reproduced, stored or distributed in any form or by any means, electronic or mechanical, including photocopying, without written permission from the publisher. Product or company names used in this set are for identification purposes only. Inclusion of the names of the products or companies does not indicate a claim of ownership by IGI Global of the trademark or registered trademark.

Library of Congress Cataloging-in-Publication Data

Names: Dash, Sujata, 1969- editor. | Tripathy, B. K., 1957- editor. | Rahman, Atta Ur, 1982- editor.
Title: Handbook of research on the modeling, analysis, and application of nature-inspired metaheuristic algorithms / Sujata Dash, B.K. Tripathy, and Atta Ur Rahman, editors.
Description: Hershey, PA : Information Science Reference, [2018] | Includes bibliographical references.
Identifiers: LCCN 2017012030| ISBN 9781522528579 (hardcover) | ISBN 9781522528586 (ebook)
Subjects: LCSH: Natural computation--Handbooks, manuals, etc. | Heuristic algorithms--Handbooks, manuals, etc. | Engineering mathematics--Handbooks, manuals, etc. | Science--Mathematics--Handbooks, manuals, etc.
Classification: LCC QA76.9.N37 H3646 2018 | DDC 006.3/8--dc23 LC record available at https://lccn.loc.gov/2017012030

This book is published in the IGI Global book series Advances in Computational Intelligence and Robotics (ACIR) (ISSN: 2327-0411; eISSN: 2327-042X)

British Cataloguing in Publication Data
A Cataloguing in Publication record for this book is available from the British Library.

All work contributed to this book is new, previously-unpublished material. The views expressed in this book are those of the authors, but not necessarily of the publisher.

For electronic access to this publication, please contact: eresources@igi-global.com.

Table of Contents

Preface xxi

Acknowledgment xxix

Chapter 1
Metaheuristic-Based Hybrid Feature Selection Models 1
Sujata Dash, North Orissa University, India

Chapter 2
Swarm-Based Nature-Inspired Metaheuristics for Neural Network Optimization 23
Swathi Jamjala Narayanan, VIT University, India
Boominathan Perumal, VIT University, India
Jayant G. Rohra, VIT University, India

Chapter 3
A Novel Hybrid Model Using RBF and PSO for Net Asset Value Prediction 54
C. M. Anish, Guru Ghasidas Vishwavidyalaya, India
Babita Majhi, Guru Ghasidas Vishwavidyalaya, India
Ritanjali Majhi, NIT Warangal, India

Chapter 4
Memetic Algorithms and Their Applications in Computer Science 73
B. K. Tripathy, VIT University, India
Sooraj T. R., VIT University, India
R. K. Mohanty, VIT University, India

Chapter 5
A New Data Hiding Scheme Combining Genetic Algorithm and Artificial Neural Network 94
Ayan Chatterjee, Sarboday Public Academy, India
Nikhilesh Barik, Kazi Nazrul University, India

Chapter 6
A Statistical Scrutiny of Three Prominent Machine-Learning Techniques to Forecast Machining Performance Parameters of Inconel 690 104
Binayak Sen, NIT Agartala, India
Uttam Kumar Mandal, NIT Agartala, India
Sankar Prasad Mondal, Midnapore College (Autonomous), India

Chapter 7
Insights Into Simulated Annealing..... 121
Khalil Amine, Mohammed V University, Morocco

Chapter 8
Automatic Test Data Generation Using Bio-Inspired Algorithms: A Travelogue..... 140
Madhumita Panda, North Orissa University, India
Sujata Dash, North Orissa University, India

Chapter 9
Development of an Efficient Prediction Model Based on a Nature-Inspired Technique for New Products: A Case of Industries From the Manufacturing Sector 160
Vikas Bhatnagar, NIT Warangal, India
Ritanjali Majhi, NIT Warangal, India
S. L. Tulasi Devi, NIT Warangal, India

Chapter 10
Applications of Hybrid Intelligent Systems in Adaptive Communication 183
Atta ur Rahman, University of Dammam, Saudi Arabia

