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4th International Workshop on New Approaches for Multidimensional Signal Processing NAMSP'2023

WORKSHOP PROGRAM

Technical University of Sofia
Sofia, Bulgaria
July 6-8, 2023

Springer

http://rcvt.tu-sofia.bg/NAMSP2023

General Information

The purpose of the workshop is to bring together researchers working in the various areas of Multidimensional Signal Processing and its applications in fields like Telecommunications, Computer Vision, Healthcare, Bioinformatics, Remote Ecological Monitoring, Agricultue, Forestry and others. The workshop proposes themes like: Multidimensional Image Processing, Sensor Heterogeneous Data Clustering, Spatio-Temporal Filtering, Multidimensional Interpolation, Multidimensional Object Segmentation, Multiview Representation, Multidimensional Visualization, Virtual and Augmented Reality and others. Authors are invited to present their recently achieved results, exchange ideas and cooperate in a friendly framework.

The Workshop will take place online with a host **Technical University of Sofia, Bulgaria between the 6th and 8th of July 2023**. We hope that the participants will appreciate the predisposing environment for future collaboration.

We welcome you to NAMSP'2023!

NAMSP 2023 is organized under the frame of the research project *KP-06-N27/16 "Development of efficient methods and algorithms for tensor-based processing and analysis of multidimensional images with application in interdisciplinary fields"*, financed by the **Ministry of Education and Science, Bulgaria**.

The main objectives of the project are related to the development of new efficient methods and algorithms for the representation, processing and analysis of multi-dimensional images (MDI) of various types, such as: video clips, sequences of thermal imaging (TVI) and ultrasound images (USI), multispectral images (MSI), computed tomography (CTI), magnetic resonance imaging (MRI), nuclear magnetic resonance (NMRI), positron emission tomography (PET), magnetic resonance imaging (MRTI), etc. The fulfillment of these goals requires the following main tasks to be solved:

First task: presentation of MDI based on new tensor decomposition methods.

Second task: MDI processing based on a new method of adaptive 3D tensor-based interpolation and the development of a new method of multidimensional adaptive LMS filtration.

Third task: MDI analysis based on tensor-based new intelligent methods and algorithms for segmentation of 3D objects developed by the members of the collective, which are distinguished by increased accuracy with respect to the nearest known ones.

Fourth task: simulation of the developed new algorithms based on the use of available test databases containing different types of real MDIs.

Fifth task: Dissemination of the results obtained from the implementation of the project through participation in specialized international forums in the field of information technologies: telecommunications, medicine, biotechnology, agriculture, etc., as well as in specialized refereed scientific publications (magazines, conference proceedings, etc.), including those with an impact factor. It is planned to organize an international scientific seminar on the subject of the project, at which some of the main results obtained by the scientific team in the process of project implementation will be presented.

Sixth task: Increasing the qualifications of the young participants in the project: students, doctoral students and university professors, and as a result - increasing the capacity of the personnel of the Technical University-Sofia, etc.

The obatined results from investigated new methods will be described in papers presented at the workshop.

NAMSP 2023 is part of the "Days of Science" at Technical University of Sofia, with the kind collaboration of the Research and Development Sector at TU-Sofia, Bulgaria.

Main topics of interest

Image Processing Specific Topics

- N-Dimensional (N-D) Multicomponent Image Processing
- Adaptive N-D Filtration in Intelligent Image Systems
- Multidimensional Image Representation and Super-Resolution
- Compression of Multidimensional Spatio-Temporal Images
- Multidimensional Image Transmission Systems
- Three-Dimensional (3D) Image Processing and Reconstruction
- Multidimensional (MD) Computer Vision Systems
- Multidimensional Multimedia Systems
- Reasoning-Based Intelligent Systems for MD Image Processing
- Intelligent Analysis of MD Medical Images
- Learning-Based MD Image Processing and Expert Systems
- Neural Networks for MD Image Processing
  - MD Image Preprocessing for Pattern Recognition
- Generic and Fuzzy Systems for MD Image Processing, Analysis and Recognition
  - Data-Based MD Image Retrieval and Knowledge Data Mining
- Watermarking, Hiding and Encryption of MD Images
- Surveillance Systems, Based on Intelligent MD Image Processing
- Objects Detection and Tracking, Based on MD Image Processing
  - Intelligent Multi-Spectral and Hyper-Spectral Image Processing

