The 4th International Conference on

Medical Imaging and Computer-Aided Diagnosis

MICAD 2023

Conference Schedule

▶ Dec. 9-10, 2023 | Cambridge, United Kingdom

▶ https://www.micad.org

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2023 The 4th International Conference on Medical Imaging and Computer-Aided Diagnosis (MICAD2023)

9-10 December 2023
Cambridge, UK

Content

Note:

1. All the participants are advised to arrive before 8:30, 10 December.
2. Certificate of participation can be collected at the registration counter.
3. Please copy PPT files of your presentation to the secretary when registration.
4. The organizer doesn't provide accommodation, and we suggest you make an early reservation.
5. If you want to deliver oral presentation but your paper is not in the session list, please contact us by Email: cfp@micad.org

Instruction about Oral Presentation

Devices Provided by the conference Organizer:

- Laptops
- Projectors & Screen
- Laser Sticks

Materials Provided by the Presenters:

- PowerPoint or PDF files
- Duration of each Presentation:
  Regular Oral Session: about 12 Minutes of Presentation and 3 Minutes of Q&A

Introduction

The 4th International Conference on Medical Imaging and Computer-Aided Diagnosis (MICAD2023) will be held on December 9-10, 2023 in Cambridge, UK.

As an annual conference that has been successfully held in the past three years in Oxford (UK, 2020), Shanghai (China, 2020 Summer Forum), Birmingham (UK, 2021), and the University of Leicester (UK, 2022), MICAD aims to provide a platform for researchers, academics, and industry professionals to come together and discuss the latest advancements in medical imaging and computer-aided diagnosis. The conference offers Keynote Speeches, Oral Presentations, and Poster Presentations, providing a comprehensive overview of the latest research findings in these fields. Conference Proceedings will be published under Springer's esteemed "Lecture Notes in Electrical Engineering" series (ISSN: 1876-1100), and finally indexed by EI-Compendex, SCOPUS, and Springerlink.

On behalf of the organizing committee, we cordially invite all of you to participate in MICAD2023, and we believe you would be harvested academically and enjoy Cambridge customs.

Organizing Committee of MICAD2023

Venue (Dec. 10, 2023)

Healey Room, Westminster Coll, Westminster College, Madingley Rd, Cambridge CB3 0AA, UK

Map

Conference Committee

General Chairs
Prof. Alejandro F Frangi, The University of Manchester, UK
Prof. Yu-dong Zhang, University of Leicester, UK

General Co-Chairs
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Asst. Prof. Thi Hoang Ngan Le, University of Arkansas, USA

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Prof. Albert Chung, Hong Kong University of Science and Technology, Hong Kong SAR, China
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Prof. Dr. Thomas Schultz, Institute of Computer Science II, University of Bonn, Germany
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Asst. Prof. Yao Sui, Peking University, China
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Dr. Juan Miguel Valverde, University of Eastern Finland, Finland
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Dr. Guang Yang, National Heart & Lung Institute, Imperial College London, United Kingdom
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Asst. Prof. Chin-Chih Chang, Chung Hua University, Taiwan
Dr. Mohammadreza HoseinyFarahabady, University of Sydney, Austarlia
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Dr. Mohd Farid bin Atan, Universiti Malaysia Sarawak, Malaysia
Dr. Jiaming Hu, Zhejiang University, China
Dr. Jiancai Huang, Central South University, China
Asst. Prof. Esteban Guerrero, University of Vaasa, Finland
Dr. Sabrina Ramnarine, King's College London, UK
Asst. Prof. Francesco Cauteruccio, Polytechnic University of Marche, Italy

Time Schedule (London Time, UTC+0)

December 9 (Online in ZOOM)

Invited Speech Session

09:00 – 09:35	Assoc. Prof. Yangang Wang | Southeast University, China
09:35 – 10:10	**Progress and outlook of AI in Medical Imaging** Prof. Huimao Zhang | The First Hospital of Jilin University, China
10:10 – 10:45	**Artificial Intelligence for Multi-Institutional Data Learning** Assoc. Prof. Sang Hyun Park | Daegu Gyeongbuk Institute of Science and Technology, South Korea
10:45 – 11:20	**A Transparent and Explainable AI to Aid Clinical Diagnosis in General Practice** Prof. Qin Zhang | Tsinghua University, China
11:20 – 11:55	Asst. Prof. Sujatha Krishnamoorthy, Wenzhou-Kean University, China
11:55 – 12:30	Invited Speech 6

Oral Presentation Session

12:30 – 12:45	**55 End-to-end Autoencoding Architecture for the Simultaneous Generation of Medical Images and Corresponding Segmentation Masks** Kebaili Aghiles | University of Rouen-Normandy, France
12:45 – 13:00	**79 Self-supervised Probe Pose Regression via Optimized Ultrasound Representations for US-CT Fusion** Mohammad Farid Azampour | Technical University of Munich, Germany
13:00 – 13:15	**82 Classification of Children with/without Autism Spectrum Disorder Using Speech Signal** Nguyen Cong-Phuong | Hanoi University of Science and Technology, Vietnam
13:15 – 13:30	**95 Identification of FECG from AECG Recordings Using ICA over EMD** Sanghamitra Subhadarsini Dash | National Institute of Technology Puducherry, India
13:30 – 13:45	**109 Classification of Pathological Speech in Speakers with Cleft Palate: Decision Tree Approach** Abd el hak Gasmi | National Institute for Research in Education, Algeria
13:45 – 14:00	Oral 6（Paper 110）
14:00 – 14:15	**100 Navigating Privacy and Security Challenges in Electronic Medical Record (EMR) Systems: Strategies for Safeguarding Patient Data in Developing Countries – A Case Study of the Pacific** Priynka Sharma | The University of the South Pacific, Fiji
14:15 – 14:30	**105 Ret2Ret: Retinal Blood Vessel Extraction via Improved Pix2Pix Image Translation** Rohan Banerjee | Jadavpur University, India
14:30 – 14:45	Oral 9

Time Schedule (London Time, UTC+0)

December 10 (Healey Room, Westminster Coll, Westminster College, & Online in ZOOM)

08:00 –08:50	**Registration**
08:50 – 09:00	**Opening Remarks**

Keynote Speech Session

09:00 – 09:35	**Seeing Triple: Working Across Modalities, Anatomies or Tasks for Medical Imaging and Computer-Aided Diagnosis** Prof. Greg Slabaugh | Queen Mary University of London, UK
09:35 – 10:10	**Reliable AI in Medical Imaging: Successes, Challenges, and Limitations** Prof. Gitta Kutyniok | Ludwig Maximilian University of Munich, Germany
10:10 – 10:45	**Small-data AI and Its Applications to Diagnostic Aid and Virtual AI Imaging** Prof. Kenji Suzuki | Tokyo Institute of Technology, Japan
10:45 – 11:00	**Group Photo & Coffee Break**
11:00 – 11:35	**Image Guided Radiotherapy - from Bench to Bedside** Prof. Marcel Van Herk | University of Manchester, UK
11:35 – 12:10	**Particularity and Challenges of Machine Learning for Intra-operative Imaging (MLMI2): Towards precision and Intelligence in high intensity, dynamic environments** Prof. Nassir Navab | Technical University of Munich, Germany

