

This content has been downloaded from IOPscience. Please scroll down to see the full text.

Download details:

IP Address: 3.147.193.245

This content was downloaded on 06/05/2024 at 16:14

Please note that [terms and conditions apply](#).

You may also like:

[Advances in Image and Data Processing using VLSI Design, Volume 1](#)

[Development of Spreadsheet-Based Integrated Transaction Processing Systems and Financial Reporting Systems](#)

I M Ariana and I M Bagiada

[Assembly systems planning with use of databases and simulation](#)

Š Vaclav, P Kostal, D Michal et al.

[Holographic Health Calculation Method of Video and Image Based on Fuzzy Comprehensive Evaluation](#)

Xue Song

[Imaging Systems and Techniques 2011](#)

George Giakos, Mohd Zaid Abdullah, Wuqiang Yang et al.

[Imaging Systems and Techniques](#)

George Giakos, Wuqiang Yang, M Petrou et al.

Computational Intelligence Based Solutions for Vision Systems

IOP Series in Next Generation Computing

Series editors

Prateek Agrawal

University of Klagenfurt, Austria and Lovely Professional University, India

Anand Sharma

Mody University of Science and Technology, India

Vishu Madaan

Lovely Professional University, India

About the series

The motive of this series is to develop a trusted library on advanced computational methods, technologies and their applications.

This series focuses on the latest developments in next generation computing, and in particular on the synergy between computer science and other disciplines. Books in the series will explore new developments in various disciplines that are relevant for computational perspective including foundations, systems, innovative applications and other research contributions related to the overall design of computational tools, models and algorithms that are relevant for the respective domain. It encompasses research and development in artificial intelligence, machine learning, block chain technology, quantum cryptography, quantum computing, nanoscience, bioscience-based sensors, IoT applications, nature inspired algorithms, computer vision, bioinformatics etc. and their applications in the areas of science, engineering, business and social sciences. It covers a broad spectrum of applications in the community, from industry, government, and academia.

The aim of the series is to provide an opportunity for prospective researchers and experts to publish works based on next generation computing and its diverse applications. It also provides a data-sharing platform that will bring together international researchers, professionals and academics. This series brings together thought leaders, researchers, industry practitioners, and potential users of different disciplines to develop new trends and opportunities, exchange ideas and practices related to advanced computational methods and promote interdisciplinary knowledge.

Computational Intelligence Based Solutions for Vision Systems

Edited by

Varun Bajaj and Irshad Ahmad Ansari

*Electronics and Communication Engineering, PDPM Indian Institute of Information
Technology Design and Manufacturing, Jabalpur, India*

IOP Publishing, Bristol, UK

© IOP Publishing Ltd 2022

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior permission of the publisher, or as expressly permitted by law or under terms agreed with the appropriate rights organization. Multiple copying is permitted in accordance with the terms of licences issued by the Copyright Licensing Agency, the Copyright Clearance Centre and other reproduction rights organizations.

Certain images in this publication have been obtained by the authors from the Pixabay website, where they were made available under the Pixabay License. To the extent that the law allows, IOP Publishing disclaims any liability that any person may suffer as a result of accessing, using or forwarding the images. Any reuse rights should be checked and permission should be sought if necessary from Pixabay and/or the copyright owner (as appropriate) before using or forwarding the images.

This book contains photographs of identifiable persons. Consent to print these photographs has been obtained by the authors from the individuals.

Permission to make use of IOP Publishing content other than as set out above may be sought at permissions@iopublishing.org.

Varun Bajaj and Irshad Ahmad Ansari have asserted their right to be identified as the authors of this work in accordance with sections 77 and 78 of the Copyright, Designs and Patents Act 1988.