- Intelligent Multi-View Image Processing
- Real-Time MD Image Processing Systems and Tramsmission
- MD Image Processing in Robot Systems
- Intelligent Visualization of MD Images
- Web-Based Search Systems for MD Images
- Forensic Analysis Systems for MD Images

General Data Processing and Generation Topics

- Pattern Recognition
  - Deep Learning
  - Machine Learning
  - Machine Intelligence
  - Neural Networks
  - Data Mining
- Tensor-based Data Processing
- Self-organization Modeling
  - Biomedicine
  - Biological Modeling
  - Bio-inspired Methods
  - Biomedical Computing
  - Financial Modeling
  - Social Modeling
  - Medical Imagistic
  - Virtual Reality
  - Augmented Reality
- 3D and Multiview Visualization
  - Telepresence
  - Computer Graphics
  - Computer Animation
  - and others…

NAMSP'2023 Committees

Honorary Chair: *Prof. Lakhmi Jain, KES International, Selby, UK*

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Prof. Roumen Kountchev, Technical University of Sofia, Bulgaria

Prof. Srikanta Patnaik, Director, I.I.M.T., Bhubaneswar

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Assoc. Prof. Ivo Draganov, Technical University of Sofia, Bulgaria

NAMSP'2023 Program

All Hours are Bulgarian Time (GMT+3)

July 6th, 2023 (Thursday)

Joining link:

10:00 – 10:30 Opening

10:30-12:30 Plenary Session

Chairmen: Prof. Parvinder Singh, DCRUST, India

Prof. Rumen Mironov, Technical University of Sofia, Bulgaria

10:30 – 11:00 Plenary Lecture 1: Patnaik, S., Model of Cognition and its Applications to Robot Perception & Computational Vision

11:00 – 11:30 Plenary Lecture 2: Singh, P., Rice Leaves Disease Detection using Convolutional Neural Network Techniques

11:30 – 12:00 Plenary Lecture 3: Nagy, S., Structural Entropies in Image Processing

12:00 – 12:30 Plenary Lecture 4: Milanova, M., Pyramidal Decomposition Used in Generative Artificial Intelligence Models

12:30 – 13:00 Break

13:00 – 15:00 Paper Session 1

Chairman: Prof. Parvinder Singh, DCRUST, India

13:00-13:15 Sathvik Durgapu, Dhanvanth Reddy Yerramreddy, Veerababu Addanki, Vyshnav Durgapu and Sasi Sai Nadh Boddu, Enhancing Semantic Segmentation through Cycle-consistent Label Propagation in Video

13:15-13:30 Payal Jangra and Dr. Manoj Duhan, Energy Efficient VgSOT-MTJ based 1 bit subtractor

13:30-13:45 Parvinder Singh, Pardeep Kumar and Audithan Sivaraman, Review of the security risks and practical concerns with current and future (6G) communications technology

13:45-14:00 Bharti Sharma, Tripti Rathee, Minakshi Tomer and Parvinder Singh, Handwritten Mathematic Expression Conversion to Docx

14:00-14:15 Salisu Nuhu, Optimization of Quicklime Production from Eggshell Using Response Surface Methodology

14:15 – 14:45 Break

14:45 – 16:00 Paper Session 2

Chairman: Prof. Rumen Mironov, Technical University of Sofia, Bulgaria

14:45-15:00 Lakhmi Jain, Roumen Kountchev and Roumiana Kountcheva, Deep Representation and Analysis of Visual Information, Based on the IDP Decomposition

15:00-15:15 Lakhmi Jain, Roumen Kountchev and Roumiana Kountcheva, New Approach for Locally Adaptive Processing of Color Images Represented as Vector Fields

15:15-15:30 Veska Georgieva and Diana Tsvetkova, Some Trends in Application of Geometric Approaches in Multimodal Medical Image Fusion

15:30-15:45 Ishan Wickramasingha, Biniyam Mezgebo and Sherif Sherif, Weighted Tensor Least Angle Regression for Solving Sparse Weighted Multilinear Least Squares Problems

15:45-16:00 Mariofanna Milanova, Saiteja Raavikanti and Md Rizwanul Kabir, Token-Centric Entity Resolution with Graph Convolutional Neural Networks