Oral Presentation Session 1

12:10 – 12:25	**64 Survival Modeling of Disease Consequences and Post-Disease Syndromes** Michal Haindl | Institute of Information Theory and Automation, Czech Academy of Sciences, Czechia
12:25 – 12:40	**46 Detecting Pulmonary Lesions in Low-Prevalence Real-World Settings using Deep Learning** Daniel Kvak | Carebot, Inc., Czech Republic
12:40 – 12:55	**93 Preliminary diagnostic evaluation based on data from a test game simulating standard mobile device use** Norbert Zolek | Institute of Fundamental Technological Research Polish Academy of Sciences, Poland
12:55 – 13:30	**Lunch**

Time Schedule (London Time, UTC+0)

Invited Speech Session

13:30 – 14:00 **Intelligent Photoacoustic Imaging**

Asst. Prof. Fei Gao | ShanghaiTech University, China

14:00 – 14:30 **Machine Learning-Based Ideal Observer Computation for Task-Based Assessment of Medical Imaging Systems**

Asst. Prof. Weimin Zhou | Shanghai Jiao Tong University, China

Oral Presentation Session 2

14:30 – 14:45 **57 Evaluation of Randomized Input Sampling for Explanation (RISE) for 3D XAI - Proof of Concept for Black-Box Brain-Hemorrhage Classification**

Jack Highton | King's College London, UK

14:45 – 15:00 **59 Multi-Task Learning Approach for Unified Biometric Estimation from Fetal Ultrasound Anomaly Scans**

Mohammad Areeb Qazi | Mohamed bin Zayed University of Artificial Intelligence, United Arab Emirates

15:00 – 15:15 **60 Deep learning approaches for automated classification of muscular dystrophies from MRI**

Lotte Huysmans | KU Leuven, Belgium

15:15 – 15:30 **88 Machine Learning and AI Approaches for Classifying Primary Brain Tumours Using Conventional MRI Scans**

Nitya Kuruvila | Queen's University, Canada

15:30 – 15:45 **98 Multimodal 3D Image Registration methodology for Cerebral Aneurysm Wall inflation**

Karuppiah Alagan Azhaganmaadevi | Indian Institute of Technology Madras, India

15:45 – 16:00 **Coffee Break**

Time Schedule (London Time, UTC+0)

December 10 (Healey Room, Westminster Coll, Westminster College, & Online in ZOOM)

Oral Presentation Session 3

16:00 – 16:15	**70 Energy-efficient 3D convolution using Interposed Memory Accelerator eXtension 2 for Medical Image Processing** Ren Imamura | NARA Institute of Science and Technology, Japan
16:15 – 16:30	**72 Grey Level Texture Features for Segmentation of Chromogenic Dye RNAscope From Breast Cancer Tissue** Andrew Neil Davidson | University of Canterbury, New Zealand
16:30 – 16:45	**77 Modified technique "Modus Spirdonov 1" in fine-needle aspiration biopsy under ultrasonographical control** Yordan Spirdonov | Medical University of Sofia, Bulgaria
16:45 – 17:00	**78 Customized position with a breast pad for MDCT – A Single-Institution experience for breast cancer staging** Yordan Spirdonov | Medical University of Sofia, Bulgaria
17:00 – 17:15	**106 A Data Augmentation Approach to Enhance Breast Cancer Segmentation** Abdalrahman Hmod Alblwi | University of Delaware, United States
17:15 – 17:20	**Best Paper Award**

Dec. 9, 2023

Invited Speakers (in chronological order)

Assoc. Prof. Yangang Wang
Southeast University, China

Bio: Yangang Wang is currently an associate professor in School of Automation at Southeast University (SEU). Before joining in SEU, he worked as a research scientist at Microsoft Research Asia (MSRA) from 2014 to 2017. He received his Ph.D. in 2014 from Department of Automation at Tsinghua University, advised by Prof. Qionghai Dai. His primary research area involves in Computer Vision, Computer Graphics and Virtual Reality. His most recent research interests are digital virtual human (DVH) and dynamic shape reconstruction with single or multiview cameras (a.k.a. markerless motion capture), including 3D/4D human capture, modeling and reconstruction, Hand pose acquisition, modeling and simulation, Body shape reconstruction, simulation and control, and Tiny motion or vibration sensing, measurement and analysis. He is a program committee member of AAAI2019-2022, Chinagraph2020-2022 and CICAI2022. He also serves as the paper reviewer of SIGGRAPH / TVCG / TPAMI / CVPR / ICCV / NeurIPS and etc.

Dec. 9, 2023

Invited Speakers (in chronological order)

Prof. Huimao Zhang
The First Hospital of Jilin University, China

Bio: Prof. Huimao Zhang is the Chair of the Department of Radiology at the First Hospital of Jilin University, China. She also serves as vice chair of the Chinese Society of Radiology, standing member of the Chinese Radiologist Association, chair of the Jilin Medical Association in Radiology, chair of Data Science and Artificial Intelligence Committee of the 15th Session of the Chinese Society of Radiology and vice chair of Abdominal Committee of the 15th Session of the Chinese Society of Radiology. Her research interests are oncologic imaging with special interest for Lung cancer, colo-rectal cancer, liver cancer, AI in oncologic imaging and emergency imaging, focusing on radiological imaging database construction, multi-organ segmentation, big data mining and disease screening.

Speech Title: Progress and outlook of AI in Medical Imaging

Abstract: Due to the aging population and the rising incidence of chronic diseases, China is facing a significant challenge of growing shortage of doctors. Over the past decade, artificial intelligence (AI) has revolutionized all aspects of healthcare, which has shown great potential in addressing the challenges posed by the growing shortage of radiologists. China's AI industry has entered a new stage of development. An overview of the significant progress of medical imaging AI in practical applications would be provided, including optimizing workflow and assisting in disease diagnosis and treatment. Subsequently, the problems we are facing and the future outlook would be discussed.

Dec. 9, 2023

Invited Speakers (in chronological order)

Assoc. Prof. Sang Hyun Park
Daegu Gyeongbuk Institute of Science and Technology, South Korea

Bio: Sang Hyun Park is an Associate Professor in the Department of Robotics and Mechatronics Engineering at the Daegu Gyeongbuk Institute of Science & Technology (DGIST), South Korea (https://www.dgist.ac.kr/en/). He obtained his Ph.D. in Electrical and Computer Engineering from Seoul National University in February 2014. Following that, he dedicated two years as a Postdoctoral Fellow in the Biomedical Research Imaging Center at the University of North Carolina (2014-2016) and another year as a Postdoctoral Fellow at SRI International (2016-2017). His primary research focuses on medical image analysis, computer vision, and machine learning, encompassing areas such as weakly supervised learning, few-shot learning, generative AI, and federated learning. Selected as a Fulbright visiting scholar in 2024, Sang Hyun Park actively contributes to the research community. He served as an area chair of MICCAI 2023 and has been a co-organizer of the Predictive Intelligence in Medicine (PRIME) workshop at MICCAI for the past six years. He is also participating as an organizing team for MICCAI 2025 held in Korea. Moreover, he has undertaken the role of a reviewer for esteemed conferences and journals, including MICCAI, AAAI, CVPR, ECCV, TMI, and MedIA, over the last three years.