ISBN 978-0-7503-4821-8 (ebook)
ISBN 978-0-7503-4819-5 (print)
ISBN 978-0-7503-4822-5 (myPrint)
ISBN 978-0-7503-4820-1 (mobi)

DOI 10.1088/978-0-7503-4821-8

Version: 20220501

IOP ebooks

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

Published by IOP Publishing, wholly owned by The Institute of Physics, London

IOP Publishing, Temple Circus, Temple Way, Bristol, BS1 6HG, UK

US Office: IOP Publishing, Inc., 190 North Independence Mall West, Suite 601, Philadelphia, PA 19106, USA

Dedicated to my father the late Mahendra Bajaj and family members.

—Varun Bajaj

Dedicated to my lovely daughter 'Eimaan'.

—Irshad Ahmad Ansari

Contents

Preface	xv
Acknowledgements	xvii
Editors biographies	xviii
List of contributors	xx
1 Drone-based vision system: surveillance during calamities	1-1
<i>Ankit Charan Janbandhu, Sachin Sharma, Irshad Ahmad Ansari and Varun Bajaj</i>	
1.1 Introduction	1-1
1.2 Surveillance system	1-2
1.2.1 The importance of surveillance systems	1-3
1.2.2 The use of drones in surveillance system	1-6
1.3 Proposed method	1-6
1.3.1 Detecting human faces	1-7
1.3.2 Tracking human faces	1-10
1.3.3 Locating and capturing human faces	1-14
1.3.4 Counting the number of people	1-16
1.3.5 Drone deployment and testing	1-16
1.4 Conclusion	1-16
References	1-18
2 Use of computer vision to inspect automatically machined workpieces	2-1
<i>Virginia Riego del Castillo and Lidia Sánchez-González</i>	
2.1 Introduction	2-1
2.2 Related works	2-2
2.3 Methods	2-3
2.3.1 Image acquisition	2-3
2.3.2 Surface analysis to determine workpiece quality	2-5
2.3.3 Burr detection	2-8
2.3.4 Classification	2-11
2.4 Experimental set-up	2-12
2.5 Experimental results	2-14
2.5.1 Workpiece quality	2-14
2.5.2 Burrs	2-16

2.6	Conclusions and future work	2-17
	References	2-18
3	Machine learning for vision based crowd management	3-1
	<i>K S Kavitha and Megha P Arakeri</i>	
3.1	Introduction	3-1
3.2	Related work	3-2
3.2.1	A review of people count detection techniques	3-2
3.3	Proposed methodology	3-4
3.3.1	The architecture of the proposed system	3-4
3.3.2	An objective technique for counting people	3-5
3.3.3	The architecture of YOLOV3	3-8
3.4	Experimental results	3-11
3.4.1	Dataset	3-11
3.4.2	Performance analysis	3-11
3.5	Conclusion	3-14
	References	3-15
4	Skin cancer classification model based on hybrid deep feature generation and iterative mRMR	4-1
	<i>Orhan Yaman, Sengul Dogan, Turker Tuncer and Abdulhamit Subasi</i>	
4.1	Introduction	4-1
4.1.1	Background	4-1
4.1.2	Motivation	4-2
4.1.3	Literature review	4-2
4.1.4	Our model	4-4
4.1.5	Contributions	4-4
4.1.6	Study outline	4-4
4.2	Material	4-4
4.3	Preliminary	4-5
4.3.1	Residual networks	4-7
4.3.2	DenseNet201 model	4-7
4.3.3	MobileNetV2 model	4-8
4.3.4	ShuffleNet model	4-8
4.4	The proposed framework	4-9
4.4.1	Feature generation	4-9
4.4.2	Iterative mRMR feature selector	4-11
4.4.3	Classification	4-12