16:00-16:15 Taiwo Famuyiwa and Mariofanna Milanova, A Comparison of Particle Swarm Optimization and Stochastic Gradient Descent in Training Transformer and LSTM to Detect Cyberbullying

July 7th, 2023 (Friday)

Joining link: to be announced…

10:00 – 11:30 Paper Session 1

Chairman: Dr. Roumiana Kountcheva, T&K Engineering, Bulgaria

10:00 – 10:15 *Haipeng Wang, Lequn Fu, Intervention Shared Control for Human-robot Collaborative Exploration in Search and Rescue*

10:15 – 10:30 *Ci Song, Hybrid Prediction Model for Mechanical Properties of Low Alloy Steel based on SVR-MLP*

10:30 – 10:45 *Zhenquan Shen, Zhan Song, Zhenzhong Xiao, Xiang Chen, A human-inspired Semantic SLAM based on parking-slot number for Autonomous Valet Parking*

10:45 – 11:00 *Jian Zhang, Yunjing Liu, Jian Kuang, Aiping Pang, Synthesis Design of Electric Vehicle Powertrain Systems*

11:00 – 11:15 *Zhengguang Zhang, Jing Chen, Discussion on the Establishment and Application of Intelligent Design Platform for Concrete Proportioning*

11:15 – 11:30 *Wenzhan Xie, Jiaqian Yan, Mingxun Zhang, Yihan Chen, Effect of Rehabilitation Robot Training on Cognitive Function in Stroke Patients : A Systematic Review and Meta-analysis*

11:30 – 12:00 Break

12:00 – 13:15 Paper Session 2

Chairman: Prof. Ivo Draganov, Technical University of Sofia, Bulgaria

12:00 – 12:15 *Ning Chen, Zixi Yang, Benli Ye, Huiqiao Guo, Feng Wang, Chenxi Zhang, Dongxu Wang, The Application Value of Virtual Reality Navigation Combined with Rapid on-site Evaluation in CT-guided Lung Biopsy*

12:15 – 12:30 *Taohai Han, Hongkai Wang, Gray and White Matters Segmentation in Brain CT Images using Multi-Task Learning from Paired CT and MR Images*

12:30 – 12:45 *Daili Yang, Bin Gao, Liwei Huang, Boyu Chen, Yaozong Chen, Wearable Long-term Graph Learning for Non-invasive Mental Health Evaluation*

12:45 – 13:00 *Chaozhi Cheng, Music Personalized Recommendation System Based on Deep Learning*

13:00 – 13:15 *Nan Zhang, Xu Liu, Research on behavior control method in 3D virtual animation design based on the purpose of improving the effect of overseas dissemination*

13:15 Closing

Invited Speakers

Prof. Dr. Srikanta Patnaik, Director, I.I.M.T., Bhubaneswar

Title of Lecture: **Model of Cognition and its Applications to Robot Perception & Computational Vision**

Abstract: Cognitive Science is an interdisciplinary field that has arisen during the past decade at the intersection of a number of existing disciplines, including psychology, linguistics, computer science, philosophy, and physiology. The shared interest that has produced this coalition understands the nature of the mind. This quest is an old one, dating back to antiquity in the case of philosophy, but new ideas are emerging from the fresh approach of Cognitive Science.

The field of cognitive science overlaps AI. Cognitive scientists study the nature of intelligence from a psychological point of view, mostly building computer models that help elucidate what happens in our brains during problem solving, remembering, perceiving, and other psychological processes. One major contribution of AI and cognitive science to psychology has been the information processing model of human thinking in which the metaphor of brain-as-computer is taken quite literally.

Various States of Cognition:
- Sensing and Acquisition
- Reasoning
- Attention
- Recognition
- Learning
- Planning
- Action and Coordination

Cognitive Memory: Sensory information is stored in human brain at closely linked neuron cells. Information in some cells could be preserved only for a short duration, which is referred as Short Term Memory (STM). Further, there are cells in human brain that can hold information for quite a long time, which is called Long Term Memory (LTM).