Speech Title: Artificial Intelligence for Multi-Institutional Data Learning

Abstract: Artificial Intelligence (AI) is revolutionizing the field of medicine by providing advanced tools and techniques for medical image analysis. Recently, foundation models trained on large-scale datasets have shown high performance; however, it's challenging to train such models in the medical domain. Medical data is decentralized across various institutions, complicating the creation of substantial training datasets, and labels are frequently incomplete. Moreover, images obtained from diverse domains may manifest variations in characteristics. In this talk, I will introduce few-shot learning, domain adaptation, and federated learning techniques as innovative solutions to surmount these challenges in the field of medical image analysis.

Dec. 9, 2023

Invited Speakers (in chronological order)

Prof. Qin Zhang
Tsinghua University, China

Bio: Qin Zhang graduated from Tsinghua University, Beijing, China, with BS., MS. and Ph.D. Degrees in nuclear engineering in 1982, 1984 and 1989 respectively. He was a visiting scholar with University of Tennessee, Knoxville, TN, USA, and University of California, Los Angeles, CA, USA, from 1987 to1989, working on system reliability engineering and intelligent fault diagnoses. He is now a professor of Institute of Nuclear and New Energy Technology and Department of Computer Science and Technology, Tsinghua University, emeritus member of China Association for Science and Technology, member of International Nuclear Energy Academy, fellow of China Association for Artificial Intelligence (CAAI) and director of the specialized committee for causality and uncertainty in AI of CAAI, consultant of the specialized committee for wise medical care of CAAI. He originally developed a new AI model called Dynamic Uncertain Causality Graph for fault and disease diagnoses.

Speech Title: A Transparent and Explainable AI to Aid Clinical Diagnosis in General Practice

Abstract: DUCG (Dynamic Uncertain Causality Graph) is a new AI model to graphically represent clinical knowledge with uncertainty and make probabilistic reasoning for clinical diagnosis in general practice. Compared with the data-driven AI models, DUCG is knowledge-driven, transparent and explainable. This presentation will show online how DUCG guides primary clinicians to make clinical diagnoses for 64 chief complaints covering more than 1000 diseases included in 48 diagnostic models, and how to collect clinical information or what medical checks should be done step by step for each individual patient. Meanwhile, how the clinical experts work with DUCG platform to construct the 48 diagnostic models will be presented. The 48 models are: cough and sputum, dyspnea, abdominal pain, diarrhea, hematemesis, nasal congestion, epistemic, hematochezia, nausea and vomiting, arthralgia, hemoptysis, fever, lower urinary tract symptoms (frequent urination, urgency, pain in urination, dysuria, polyuria, gross hematuria, leakage of urine), chest pain, jaundice, anemia, edema, obesity, wasting, sore throat, palpitation, fever in children, neck and low back pain (neck pain, low back pain, back pain) , dizziness, headache, constipation, rash, dysphagia, lymph node enlargement, cyanosis, numbness of extremities, vaginal bleeding, abnormal vaginal discharge, vulval pruritus, decreased menstruation or amenorrhea, abdominal distension, syncope, tinnitus, deafness, earache, acid reflux, heartburn, hiccup, belching, mass, oliguria or anuria, eye diseases (eye pain, redness, tears), visual acuity (abnormal vision, visual field defect, visual object deformation, color vision change, flash sensation, diplopia, strabismus). Except that the last two models are waiting for third-party verification, the diagnostic precisions verified by third-party hospitals for the other 46 models are all more than 95%, in which the precision for every disease (including uncommon diseases) is no less than 80%. So far, about one million diagnosis cases in real world have been performed, in which only 17 cases were incorrect and the mistakes in DUCG were found and corrected. No same incorrect diagnoses appear after the corrections. Statistics show that DUCG can increase the ability of primary clinicians to diagnose diseases several times more than without DUCG.

Dec. 9, 2023

Invited Speakers (in chronological order)

Assist. Prof. Sujatha Krishnamoorthy
Wenzhou-Kean University, China

Bio: Sujatha krishnamoorthy is the Assistant professor of Computer Science at Wenzhou - kean University. Earlier to WKU she was the Research and Development Head at Sri krishna college of Engineering and Technology , Coimbatore ,India. she has over 7 years of research experience and over a decade long experience in teaching . Her specialization is Digital image processing with Image fusion. She has published over 60 papers in International refereed journals like Springer and Elsevier. She has delivered several guest lectures, seminars and chaired a session for various Conferences. She is serving as a Reviewer and Editorial Board Member of many reputed Journals and acted as Session chair and Technical Program Committee member of National conferences and International Conferences .She has received a Best Researcher Award during her research period.

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Keynote Speakers (in chronological order)

Prof. Greg Slabaugh
Director of the Digital Environment Research Institute (DERI)
Professor of Computer Vision and AI at Queen Mary University of London, UK

Bio: Greg Slabaugh is Professor of Computer Vision and AI and Director of the Digital Environment Research Institute (DERI) at Queen Mary. His primary research interests include computer vision and deep learning, with applications to computational photography and medical image computing. Prior to joining Queen Mary University of London in 2020, he was Chief Scientist in Computer Vision (EU) for Huawei Technologies R&D where he led a team of research scientists working in computational photography, studying the camera image signal processor (ISP) pipeline including denoising, demosaicing, automatic white balance, super-resolution, and colour enhancement for high quality photographs and video. Earlier industrial appointments include Medicsight, where he led a team of research scientists in detection of pre-cancerous lesions in the colon and lung, imaged with computed tomography; with the company's ColonCAD product receiving FDA clearance and CE marking. He also was an employee of Siemens, where he performed research in medical image computing and 3D shape modelling. He holds 36 granted patents and has roughly 200 publications. He earned a PhD in Electrical Engineering from Georgia Institute of Technology in Atlanta, USA where his thesis focused on reconstruction of 3D shapes from 2D photographs. For six years he was an academic at City, University of London where he taught modules in computer vision, graphics, computer games technology, and programming in addition to leading research grants funded by the European Commission, EPSRC and Innovate UK. He was awarded a university-wide Research Student Supervision Award in 2017, and a Teaching in the Schools award for the School of Mathematics, Computer Science, and Engineering in 2016.

Speech Title: Seeing Triple: Working Across Modalities, Anatomies or Tasks for Medical Imaging and Computer-Aided Diagnosis

Abstract: A patient’s journey in the healthcare system often results in multiple data streams including medical images, but also other non-imaging modalities. And even for a single modality, we may want to leverage it for multiple purposes. Starting from a simplified abstraction of the field of medical image computing, this talk will present short vignettes of our recent research, touching on multi-modal, multi-task, and multi-anatomy deep learning applied to medical images.