4.5	Results and discussion	4-13
4.5.1	Experimental set-up	4-13
4.5.2	Results	4-13
4.5.3	Discussion	4-15
4.6	Conclusions and future works	4-21
	References	4-21
5	An analysis of human activity recognition systems and their importance in the current era	5-1
	<i>Chaitanya Krishna Pasula and V M Manikandan</i>	
5.1	Introduction	5-1
5.2	Stages in human activity recognition	5-3
5.3	Applications of human activity recognition	5-3
5.3.1	Security video surveillance and home monitoring	5-3
5.3.2	Retail	5-4
5.3.3	Healthcare	5-4
5.3.4	Smart homes	5-5
5.3.5	Workplace monitoring	5-5
5.3.6	Entertainment	5-5
5.4	Approaches for human activity recognition	5-5
5.4.1	The HAR process using 3D posture data	5-5
5.4.2	Human action recognition using DFT	5-6
5.4.3	The local SVM approach	5-6
5.4.4	A robust approach for action recognition based on spatio-temporal features in RGB-D sequences	5-7
5.4.5	SlowFast networks for video recognition	5-7
5.4.6	Long-term recurrent convolutional networks for visual recognition and description	5-8
5.4.7	3D convolutional neural networks for human action recognition	5-9
5.4.8	Human activity recognition using an optical flow based feature set	5-9
5.4.9	Learning a hierarchical spatio-temporal model	5-9
5.4.10	Human action recognition using trajectory-based representation	5-10
5.4.11	Human activity recognition using a deep neural network with contextual information	5-10

5.5	Challenges in human activity recognition	5-11
5.5.1	Dataset	5-11
5.5.2	Sensors	5-12
5.5.3	Experimentation environment	5-12
5.5.4	Intraclass variation and interclass similarity	5-12
5.5.5	Multi-subject interactions and group activities	5-12
5.5.6	Training	5-13
5.5.7	Challenges in HAR applications	5-13
5.6	Datasets available for activity detection research	5-13
5.6.1	Action-level dataset	5-14
5.6.2	Interaction-level dataset	5-14
5.6.3	Group activities level dataset	5-15
5.6.4	Behavior-level dataset	5-16
5.7	Scope for further research in this domain	5-17
5.8	Conclusion	5-17
	References	5-18
6	A deep learning-based food detection and classification system	6-1
	<i>Bhan Singh, Divyanshu, Mayur Kashyap, Himanshu Gupta and Om Prakash Verma</i>	
6.1	Introduction	6-2
6.2	Literature review	6-3
6.3	Theory	6-4
6.3.1	YOLOv3	6-5
6.3.2	YOLOv4	6-5
6.3.3	SSD	6-7
6.4	Methodology/experiments	6-8
6.4.1	Dataset	6-8
6.4.2	Data augmentation	6-9
6.4.3	Implementation	6-9
6.4.4	Software and hardware	6-10
6.4.5	Performance parameters	6-10
6.5	Results	6-11
6.6	Conclusion and future scope	6-12
	References	6-16

7	The detection of images recaptured through screenshots based on spatial rich model analysis	7-1
	<i>Areesha Anjum and Saiful Islam</i>	
7.1	Introduction	7-1
7.2	Literature review	7-3
7.3	Spatial rich model	7-7
	7.3.1 Computing noise residuals	7-8
	7.3.2 Residual truncation and quantization	7-8
	7.3.3 Formation of a sub-model with co-occurrence matrices	7-9
7.4	Proposed work	7-9
	7.4.1 Selection of the neighborhood descriptor	7-10
7.5	Experimental results	7-10
	7.5.1 Screenshot dataset	7-10
	7.5.2 Detection performance of the neighborhood descriptors	7-15
	7.5.3 The detection performance of neighborhood descriptors with an ensemble classifier	7-15
	7.5.4 Detection performance of neighborhood descriptors with an SVM	7-16
	7.5.5 Performance comparison of the neighborhood descriptors	7-17
7.6	Conclusion	7-18
7.7	Future work	7-18
	References	7-19
8	Data augmentation for deep ensembles in polyp segmentation	8-1
	<i>Loris Nanni, Daniela Cuza, Alessandra Lumini and Sheryl Brahnam</i>	
8.1	Introduction	8-1
8.2	Deep learning for semantic image segmentation	8-3
8.3	Stochastic activation selection	8-4
8.4	Data augmentation	8-5
	8.4.1 Spatial stretch	8-5
	8.4.2 Shadows	8-6
	8.4.3 Contrast and motion blur	8-6
	8.4.4 Color change and rotation	8-7
	8.4.5 Segmentation	8-8
	8.4.6 Rand augment	8-8
	8.4.7 RICAP	8-9
	8.4.8 Color and shape change	8-10
	8.4.9 Occlusion 1	8-10