Cycles of Cognition:
- Acquisition Cycle
- Perception Cycle
- Learning & Coordination Cycle

Applications:
- Sensing Technology
- Data acquisition & Data Fusion
- Perception, Computational Vision
- Stereo Vision
- Reasoning & Learning
- Soft Computing
- Actuation
- Agent/ Multi Agent System, Robotics, Humanoid

Biographical Notes: Prof. Srikanta Patnaik has received his Bachelor in Engineering from University College of Engineering, Burla (presently VSSUT, Burla) in 1989, MBA from Sambalpur University in 1991 and Ph. D. (Engineering) from Jadavpur University, India in 1999. He has served at University College of Engineering, Burla and Fakir Mohan University and SOA University for more than 30 years. Presently, Prof. Srikanta Patnaik is Director of I.I.M.T., Bhubaneswar, which is an AICTE approved management institute.

He has supervised more than 30 Ph. D. Theses and 100 Master theses in the area of Computational Intelligence, Machine Learning, Soft Computing Applications and Re-Engineering. Dr. Patnaik has published more than 100 research papers in international journals and conference proceedings. He is author of 3 text books and edited more than 100 books and few invited book chapters, published by leading international publisher like IEEE, Elsevier, Springer-Verlag, Kluwer Academic, IOS Press and SPIE.

Dr. Srikanta Patnaik is the Editors-in-Chief of International Journal of Information and Communication Technology and International Journal of Computational Vision and Robotics published from Inderscience Publishing House, England and, Editor of Journal of Information and Communication Convergence Engineering and Associate Editor of Journal of Intelligent and Fuzzy Systems (JIFS). He is also Editors-in-Chief of Book Series on "Modeling and Optimization in Science and Technology" published from Springer, Germany and Advances in Computer and Electrical Engineering (ACEE) and Advances in Medical Technologies and Clinical Practice (AMTCP), published by IGI Global, USA.

Prof. Patnaik is a Guest Professor to Hunan University of Finance and Economics, Changsha and Kunming University of Science and Technology, Kunming, China and visiting professors to some of the B-Schools of Europe and South East Asia.

Prof. Patnaik is awarded with MHRD Fellowship by the Government of India, for the year 1996. He is nominated for MARQUIS Who's Who for the year 2004 and nominated as International Educator of the Year 2005 by International Biographical Centre, Great Britain. He ahs been awarded with the certificate of merit for the best paper entitled "Face recognition by ANN using wavelet Transform Coefficients" by The Institute of Engineers (India) for the year 2004-05.

He is a member of Institute of Electrical and Electronics Engineering (IEEE) and Association for Computing Machinery (ACM). He is also Fellow of IETE, Life Member of ISTE, and CSI. Dr. Patnaik has visited various countries such as Japan, China, Hong Kong, Singapore, Indonesia, Iran, Malaysia, Philippines, South Korea, United Arab Emirates, Morocco, Algeria, Thailand and Vietnam for delivering Key note addresses at various conferences and symposiums.

Prof. Dr. Parvinder Singh, Full Professor, Department of Computer Science & Engineering, Deenbandhu Chhotu Ram University of Science & Technology, Murthal, Haryana, India

Title of Lecture: **Rice Leaves Disease Detection using Convolutional Neural Network Techniques**

Abstract: The world's population is expected to increase by 2 billion persons in the next 30 years, from7.7billion currently to 9.7 billion in 2050, and can peak at nearly 11 billion around 2100. Most of the world's population regards rice as the primary grain, and it is the source of a substantial portion of total calories for over half the earth's population. Like other plants, rice is susceptible to diseases that may affect the quantity and quality of produce. It sometimes results in anywhere between 20–40% crop loss production. Early detection of these diseases can positively affect the harvest, and thus, farmers would have to be knowledgeable about the various disease and how to identify them visually. Even then, it is an impossible task for farmers to survey the vast farmlands daily. Even if this is possible, it becomes a costly task that will in turn increases the price of rice for consumers. So, an automated system is needed, this research methodology proposed a novel SS-PEDCNN-based rice plant disease detection with a severity assessment system. Initially, the contrast level of the input image is enhanced to avoid various factors, such as illumination variations using CLT-DPHE. Then, the background of the input image is removed to reduce the complexity of the input image using SE-GMM. After that, the separate parts (i.e., stem, sheath, leaf) of the input plant by considering the outer shape of the input image, is segmented using CDSO-ARG; then, each part of the input image color is transformed because the color is varying for different diseases. Then, based on the different color models of different parts, the input image is clustered as healthy and diseased. From the disease parts, the features are extracted, and the features are given as input to the SS-PEDCNN classifier, which predicts the rice stem rot, rice sheath spot, rice sheath rot, bacterial leaf streak, leaf smut, rice kernel smut, rice sheath, blight, leaf scald, rice stack burn, and rice blast diseases. From the disease, the severity level is predicted by using POI with the fuzzy rule.