Dec. 10, 2023

Keynote Speakers (in chronological order)

Prof. Gitta Kutyniok
Professor at Ludwig Maximilian University of Munich, Germany

Bio: Gitta Kutyniok received the Diploma degree in mathematics and computer science and the Ph.D. degree from Universität Paderborn, Germany, and the Habilitation degree in mathematics from the Justus-Liebig Universität Gießen, in 2006.,From 2001 to 2008, she held visiting positions at several U.S. institutions, including Princeton University, Stanford University, Yale University, Georgia Institute of Technology, and Washington University in St. Louis, and was a Nachdiplomslecturer with ETH Zurich in 2014. In 2008, she became a Full Professor of mathematics with the University of Osnabruck, and moved to Berlin three years later, where she held the Einstein Chair of the Institute of Mathematics, Technical University of Berlin and a courtesy appointment with the Department of Computer Science and Engineering until 2020. She is currently the Bavarian AI Chair of Mathematical Foundations of Artificial Intelligence, Ludwig Maximilian University of Munich, and an Adjunct Professorship in machine learning with the University of Tromsø. Her main research interests include in the areas of applied harmonic analysis, artificial intelligence, compressed sensing, high-dimensional data analysis, imaging science, inverse problems, machine learning, partial differential equations, and applications to life sciences and telecommunication.

Speech Title: Reliable AI in Medical Imaging: Successes, Challenges, and Limitations

Abstract: Deep neural networks as the current work horse of artificial intelligence have already been tremendously successful in real-world applications, ranging from science to public life. The area of (medical) imaging sciences has been particularly impacted by deep learning-based approaches, which sometimes by far outperform classical approaches for particular problem classes. However, one current major drawback is the lack of reliability of such methodologies.

In this lecture we will first provide an introduction into this vibrant research area. We will then present some recent advances, in particular, concerning optimal combinations of traditional model-based methods with deep learning-based approaches in the sense of true hybrid algorithms. Due to the importance of explainability for reliability, we will also touch upon this area by highlighting an approach which is itself reliable due to its mathematical foundation. Finally, we will discuss fundamental limitations of deep neural networks and related approaches in terms of computability, and how these can be circumvented in the future, which brings us in the world of novel computing hardware such as neuromorphic computing.

Dec. 10, 2023

Keynote Speakers (in chronological order)

Prof. Kenji Suzuki
Professor of Biomedical Artificial Intelligence, Founding Director of BMAI
Vice Chair of Department of Information and Communications Engineering BioMedical Artificial Intelligence Research Unit (BMAI)
Institute of Innovative Research at Tokyo Institute of Technology, Japan

Bio: Kenji Suzuki, Ph.D. (Nagoya University) worked at Hitachi Medical Corp, Aichi Prefectural University, Japan, as a faculty member, in Department of Radiology, University of Chicago, as Assistant Professor, and Medical Imaging Research Center, Illinois Institute of Technology, as Associate Professor (Tenured). He is currently a Professor (Tenured) & Founding Director of Biomedical Artificial Intelligence Research Unit, Institute of Innovative Research, Tokyo Institute of Technology, Japan. He published more than 390 papers (including 120 peer-reviewed journal papers). He has been actively researching on deep learning in medical imaging and AI-aided diagnosis in the past 25 years, especially his early deep-learning model was proposed in 1994. His papers were cited more than 15,000 times, and his h-index is 59. He is inventor on 37 patents (including ones of earliest deep-learning patents), which were licensed to several companies and commercialized. He published 15 books and edited 16 journal special issues. He has been awarded numerous grants including NIH, NEDO, and JST grants, totaling $17M. He serves as Editors of 34 leading international journals including Pattern Recognition. He chaired 120 international conferences. He received 23 awards, including 3 Best Paper Awards in leading journals.

Speech Title: Small-data AI and Its Applications to Diagnostic Aid and Virtual AI Imaging

Abstract: Deep leaning becomes one of the most active areas of research in medical imaging. My group has been actively studying on deep learning in medical imaging in the past 25 years, including ones of the earliest deep-learning models for medical image processing, semantic segmentation of lesions and organs, lesion/organ enhancement, and classification of lesions in medical imaging. In this talk, small-data AI that can be trained with a small number of cases is introduced. Our small-data AI was applied to develop AI-aided diagnostic systems (“AI doctor”) and deep-learning-based imaging for diagnosis (“virtual AI imaging”), including 1) AI systems for cancer detection and diagnosis with medical images, and 2) virtual AI imaging systems for separation of bones from soft tissue in chest radiographs and those for radiation dose reduction in CT and mammography. Some of them have been commercialized via FDA approval in the U.S., including the first FDA-approved deep-learning product.
Research Interests: Artificial intelligence, Deep learning, Machine learning, AI-aided system, Computer-aid diagnosis, Medical image analysis

Dec. 10, 2023

Keynote Speakers (in chronological order)

Prof. Marcel Van Herk
Chair in Radiotherapy Physics, University of Manchester, UK

Bio: Physicist Marcel van Herk is responsible for a programme of international leading cancer research and innovation, closely interfaced with clinical practice. The group's focus is on improving accuracy of radiation therapy including target volume definition, treatment planning, image guidance and imaging-based treatment follow-up generating real-world evidence from very large cohorts of patients.
His multidisciplinary group is part of the division of cancer sciences. It includes 2 senior lecturers (one honorary), 5 research associates, 24 PhD students, 14 masters' students and 6 clinical scientist (HSST) students who cover physics, clinical oncology, clinical physics, radiography, and radiology. All research is directly aimed at improving the clinical practice of cancer treatment in the Christie, UK, and the world. A key element is the direct collaboration with academic clinicians, of which there are few. His work led to new standards of care in cancer treatment delivery and is recognised internationally as practice changing. Marcel has (co-) authored 300 papers in peer reviewed journals.

Speech Title: Image Guided Radiotherapy - from Bench to Bedside

Abstract: Radiotherapy entails treating cancer with radiation. The most common form is external beam treatment with a linear accelerator. In the last decades this technology has evolved tremendously, and all treatments are now prepared in a meticulous way to maximise dose delivered to the tumour and avoid delivering unnecessary dose to healthy organs close to the tumour. The actual delivery of the treatment requires precisely aligning the target with the treatment beams, and this has been the focus of the first part of my career. I have developed 2D, 3D and 4D imaging solutions integrated with the radiotherapy machine that have been clinically implemented on a very large scale. To enable clinical implementation, the associated software must be straightforward to use and understand. When developing such software, it is important to always keep the clinical requirements in mind, and focus on algorithm stability and acquiring the correct user input. For instance, a simple but important factor is the definition of the region of interest in (rigid) image registration applications. This conveys important clinical information (the most important anatomy), greatly improves algorithm stability by limiting deformations, and provides guidance for algorithm validation. I would therefore argue that design of the user interface, image visualisation and awareness of clinical requirements are as important as the applied algorithms - a fact that is sometimes overlooked by researchers in the medical image computing field. For this reason, collaboration with clinicians and allied healthcare professionals is essential. Another issue that is often forgotten is that clinicians themselves have uncertainty and variability and that there is no such thing as a ground truth to train algorithms. We have been working to improve this situation by training and protocol development, and more recently by big data analysis. For instance, by correlating dose distributions of thousands of patients with clinical outcomes, we have been able to detect that dose to the base of the heart is most predictive of outcomes and this has led to the definition of a new organ at risk, that is currently being tested in a clinical trial.