8.4.10	Occlusion 2	8-11
8.4.11	GridMask	8-11
8.4.12	AttentiveCutMix	8-11
8.4.13	Modified ResizeMix	8-12
8.4.14	Color mapping	8-12
8.5	Results on colorectal cancer segmentation	8-13
8.5.1	Datasets, testing protocol and metrics	8-13
8.5.2	Experiments	8-14
8.6	Conclusion	8-19
	References	8-20
9	Identification of the onset of Parkinson's disease through a multiscale classification deep learning model utilizing a fusion of multiple conventional features with an nDS spatially exploited symmetrical convolutional pattern	9-1
	<i>Ranita Khumukcham and Gaurav Saxena</i>	
9.1	Introduction	9-2
9.1.1	A comprehensive literature review	9-4
9.1.2	Contributions	9-8
9.2	Proposed methodology	9-9
9.2.1	Retrieval of voice samples	9-9
9.2.2	Pre-processing	9-10
9.2.3	Proposed multiscale multiple feature convolution with hybrid n-dilations (MMFCHnD) architecture	9-11
9.3	Experimental results and discussion	9-15
9.3.1	Evaluation metrics	9-15
9.3.2	Development of the training and testing images	9-17
9.3.3	Deep learning training details	9-17
9.3.4	Implementation results	9-18
9.4	Conclusion	9-21
	References	9-22
10	Computer vision approach with deep learning for a medical intelligence system	10-1
	<i>Monali Gulhane</i>	
10.1	Introduction	10-1
10.2	Defining computer vision	10-3

10.3	Computer vision in practice	10-4
10.3.1	Medical imaging	10-5
10.3.2	Cardiology	10-6
10.3.3	Pathology	10-7
10.3.4	Dermatology	10-8
10.3.5	Ophthalmology	10-8
10.3.6	Video for medical purposes	10-9
10.3.7	The presence of humans	10-10
10.3.8	Implementation in the clinic	10-11
10.4	A case study of vision based machine learning	10-14
10.4.1	Networks of neurons	10-14
10.5	Data preparation overview	10-16
10.5.1	Data access and querying	10-17
10.5.2	De-identification	10-18
10.5.3	Data retention	10-18
10.5.4	Medical image resembling	10-19
10.5.5	Choosing an appropriate label and a definition of ground truth	10-19
10.5.6	The truth or the label's quality	10-19
10.6	The future of computer vision and natural language processing in healthcare	10-19
10.7	Research related problems in computer vision	10-20
10.7.1	View of CNN through computer vision	10-20
10.7.2	Visualizations based on gradients	10-20
	References	10-21
11	Machine learning in medicine: diagnosis of skin cancer using a support vector machine (SVM) classifier	11-1
	<i>Siddarth Shah, Dipen Gohil, Rutvik Shah and Manan Shah</i>	
11.1	Introduction	11-1
11.2	Technologies used in skin cancer detection	11-2
11.3	Support vector machines (SVMs)	11-3
11.4	The SVM in skin cancer detection	11-5
11.4.1	Image acquisition	11-5
11.4.2	Feature extraction	11-7
11.4.3	SVM classification	11-8

11.5	Brief description of skin cancer detection	11-9
11.6	Challenges faced by SVMs	11-13
11.7	Future aspects in skin cancer detection	11-13
11.8	Conclusion	11-14
	References	11-14