Chapter 11
DE-Based RBFNs for Classification With Special Attention to Noise Removal and Irrelevant Features 218
Ch. Sanjeev Kumar Dash, Silicon Institute of Technology, India
Ajit Kumar Behera, Silicon Institute of Technology, India
Sarat Chandra Nayak, Kommuri Pratap Reddy Institute of Technology, India

Chapter 12
Competency Mapping in Academic Environment: A Swarm Intelligence Approach 244
Sushri Samita Rout, Silicon Institute of Technology, India
Bijan Bihari Misra, Silicon Institute of Technology, India

Chapter 13
An Overview of the Last Advances and Applications of Greedy Randomized Adaptive Search Procedure 264
Airam Expósito Márquez, Universidad de La Laguna, Spain
Christopher Expósito-Izquierdo, Universidad de La Laguna, Spain

Chapter 14
Defect Detection of Fabrics by Grey-Level Co-Occurrence Matrix and Artificial Neural Network 285
Dilip k. Choudhury, GIET Gunupur, India
Sujata Dash, North Orissa University, India

Chapter 15
A Holistic-Based Multi-Criterion Decision-Making Approach for Solving Engineering Sciences Problem Under Imprecise Environment 298
Syed Abou Iltaf Hussain, NIT Agartala, India
Sankar Prasad Mondal, Midnapore College (Autonomous), India
Uttam Kumar Mandal, NIT Agartala, India

Chapter 16
A Comprehensive Review of Nature-Inspired Algorithms for Feature Selection 331
Kauser Ahmed P, VIT University, India
Senthil Kumar N, VIT University, India

Chapter 17
Nature-Inspired-Algorithms-Based Cellular Location Management: Scope and Applications 346
Swati Swayamsiddha, Indian Institute of Technology Kharagpur, India
Chetna Singhal, Indian Institute of Technology Kharagpur, India
Rajarshi Roy, Indian Institute of Technology Kharagpur, India

Chapter 18
Fuzziness in Ant Colony Optimization and Their Applications 363
Deepthi P. Hudedagaddi, VIT University, India
B. K. Tripathy, VIT University, India

Chapter 19
Application of Natured-Inspired Technique to Odia Handwritten Numeral Recognition 377
Puspalata Pujari, Guru Ghasidas Vishwavidyalaya, India
Babita Majhi, Guru Ghasidas Vishwavidyalaya, India

Chapter 20
Intelligent Technique to Identify Epilepsy Using Fuzzy Firefly System for Brain Signal Processing 400
Sasikumar Gurumoorthy, Sree Vidyanikethan Engineering College (Autonomous), India
B. K. Tripathy, VIT University, India

Chapter 21
Analysis and Implementation of Artificial Bee Colony Optimization in Constrained Optimization Problems 413
Soumya Sahoo, C. V. Raman College of Engineering, India
Sushruta Mishra, C. V. Raman College of Engineering, India
Brojo Kishore Kishore Mishra, C. V. Raman College of Engineering, India
Monalisa Mishra, C. V. Raman College of Engineering, India

Chapter 22
Escalation of Prediction Accuracy With Virtual Data: A Case Study on Financial Time Series..... 433
Sarat Chandra Nayak, Kommuri Pratap Reddy Institute of Technology, India
Bijan Bihari Misra, Silicon Institute of Technology, India
Himansu Sekhar Behera, Veer Surendra Sai University of Technology, India

Chapter 23
Determination of Spatial Variability of Rock Depth of Chennai..... 462
Pijush Samui, National Institute of Technology Patna, India
Viswanathan R., Galgotias University, India
Jagan J., VIT University, India
Pradeep U. Kurup, University of Massachusetts – Lowell, USA

Compilation of References 480

About the Contributors 528

Index 536

Chapter 19
Application of Natured-Inspired Technique to Odia Handwritten Numeral Recognition

Puspalata Pujari
Guru Ghasidas Vishwavidyalaya, India

Babita Majhi
Guru Ghasidas Vishwavidyalaya, India

ABSTRACT

In this chapter an effort has been made to develop a hybrid system using functional link artificial neural network (FLANN) and differential evolution (DE) for effective recognition of Odia handwritten numerals. The S-transform (ST) is chosen for feature extraction from handwritten numerals and these are further reduced by using principal component analysis (PCA). After reduction of feature the reduced features are applied to FLANN model for recognition of each numeral. Further differential evolution algorithm (DE) is used for the optimization of weights of FLANN classifier. For performance comparison, genetic algorithm (GA) and particle swarm optimization (PSO) based FLANN models (FLANN_GA and FLANN_PSO) are also designed and simulated under similar condition. The efficiency of proposed DE based FLANN (FLANN_DE) method is assessed through simulation with standard dataset consisting of 4000 handwritten Odia numerals. The results of three models are compared and it is observed that the FLANN_DE model provides the best result as compared to other models.