Dec. 10, 2023

Keynote Speakers (in chronological order)

Prof. Dr. Nassir Navab
Professor and Director of the Laboratories for Computer Aided Medical Procedures at Technical University of Munich (TUM)
Adjunct Professor, Johns Hopkins University
Director of Medical Augmented Reality Summer School Series at Balgrist Hospital, Zurich

Bio: Nassir Navab is a full professor and director of the Laboratories for Computer Aided Medical Procedures (CAMP: http://campar.in.tum.de) at Technical University of Munich (TUM) and an Adjunct Professor at Johns Hopkins University (http://camp.lcsr.jhu.edu/). He is also the director of Medical Augmented Reality (http://medicalaugmentedreality.org/) summer school series at Balgrist Hospital in Zurich. He is Fellow of the MICCAI Society and acted on its board of directors from 2007 to 2012 and from 2014 to 2017. He has been one of the founders of and is serving on the Steering Committee of the IEEE Symposium on Mixed and Augmented Reality since 2001. He is the author of hundreds of peer reviewed scientific papers and 51 granted US and over 80 international patents. He served as General Chair for MICCAI 2015, ISMAR 2001, 2005 and 2014. He is a founding board member of IPCAI 2010-2021 and Area Chair for ICCV 2022 and ECCV 2020. He is on the editorial board and advisory board of many international journals including IEEE TMI and MedIA.

Speech Title: Particularity and Challenges of Machine Learning for Intra-operative Imaging (MLMI2): Towards precision and Intelligence in high intensity, dynamic environments

Abstract: Over the past decade, the rapid advancements in machine learning have revolutionized various fields, significantly impacting our lives. In this talk, we will delve into the realm of medical applications and explore the challenges and opportunities associated with integrating these cutting-edge technologies into computer-assisted interventions. Our primary focus will be on fostering acceptance and trust in machine learning and robotic solutions within the medical domain, which often necessitates the path through Intelligence Amplification (IA). Augmented Reality allows us to leverage IA to augment human intelligence and expertise, ultimately paving the way for the seamless integration of Artificial Intelligence (AI) and robotics into clinical solutions.
Drawing from some groundbreaking research conducted at the Chair of Computer-Aided Medical Procedures at both TU Munich and Johns Hopkins Universities, I will present a series of novel techniques developed to address the unique demands of medical applications. Specifically, we will explore their practical implementations in diverse areas, including Robotic Ultrasound Imaging, Multimodal Data Analysis, and Semantic Scene Graphs for Holistic Modeling of Surgical Domain. Furthermore, I will showcase compelling examples of how Augmented Reality solutions can serve as catalysts for embracing AI in computer-assisted surgery. By harnessing the power of intelligence amplification, we can unlock the full potential of AI technologies, bolstering acceptance and driving the future of computer-assisted interventions. Join me on this enlightening journey as we navigate the intricate intersection of machine learning, medical advancements, and the path from intelligence amplification to artificial intelligence in healthcare.

Dec. 10, 2023

Invited Speakers (in chronological order)

Asst. Prof. Fei Gao
ShanghaiTech University, China

Bio: Dr. Fei Gao is an assistant professor in ShanghaiTech University, and PI of Hybrid Imaging System Laboratory (HISLab: www.hislab.cn). He received Chinese Government Award for Outstanding Self-Financed Students Abroad (2014), Springer Thesis Award (2016).

He is currently serving as associate editors of several journals, including Photoacoustics, Medical Physics, Ultrasound in Medicine and Biology, IEEE Photonics Journal. He also serves as TPC member of IEEE Ultrasonics Symposium. He has published about 170 journal and conference papers with 2700+ citations. His interdisciplinary research topics include photoacoustic (PA) imaging physics (proposed non-line-of-sight PA imaging, passive PA effect, PA resonance imaging, phase-domain PA sensing, pulsed-CW hybrid nonlinear PA imaging, TRPA-TRUE focusing inside scattering medium, etc.), biomedical circuits and systems (proposed miniaturization methods of laser source and ultrasound sensors, delay-line based DAQ system, hardware acceleration for PA imaging, etc.), algorithm and AI (proposed frameworks such as Ki-GAN, AS-Net, Y-Net, EDA-Net, DR2U-Net, etc,), as well as close collaboration with doctors to address unmet clinical needs (Some prototypes are under clinical trials).

Speech Title: Intelligent Photoacoustic Imaging

Abstract: The intelligence of medical imaging equipment is an irreversible trend, which has greatly accelerated the diagnostic procedure using CT and MRI. Photoacoustic imaging (PAI), as an emerging biomedical imaging modality revealing molecular/functional information noninvasively in deep tissue, is expected to be empowered by advanced artificial intelligence techniques. This is named as intelligent PAI, i.e. iPAI. Basically, there are three important scientific problems to be solved: (1) how to achieve the intelligence of PAI hardware system; (2) how to achieve the intelligence of PAI image reconstruction and processing; (3) how the intelligence of PAI system add values to the clinical practice. In this talk, we will introduce (1) handheld and endoscopic photoacoustic probes that can achieve adaptive adjustable bright-field and dark-field illumination, as well as a ring-shaped photoacoustic tomographic imaging system with adjustable imaging field of view, which can achieve optimal design of light scheme and ultrasound detection sensitivity employed by intelligent algorithms. (2) The method of fusing analog circuits with deep learning image reconstruction to achieve single-pixel real-time photoacoustic imaging. (3) A new framework combining traditional photoacoustic image reconstruction algorithms with deep learning algorithms, improving accuracy while preserving generalization. (4) Hardware acceleration of photoacoustic image reconstruction algorithms and intelligent data acquisition system design based on FPGA platform. (5) Non-line-of-sight photoacoustic imaging to overcome skull's aberration by detecting PA signals through temporal bones. In the last part, we will introduce several potential biomedical applications of iPAI, which can benefit from the intelligent system design and deep learning algorithms, followed by discussion of the challenges and future directions of iPAI.

Dec. 10, 2023

Invited Speakers (in chronological order)

Asst. Prof. Weimin Zhou
Shanghai Jiao Tong University (SJTU), China

Bio: Weimin Zhou, Ph.D. is a Tenure-Track Assistant Professor at the Global Institute of Future Technology at Shanghai Jiao Tong University (SJTU). Before joining SJTU in 2022, he was a Postdoctoral Scholar in the Department of Psychological & Brain Sciences at the University of California, Santa Barbara (UCSB).