Preface

Currently, computational intelligence (CI) is being used in a variety of applications and is thus influencing people's lives in various ways. The growth in research in advanced computing and respective fields such as intelligent vision systems (IVSs) is assisting people by allowing rapid response and ease of use. The advancement of IVSs depends jointly on the development of advanced computing and knowledge of vision systems. IVSs help to achieve highly efficient performance (comparable to human vision) to allow a profound understanding of different scenarios and applications. IVSs provide the ability to handle and examine the big data generated by vision sensors and make decisions based on specific requirements. CI enables the different issues that influence IVSs and their practical use to be addressed. Therefore, the merger of CI with IVSs can do wonders for the wellbeing of humans.

In recent times high performance computing has seen continued growth, affecting various fields and changing the computational domain altogether for the betterment of human life. Computer vision can be deemed as one of the most important fields which affects human life in a significant way. CI based computing can be very helpful in determining solutions for advanced vision systems as they required high-end processing capabilities. The in-depth analysis of large datasets is the basis for the development of IVSs and the same can be very helpful in vision and surveillance applications. Deep computational architecture and low level feature extraction, generation and understanding can provide new directions for the current research of vision systems.

Computer vision is a significant technology covering diverse fields. It plays an important role in the fields of information technology and intelligence. The combination of vision systems with CI is giving rise to IVSs. Computer vision is affecting different areas of human life such as surveillance, medical assistance, remote sensing, target detection, tracking, etc.

Computer vision plays a significant role in industry as well. Intelligent systems and computer vision find applications in various industrial phases such as the pre-processing, production and testing phases. Computer vision techniques are an important component of security and surveillance systems. An intelligent vision system using visible and infra-red sensors can track illegal activities and alert the user in the case of any incidents.

Considering the future issues of high performance computing and the need for IVSs, this book focuses on the advancements of this domain. This book is made up of contributions by invited research scholars, academic researchers and industry professional related to high performance computing for IVSs and related applications.

The chapters of this book are as follows. Chapter 1 provides insight into a drone based vision system, and its implementation and application for surveillance. Details of the system components, implementation steps and analysis of obtained result are provided. Chapter 2 highlights an important application of computer vision to automatically detect surface imperfections using a grey-level co-occurrence matrix

and a supervised classification technique. Chapter 3 demonstrates the use of machine learning for vision-based crowd management systems. This work utilizes a deep neural network based YOLOV3 model which is trained using the COCO dataset to detect the people in the frame. Chapter 4 develops a hybrid deep feature extraction model based on five pre-trained deep learning models and an ImRMR based feature selection model for skin cancer classification. Chapter 5 presents an analysis of human activity recognition systems and their importance in the current era. The author discusses the various applications of human activity recognition and the different methods available for automatic activity detection from videos. Chapter 6 explores three deep learning based object detection models, namely YOLOv3, YOLOv4 and SSD, based on mAP. A detailed description of data augmentation is also presented.

Chapter 7 introduces a forensic method to identify recaptured images by means of rich feature extraction from different noise residuals on multiple quantization values. The work focuses on a prominent feature in the spatial domain to classify the original images and screenshots taken from LED monitors. Chapter 8 offers multiple data augmentation approaches for boosting segmentation performance by utilizing DeepLabv3+ as the architecture and ResNet18/ResNet50 as the backbone. Chapter 9 proposes a novel multiscale object detection and location architecture for the classification of Parkinson's disease. The developed model utilizes 540 deep learning layers to learn from a wide range of features by using two unique attributes. Chapter 10 deals with the various AI-powered techniques that address several of the most critical societal health problems, including cardiovascular disease, cancer, dermatological conditions, neurological illnesses, breathing illnesses and gastrointestinal issues. In addition, various imaging techniques, such as computerized tomography, magnetic resonance, radiography, ultrasonography, dermoscopy, etc, are also discussed. Chapter 11 discusses the application of machine learning techniques in medicine. This chapter focuses on the diagnosis of skin cancer using a support vector machine (SVM) classifier.