Biographical Notes: Present position: Full Professor, Department of Computer Science & Engineering, Deenbandhu Chhotu Ram University of Science & Technology, Murthal, Haryana, India

Administrative experience: Dean Faculty of IT & CS, DCRUST, Murthal Chairperson CSED, DCRUST Murthal, Professor Incharge Security, DCRUST Murthal, Director PG Admission, DCRUST Murthal

Teaching experience: Total experience - 28 years, Presently working at Deenbandhu Chhotu Ram University of Science & Technology, Murthal, Haryana (India) (DCRUST), Completed 2 terms as Chairman, Department of Computer Science & Engineering, DCR University of Science & Technology, Murthal, Honorary Visiting Professor, University of Deusto, Spain, Worked on India Bulgaria Joint Project with Technical University of Sofia, Working in Collaboration with University of Deusto, Spain, Received two Patents (One International and One Indian) in the field of Security and Image Processing, Awarded two grants from DST and one from UGC for major projects, Organized International and National Workshops/Conferences in various cities of the world and delivered Keynote Address, Biography published in 27th edition of Marquis Who's is Who in World 2010 and all the subsequent editions, Inclusion in the Top 100 Engineers - 2012 by Cambridge, England, Published more than 100 Papers in International Journal and Conference Proceedings

Prof. Mariofanna Milanova, Professor in Computer Science, University of Arkansas at Little Rock, USA

Title of Lecture: Pyramidal Decomposition Used in Generative Artificial Intelligence Models

Abstract: During the presentation, we'll explore the implementation of Pyramidal decomposition in various Generative Artificial Intelligence Models. Pyramidal decomposition is just one example of how hierarchical representations can be leveraged in deep learning models. The specific implementation details may vary depending on the task, model architecture, and available computational resources. The advantage of pyramidal decomposition is that it allows the model to capture multi-scale information from the input, enabling better handling of objects at different sizes and levels of detail. It helps in detecting both fine-grained details and global context in the input image, leading to improved performance in tasks such as object recognition, segmentation, and image generation. This talk serves as a brief overview of our recent research.

Biographical Notes: Dr. Mariofanna Milanova is a professor in the Department of Computer Science at UA Little Rock and has been a faculty member since 2001. She received a M.Sc. in Expert Systems and Artificial Intelligence and Ph.D. in Engineering and Computer Science from the Technical University, Sofia, Bulgaria. Dr. Milanova conducted post-doctoral research in visual perception at the University of Paderborn, Germany. Dr. Milanova has extensive academic experience at various academic and research organizations worldwide.

Dr. Milanova is an IEEE Senior Member, Fulbright U.S. Scholar, and NVIDIA Deep Learning Institute University Ambassador. Dr. Milanova's work is supported by NSF, NIH, DARPA, DoD, Homeland Security, NATO, Nokia Bell Lab, NJ, USA and NOKIA, Finland. She has published more than 120 publications, over 53 journal papers, 35 book chapters, and numerous conference papers. She also has two patents.

Prof. Szilvia Nagy, Széchenyi István University, Győr, Hungary

Title of Lecture: Structural Entropies in Image Processing

Abstract: Entropies help to describe, characterize and classify probability distributions. In the case of image processing and other 2-dimensional signal processing, there are multiple approaches to use Shannon/von Neumann and Rényi entropies. Pipek and Varga introduced their structural entropy on electron densities. Their defini-tion is based on Rényi entropies, and it is used to characterize the localization type of the electron density in 1-, 2-, and 3-dimensional systems. However, other mul-tidimensional signals can be normalized in a way, that they could be interpreted as probability distribution, thus this toolbox can be used on images as well, both as a filter, and as a characterization method. There are other approaches to use entro-py for characterizing structure of graphs, granular systems, or distributions with subsystems of various size or other structural properties. In this paper the similar-ities and differences of these two approaches are studied together with their appli-cation possibilities.

Biographical Notes: Szilvia Nagy received her PhD at the Budapest University of Technology and Eco-nomics in Physics in 2005. She is a full professor at the Széchenyi István University since 2019, at the Department of Telecommunications. Her main research interest includes electron structures, signal and image analysis, wavelets and entropies.