Engineering from Washington University in St. Louis (WashU) in 2020. During his Ph.D., he worked as a Research Assistant in the Department of Biomedical Engineering at WashU and a Visiting Scholar in the Department of Bioengineering at the University of Illinois Urbana-Champaign (UIUC). Dr. Zhou possesses broad expertise in imaging science, computational image formation, visual perception, and machine learning. Dr. Zhou is the recipient of the SPIE Community Champion Award and the SPIE Medical Imaging Cum Laude Award. He also serves as a peer reviewer for a variety of journals and a program committee member for SPIE Medical Imaging. Dr. Zhou has been active in publishing research articles in top-tier journals and conference proceedings, including IEEE Transactions on Medical Imaging, Medical Physics, Journal of Biomedical Optics, Journal of Medical Imaging, and SPIE Medical Imaging.

Speech Title: Machine Learning-Based Ideal Observer Computation for Task-Based Assessment of Medical Imaging Systems

Abstract: Task-based measures of image quality (IQ) have been widely employed to support the objective assessment of medical imaging systems by academia, industry, and FDA. Task-based measures of IQ quantify the ability of an observer to perform specific tasks in images. For signal detection tasks (e.g., tumor detection), the Bayesian Ideal Observer (IO) utilizes complete task-specific information in images and sets an upper limit of observer performance. The IO has been advocated for use in optimizing medical imaging systems because, in this way, the amount of task-specific information in the measurement data can be maximized. However, in most cases, the determination of the IO test statistic is analytically intractable. Recently, machine learning methods have been developed for approximating the IO for realistic image data. In this talk, I will present state-of-the-art machine learning methods for computing the IO for signal detection tasks. Supervised learning-based methods that employ artificial neural networks (ANNs) and a sampling-based method that employs Markov-Chain Monte Carlo with generative adversarial networks (MCMC-GAN) will be described. These methods represent powerful computational tools that permit the objective assessment and optimization of medical imaging systems.

Dec. 9 Online

Oral Presentations (in chronological order)

55

Kebaili Aghiles
University of Rouen-Normandy, France

Title: End-to-end autoencoding architecture for the simultaneous generation of medical images and corresponding segmentation masks

Abstract:

Despite the increasing use of deep learning in medical image segmentation, acquiring sufficient training data remains a challenge in the medical field. In response, data augmentation techniques have been proposed; however, the generation of diverse and realistic medical images and their corresponding masks remains a difficult task, especially when working with insufficient training sets. To address these limitations, we present an end-to-end architecture based on the Hamiltonian Variational Autoencoder (HVAE). This approach yields an improved posterior distribution approximation compared to traditional Variational Autoencoders (VAE), resulting in higher image generation quality. Our method outperforms generative adversarial architectures under data-scarce conditions, showcasing enhancements in image quality and precise tumor mask synthesis. We conduct experiments on two publicly available datasets, MICCAI's Brain Tumor Segmentation Challenge (BRATS), and Head and Neck Tumor Segmentation Challenge (HECKTOR), demonstrating the effectiveness of our method on different medical imaging modalities.

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Mohammad Farid Azampour
Technical University of Munich, Germany

Title: Self-supervised Probe Pose Regression via Optimized Ultrasound Representations for US-CT Fusion

Abstract:

Aligning 2D ultrasound images with 3D CT scans of the liver holds significant clinical value in enhancing diagnostic precision, surgical planning, and treatment delivery. Conventional approaches primarily rely on optimization techniques, which often have a limited capture range and are susceptible to initialization errors. To address these limitations, we define the problem as "probe pose regression" and leverage deep learning for a more robust and efficient solution for liver US-CT registration without access to paired data. The proposed method is a three part framework that combines ultrasound rendering, generative model and pose regression. In the first stage, we exploit a differentiable ultrasound rendering model designed to synthesize ultrasound images given segmentation labels. We let the downstream task optimize the rendering parameters, enhancing the performance of the overall method. In the second stage, a generative model bridges the gap between real and rendered ultrasound images, enabling application on real B-mode images. Finally, we use a patient-specific pose regression network, trained self-supervised with only synthetic images and their known poses. We use ultrasound, and CT scans from a dual-modality human abdomen phantom to validate the proposed method.
Our experimental results indicate that the proposed method can estimate probe poses within an acceptable error margin, which can later be fine-tuned using conventional methods. This capability confirms that the proposed framework can serve as a reliable initialization step for US-CT fusion and achieve fully automated US-CT fusion when coupled with conventional methods. The code and the dataset are available at https://github.com/mfazampour/SS Probe Pose Regression.

Dec. 9 Online

Oral Presentations (in chronological order)

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Nguyen Cong-Phuong
Hanoi University of Science and Technology, Vietnam

Title: Classification of Children with/without Autism Spectrum Disorder Using Speech Signal

Abstract:

Autism Spectrum Disorder (ASD) is a neurodevelopmental and neurological disorder related to brain development, leading to problems of social communication and interaction. While there is no cure for ASD, effective and early interventions can improve its symptoms. Hence screening this problem from early ages is very important. In our research, speech of children and machine learning are used to classify children with ASD from typically developing ones. Obtained results show that the combination of speech features and k-Nearest Neighbor model is a promising approach for early detection of ASD.

95

Sanghamitra Subhadarsini Dash
National Institute of Technology Puducherry, India

Title: Identification of FECG from AECG recordings using ICA over EMD

Abstract:

Extraction of fetal ECG (fECG) signal is essential for monitoring the health of fetus during pregnancy and helps in early diagnosis of heart abnormalities, which leads to increased infant mortality rate and post-natal complications. In real scenarios, extraction of clear fECG is challenging due to maternal ECG (mECG) and other contaminated noise (such as: baseline wander and high frequency noise). This paper is focused on design, implementation, and verification of a robust approach for fECG extraction, recorded by non-invasive procedure from the pregnant women, using empirical mode decomposition (EMD), independent component analysis (ICA), and FIR filtering. The combined EMD and ICA approach are found suitable for effective extraction in real and synthetic data. EMD separates the nonstationary and non-linear time varying signals like ECG into various modes, having high to low frequencies using signal itself as a basis. The coefficients obtained during this decomposition are called intrinsic mode functions (IMFs) representing various frequency components. Different number of IMFs are combined with the residuals to create the data matrix (or mixed signals), which are fed to the ICA (extended efficient Fast-ICA and multi-combi ICA) for separating the independent components (ICs) due to their strength in separating the combination of various distribution signals. These extracted ICs (such as: thorax ECG, fECG, and noises etc.,) are subjected to FIR filtering to obtain the fECG and its corresponding heart rate (HR). This technique is validated on simulated signals for separation, prior to applying on fECG synthetic-data and aECG-data collected from PhysioBank ATM. The performance of ICA algorithm is evaluated by API.