Acknowledgements

Dr Bajaj expresses his heartfelt appreciation to his mother Prabha, wife Anuja and daughter Avadhi for their wonderful support and encouragement throughout the completion of this important book. His deepest gratitude goes to his mother-in-law and father-in-law for their constant motivation. This book is an outcome of sincere efforts that could only be given to the book due to the great support from Dr Bajaj's family.

Dr Ansari expresses his gratitude and sincere thanks to his wife, family members and teachers for their constant support and motivation.

We sincerely thanks to Professor Sanjeev Jain, Director of PDPM IIITDM Jabalpur, for his support and encouragement. We would like to thank all our friends, well-wishers and all those who keep us motivated to do more and more, better and better. We sincerely thank all the contributors for their writing on the relevant theoretical backgrounds and applications in this book.

We express our humble thanks to Dr John Navas and all the editorial staff of IOP for their great support, necessary help, appreciation and quick responses. We also wish to thank IOP for giving us this opportunity to contribute on a relevant topic with a reputed publisher. Finally we want to thank everyone who, in one way or another, helped us in editing this book.

Dr Bajaj thanks in particular his family who provided encouragement throughout the editing of the book. This book is dedicated from the heart to his father who took the lead to heaven before the completion of this book.

Last but not least we would also like to thank God for showering us with his blessings and strength to do this type of novel and quality work.

Varun Bajaj
Irshad Ahmad Ansari

Editors biographies

Varun Bajaj

Varun Bajaj (PhD, SMIEEE20) has been an Associate Professor in the department of Electronics and Communication Engineering at the Indian Institute of Information Technology, Design and Manufacturing (IIITDM) Jabalpur, India since July 2021. He was an Assistant Professor at IIITDM Jabalpur from March 2014 to July 2021. He also worked as visiting faculty at IIITDM Jabalpur from September 2013 to March 2014. He worked as an Assistant Professor in the Department of Electronics and Instrumentation, Shri Vaishnav Institute of Technology and Science, Indore, India during 2009–10. He received his PhD degree in Electrical Engineering from the Indian Institute of Technology, Indore, India, in 2014. He received his MTech degree with honours in Microelectronics and VLSI Design from the Shri Govindram Seksaria Institute of Technology and Science, Indore, India, in 2009, and his BE degree in Electronics and Communication Engineering from Rajiv Gandhi Technological University, Bhopal, India in 2006.

He is an Associate Editor of the *IEEE Sensors Journal* and the Subject Editor-in-Chief of *IET Electronics Letters*. He served as a Subject Editor of *IET Electronics Letters* from November 2018 to June 2020. He is a Senior Member of IEEE (from June 2020) and was a Member of IEEE (2016–2020), and has also contributed as an active technical reviewer for leading international journals published by IEEE, IET and Elsevier, etc. He has 128 publications which include journal papers (88), conference papers (31), books (9) and book chapters (10). The citation impact of his publications is around 3375 citations, with an h index of 30 and an i10 index of 73 (Google Scholar, November 2021). He has supervised seven PhD scholars (four completed and three in progress) and seven MTech scholars. He has been listed in the world's top 2% of researchers/scientists by Stanford University, CA (October 2021). He has worked on research projects funded by DST and CSIR. He is a recipient of various reputed national and international awards. His research interests include biomedical signal processing, AI in healthcare, brain–computer interfaces, pattern recognition and ECG signal processing.