INTRODUCTION

Over the last ten decades optical character recognition (OCR) is the most demanding area which comes under the field of pattern recognition, artificial intelligence and machine vision. There are varieties of applications of handwritten character such as postal pin code verification, passport verification, digital library system, document processing, forgery detection in banks and many more. OCR is the translation of handwritten and printed images of character into editable character. The challenging task lies in the recognition of optically processed characters. In off-line recognition method characters are recognized

DOI: 10.4018/978-1-5225-2857-9.ch019

Copyright © 2018, IGI Global. Copying or distributing in print or electronic forms without written permission of IGI Global is prohibited.

later, after their creation. But the characters are recognized immediately after their creation in an on-line method. OCR can recognize both printed and handwritten characters, but the efficiency of recognition precisely depends on the constraints associated with the characters. More constrained the character is, greater is the efficiency of the OCR system. It is very difficult to develop OCR system for totally unconstrained handwritten characters. Recognition of handwritten characters and numerals is more complex task than the printed character. Many variations are observed in handwritten character due to the style of writing, added noise, missing part, devices and medias used for image acquisition. These may be due to different size, stroke and slant of the image. Therefore there is a requirement to develop robust system which can recognize effectively any handwritten characters. This chapter develops a recognition model for offline handwritten Odia numerals using FLANN as classifier and a bio-inspired technique such as differential evolution (DE) for the weight optimization of the FLANN model. Preprocessing is the first step of OCR followed by feature extraction and classification. Before developing the recognition model preprocessing and feature extraction tasks are performed. The numeral images are preprocessed first. Then feature based recognition method is applied to measure and extract significant features from the numerals image. Then a hybrid system is developed by using FLANN classifier where the weights of FLANN classifier are optimized with DE algorithm. The features are compared to the prototypes developed in training phase. The description which provides the closest match provides the recognition. For feature extraction the recently developed S-transform (M. Hariharan et.al, 2014) is applied which retains the significant features of the pattern. These features being more in dimensions are then reduced by applying principal component analysis (PCA). For the classification task FLANN model is used, the weights of which are adjusted by minimizing the squared error value using the DE algorithm.

BACKGROUND

A concise study of the chronicle background related to the advancement of OCR is as follows. A hybrid system (S. Rajasekaran, 2003) is the integration of one or more techniques to solve complex problem in efficient way. The objective of hybrid system is to provide a better solution by suitably mixing various techniques so as to overcome the weakness of each technique. In literature several research works have been reported for recognition of characters by using hybrid techniques. A hybrid of GA and Harmony Search algorithm (HS) is suggested in (M.Y.Potrus, 2014) for online Arabic text Recognition. The problem is solved in two phases: text segmentation using dominant point detection, and recognition-based segmentation using GA and HS. The performance of the system is evaluated on 4500 Arabic words and benchmark (ADAB) dataset consisting of 7851 Arabic words with a recognition rate of 93.4% and 94–96% respectively. A feed forward neural network with evolutionary algorithms has been employed by the authors (S.Srivastava et.al, 2011) for recognition of handwritten English alphabet. A new method has been developed in (T. Pourhabibi et.al, 2011) by combining Simulated Annealing (SA) and GA for selection of feature subset using Persian fonts and a good recognition performance is suggested. The convergence rate of Guided Evolutionary Simulated Annealing is found to be better than the GA. A hybrid approach has been proposed in (N. Ozturk et.al, 2004) for feature recognition problem to step down the computational complexity with neural networks (NNs) and GAs to step down the computational complexity. Optimum network architecture has been developed by using GA based input selection approach. In (N.Das et.al, 2012) for recognition of Bangla compound character the authors have developed