Dec. 9 Online

Oral Presentations (in chronological order)

109

Abd el hak Gasmi
National Institute for Research in Education, Algeria

Title: Classification of Pathological Speech in Speakers with Cleft Palate: Decision Tree Approach

Abstract:

Our work concerns the automatic classification of Pathological Speech (PP) using the Decision Trees (DT) method. The specific goal is the automatic characterization of pathological speech, particularly that produced by individuals with facial clefts, for its application in the diagnosis, evaluation, and rehabilitation of these patients in an Algerian hospitaðl setting. We developed a corpus consisting of words containing the emphatic phoneme [ṭ] combined in 556 sound files with the Long Vowel (VL) [ā] and in 555 sound files with the Short Vowel (VC) [a]. This corpus was recorded by twenty-eight (28) speakers with cleft palate or labio-palatal cleft and a control group of thirty-eight (38) healthy speakers. Prior to this, we conducted an acoustic analysis to extract relevant features (F0, F1, F2, and F3, E0, VOT, durations [CV] and [V] of the subsequent vowel, the degree of F0 disturbance (Jitter), the degree of intensity disturbance (Shimmer), and the Harmonics to Noise Ratio (HNR)). Subsequently, a DT based on the C4.5 algorithm was applied to discriminate PP from Normal Speech (PN). The results obtained show that DTs adapt well to the recognition and classification of PP. This method allowed us to achieve appreciable Recognition Rates (RR) for PP compared to PN, with rates of 87% for VL and 85% for VC.
Our work could contribute to the development of automatic diagnostics, the establishment of expert systems leading to appreciable rates of vocal anomaly identification, and support in Speech Therapy education.

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Title: PB-FELTuCS: Patch-Based Filtering for Enhanced Liver Tumor Classification and Segmentation

Abstract:

We propose PB-FELTuCS, a Patch-Based Filtering for Enhanced Liver Tumor Classification and Segmentation network for 3DLiTS dataset. PB-FELTuCS leverages the liver segments obtainedfrom a simple 3D convolutional neural network (CNN) architecture forLiTS liver segmentation and performs a patch-driven 3D tumor segmentation and classification over the segmented liver regions. The inclusion ofpatch-based filtering as opposed to using full volumes during pre-trainingof tumor classification and segmentation networks significantly bolstersour model's robustness. Our liver segmentation network though simple,outperforms recent benchmarks, achieving an impressive Dice score of0.98. Moreover, with simpler network architectures, our technique obtains an accuracy of 89.1% in tumor classification and a 0.747 Dice scorefor tumor segmentation, highlighting the effectiveness of the proposedapproach in enhancing the precision of volumetric medical assessments.

Dec. 9 Online

Oral Presentations (in chronological order)

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Priynka Sharma
The University of the South Pacific, Fiji

Title: Navigating Privacy and Security Challenges in Electronic Medical Record (EMR) Systems: Strategies for Safeguarding Patient Data in Developing Countries – A Case Study of the Pacific

Abstract:

The adoption of Electronic Medical Record (EMR) systems has marked a transformative stage in healthcare data management worldwide. However, this transition is notably delayed by the prevailing concerns about privacy and security, particularly in the context of patient information, causing many health organizations in developing countries across the Pacific region to be cautious in their approach. The worry stems from the significant challenge of safeguarding an extensive volume of sensitive health data that exists in various forms and is distributed across diverse locations. This paper investigates the multi-layered privacy and security challenges associated with EMR systems, emphasizing Pacific developing nations' unique circumstances. The complexities surrounding data protection, compliance with privacy regulations, and the potential for data breaches are precisely examined. A case study of the Pacific region is presented to illuminate the significance of these challenges. It underlines the real-world details that healthcare providers and patients in these developing nations face as they navigate the adoption of EMR systems. Moreover, this document provides an exhaustive array of tactics for tackling these issues and guaranteeing the security of patient information. These strategies encompass robust encryption techniques, access controls, user authentication mechanisms, and ongoing security assessments. However, in response to these challenges and given the unique needs and circumstances of the Pacific region, we propose a strategic shift toward a cloud-based medical record system. This approach enhances data security and provides a cost-effective solution, especially vital in resource-constrained settings.

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Rohan Banerjee
Jadavpur University, India

Title: Ret2Ret: Retinal Blood Vessel Extraction via Improved Pix2Pix Image Translation

Abstract:

High prevalence of retinal diseases is a global concern, but the recent advances in artificial intelligence has brought in new hopes of devising automated tools for detecting and monitoring critical retinal diseases even at their onsets. An accurate segmentation of blood vessels from the retinal fundus images is a basic prerequisite for subsequent diagnosis in any computerised retinal disease diagnosis system. Although the said research area has been well studied in the past few decades, there are still scopes for improvement particularly on pathological images, since recent research has continually expanded the list of diseases that have early markers in retinal images. In this paper, we exploit the power of deep generative adversarial networks (GAN) in extraction of retinal vessels by proposing Ret2Ret which is a modified Pix2Pix GAN model for image to image (retina-to-retina) translation. The generator module of the backbone Pix2Pix model has been re-designed into a light-weight architecture having fewer parameters. In addition, we have introduced the bi-FPN architecture in the generator for an accurate extraction of thin vessels. Results show that our proposed Ret2Ret method outperforms a number of competing recent approaches on public benchmark databases like DRIVE and CHASE DB1.

Dec. 10 In person

Oral Presentations (in chronological order)

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Michal Haindl
Czech Academy of Sciences, Czechia

Title: Survival Modeling of Disease Consequences and Post-Disease Syndromes

Abstract:

We present a survival model for human maladies, which leave victims with permanent health damages requiring life-long medical observation and treatment. The model allows national health authorities to prepare sufficient medical specialists with adequate capacity in specialized clinics, vaccinations, spas, or rehabilitation facilities. We test the model on Czech Polio (Poliomyelitis Anterior Acuta) victims' data. COVID-19 or Long Covid-19 and the treatment of their wide range of ongoing health problems, where these conditions can last weeks, months, or years, can benefit from Polio and COVID-19 RNA virus similarities.

46

Daniel Kvak
Carebot, Inc., Czech Republic

Title: Detecting Pulmonary Lesions in Low-Prevalence Real-World Settings using Deep Learning

Abstract:

The rapid advancement of artificial intelligence (AI) in medical imaging has presented an exciting prospect of enhancing diagnostic accuracy and efficiency. One of the active areas of research is the use of deep-learning-based automatic detection algorithms (DLAD) in chest radiography, which has shown tremendous potential in identifying various findings such as tuberculosis or pulmonary lesions. However, despite the promising results in the controlled, high-prevalence simulated conditions typically observed in research settings, there are concerns about the use of these applications in real-world scenarios. For our study, we collected 956 chest X-ray images (CXR) from daily clinical practice at a municipal hospital. Two central readers with access to the patient's previous and subsequent examinations achieved blinded agreement for 901 CXRs, of which 21 were visually confirmed to contain one or more pulmonary lesions (prevalence: 2.3%) and 880 were found to contain no pulmonary lesions. Six radiologists of varying expertise were asked to conduct a retrospective analysis of these images. Subsequently, the performance of each radiologist was benchmarked against the ground truth and the proposed DLAD (2.0.20-v2.01). The proposed DLAD demonstrated higher sensitivity (Se of 0.905 (0.715–0.978)) than that of all assessed radiologists (RAD 1 0.238 (0.103-0.448), $p < 0.001$, RAD 2 0.333 (0.170-0.544), $p < 0.001$, RAD 3 0.524 (0.324-0.717), $p < 0.001$, RAD 40.619 (0.410-0.794), $p < 0.001$, RAD 50.667 (0.456-0.83), $p < 0.001$, RAD 60.619 (0.41-0.794), $p < 0.001$), and the difference was statistically significant. The DLAD specificity (Sp of 0.893 (0.871-0.912)) was significantly lower than that of five compared radiologists (RAD 1 0.999(0.994-1), $p < 0.001$, RAD 2 0.933 (0.915-0.948), $p < 0.001$, RAD 4 0.968 (0.955-0.978), $p < 0.001$, RAD 5 0.991 (0.982-0.996), $p < 0.001$, RAD 60.989 (0.979-0.994), $p < 0.001$), with the exception of one, mid-level experienced radiologist but the difference was not statistically significant (RAD 3 0.884 (0.861-0.904), $p = 0.685$). The results of this study demonstrate that the proposed DLAD achieves a high level of sensitivity and a relatively reliable level of specificity even when applied in low-prevalence real-world settings. As a result, the proposed DLAD can be considered beneficial for both junior and more experienced radiologists.