Irshad Ahmad Ansari

Irshad Ahmad Ansari has been a faculty member in the department of Electronics and Communication Engineering at the PDPM Indian Institute of Information Technology, Design and Manufacturing (IIITDM) Jabalpur, India, since 2017. He received his BTech degree in Electronics and Communication Engineering from Gautam Buddha Technical University (formally UPTU), Lucknow, India, in 2010, and his MTech degree in Control and Instrumentation from Dr B R Ambedkar National Institute of Technology Jalandhar, Punjab, India, in 2012. He completed his PhD at IIT Roorkee with an MHRD teaching assistantship, and subsequently joined the Gwangju Institute of Science and Technology, South Korea, as a

postdoctoral fellow. His major research interests include image processing, signal processing, soft computing, brain–computer interfaces and machine learning. He is a Senior Member of IEEE. He is currently supervising three PhD scholars. He has authored more than 55 research papers in various reputed international journals/conferences proceedings of publishers such as IEEE, Elsevier, Springer, IOP etc. He also serves as an active and potential technical reviewer for various journals of repute.

List of contributors

Areesha Anjum

Department of Computer Engineering, Zakir Husain College of Engineering and Technology, Aligarh Muslim University, Aligarh, India

Irshad Ahmad Ansari

PDPM Indian Institute of Information Technology Design and Manufacturing, Jabalpur, India

Megha Arakeri

M S Ramaiah Institute of Technology, Bangalore, India

Varun Bajaj

PDPM Indian Institute of Information Technology Design and Manufacturing, Jabalpur, India

Sheryl Brahnam

Missouri State University, Springfield, Missouri, USA

Daniela Cuza

University of Padua, Padua, Italy

Divyanshu

Dr B R Ambedkar National Institute of Technology, Jalandhar, India

Sengul Dogan

Technology Faculty, Firat University, Elazığ, Turkey

Dipen Gohil

LJ Institute of Engineering and Technology, Ahmedabad, India

Monali Gulhane

Computer Science and Engineering, St Vincent Pallotti College of Engineering and Technology, Nagpur, India

Himanshu Gupta

Dr B R Ambedkar National Institute of Technology, Jalandhar, India

Saiful Islam

Department of Computer Engineering, Aligarh Muslim University, Aligarh, UP, India

Ankit Charan Janbandhu

PDPM Indian Institute of Information Technology Design and Manufacturing, Jabalpur, India

K S Kavitha

M S Ramaiah Institute of Technology, Bangalore, India

Mayur Kashyap

Dr B R Ambedkar National Institute of Technology, Jalandhar, India

Ranita Khumukcham

Indian Institute of Information Technology Senapati, Manipur, Mantripukhri, India

Alessandra Lumini

University of Bologna, Bologna, Italy

V M Manikandan

SRM University-AP, Andhra Pradesh, India

Loris Nanni

University of Padua, Padua, Italy

Chaitanya Krishna Pasula

SRM University-AP, Andhra Pradesh, India

Virginia Riego del Castillo

Departament of Mechanical, Computer Science and Aerospace Engineering, Universidad de León, León, Spain

Lidia Sánchez-González

Departament of Mechanical, Computer Science and Aerospace Engineering, Universidad de León, León, Spain

Gaurav Saxena

Indian Institute of Information Technology Senapati, Manipur, Mantripukhri, India

Siddarth Shah

LJ Institute of Engineering and Technology, Ahmedabad, India

Manan Shah

Pandit Deendayal Energy University, Gandhinagar, India

Rutvik Shah

Silver Oak College of Engineering and Technology, Ahmedabad, India

Sachin Sharma

Research Division, Jagadish Chandra Bose Research Organisation, Gautam Budh Nagar, Uttar Pradesh, 203207, India

Bhan Singh

Dr B R Ambedkar National Institute of Technology, Jalandhar, India

Abdulhamit Subasi

Faculty of Medicine, University of Turku, Turku, Finland

Turker Tuncer

Technology Faculty, Firat University, Elazığ, Turkey

Om Prakash Verma

Dr B R Ambedkar National Institute of Technology, Jalandhar, India

Orhan Yaman

Technology Faculty, Firat University, Elazığ, Turkey