Dec. 10 In person

Oral Presentations (in chronological order)

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Norbert Zolek
Institute of Fundamental Technological Research Polish Academy of Sciences, Poland

Title: Preliminary diagnostic evaluation based on data from a test game simulating standard mobile device use

Abstract: Background: The analysis of various parameters from the test simulating standard usage of mobile devices equipped with a touch screen is described. Objective: It is a preliminary study for augmented diagnostic of various cognitive impairments based on data from standard use of mobile devices. Methods: The analysis uses data from the inertial motion sensors, timers, screen tap positions, and the device front camera for eye-gaze detection for precise feature extraction purposes. Sample measures based on times to complete the entire test, times to find individual items on the screen, as well as measures quantitatively characterizing tap positions were proposed and applied to the test results to differentiate subjects' behavior. Results: The results show clear quantitative differences in the performance of the test volunteers. There are differences in the ability to focus attention, differences in short-term memory capacity or the way the device is operated (e.g., which finger points to items on the screen). Conclusions: The results of the test, which simulates most of the basic aspects of mobile device use, allow a precise assessment of specific user behaviors, can contribute to a rationalized assessment of cognitive function and, consequently, extract features from data on the standard use of "smart devices" improve assessment of various conditions than classical tests.

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Jack Highton
King's College London, UK

Title: Evaluation of Randomized Input Sampling for Explanation (RISE) for 3D XAI - Proof of Concept for Black-Box Brain-Hemorrhage Classification

Abstract:

An increasing number of AI products for medical imaging solutions are offered to healthcare organizations, but frequently these are considered to be a ‘black-box’, offering only limited insights into the AI model functionality. Therefore, model-agnostic methods are required to provide Explainable AI (XAI) in order to improve clinicians’ trust and thus accelerate adoption. However, there is a current lack of published methods to explain 3D classification models with systematic evaluation for medical imaging applications. Here, the popular explainability method RISE is modified so that, for the first time to the best of our knowledge, it can be applied to 3D medical image classification. The method was assessed using recently proposed guidelines for clinical explainable AI. When different parameters were tested using a 3D CT dataset and a classifier to detect the presence of brain hemorrhage, we found that combining different algorithms to produce 3D occlusion patterns led to better and more reliable explainability results. This was confirmed using both quantitative metrics and interpretability assessment of the 3D saliency heatmaps by a clinical expert.

Dec. 10 In person

Oral Presentations (in chronological order)

59

Mohammad Areeb Qazi
Mohamed bin Zayed University of Artificial Intelligence, United Arab Emirates

Title: Multi-Task Learning Approach for Unified Biometric Estimation from Fetal Ultrasound Anomaly Scans

Abstract:

Precise estimation of fetal biometry parameters from ultrasound images is vital for evaluating fetal growth, monitoring health, and identifying potential complications reliably. However, the automated computerized segmentation of the fetal head, abdomen, and femur from ultrasound images, along with the subsequent measurement of fetal biometrics, remains challenging. In this work, we propose a multi-task learning approach to classify the region into head, abdomen and femur as well as estimate the associated parameters. We were able to achieve a mean absolute error (MAE) of 1.08 mm on head circumference, 1.44 mm on abdomen circumference and 1.10 mm on femur length with a classification accuracy of 99.91% on a dataset of fetal Ultrasound images. To achieve this, we leverage a weighted joint classification and segmentation loss function to train a U-Net architecture with an added classification head. The code can be accessed through Github.

60

Lotte Huysmans
KU Leuven, Belgium

Title: Deep learning approaches for automated classification of muscular dystrophies from MRI

Abstract:

The diagnosis of specific types of muscular dystrophies (MD) is mainly done through genetic testing. As this does not always provide an unambiguous result, muscle MRI images are often examined to confirm or verify the diagnosis as each MD type affects the muscles in a specific pattern. Different deep learning approaches (ResNet50 model pretrained on RadImageNet, auto-encoder model trained from scratch, segmentation U-Net model trained for muscle segmentation) were investigated to obtain image features from Dixon MRI of the proximal leg that were used for discriminating between cases with Becker Muscular Dystrophy (n=18), Limb-Girdle Muscular Dystrophy R12 (n=13) or no MD (n=16). The results are compared with classification by a conventional random forest (RF) classifier using the fat fraction percentage per muscle as features. The RF classifier and the segmentation U-Net deep learning approach performed best with an average AUC of 0.957 and 0.934 respectively. Local interpretable model-agnostic explanations (LIME) were used to explain the decisions of the RF model. Different fat replacement patterns for BMD and LGMDR12 observed in the glutei, adductors and vasti as described in literature were in part confirmed by the explanations.

Dec. 10 In person

Oral Presentations (in chronological order)

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Nitya Kuruvila
Queen's University, Canada

Title: Machine Learning and AI Approaches for Classifying Primary Brain Tumours Using Conventional MRI Scans

Abstract:

This study investigates the diagnosis of brain tumours, namely glioblastomas, the most common malignant and incurable brain tumour in adults, by invoking Machine Learning (ML) and AI approaches. We aim to diagnose and infer certain characteristics of brain tumours based on the physical phenomena of the tumour, as gleaned by conventional Magnetic Resonance Imaging (MRI), and by examining inferred identifiers which, which are resident in the cancer's demographic properties. By analyzing the MRI brain scans of living and deceased glioblastoma patients, we determine the maximum dimensions of the tumour in multiple planes, their signal characteristics and their enhancement profiles. In addition, we undertake a texture analysis of the tumours to gather data that is not immediately observable on the MRI scans. The demographic characteristics and genetic biomarkers of the cancer will also be recorded from patients' medical files. The same information will also be collected for living and deceased patients known to have different types of brain tumours. The information is then analyzed algorithmically to classify patients based on their tumour types using conventional MRI sequences. The future outcome of this research is to determine the survival times of patients with glioblastomas and provide prognostic information in a non-invasive manner, based on the physical characteristics and biological indicators of the tumour.

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Azhaganmaadevi Karuppiah Alagan
Indian Institute of Technology Madras, India

Title: Multimodal 3D Image Registration methodology for Cerebral Aneurysm Wall inflation

Abstract:

Purpose: Understanding the biofluid mechanics of a cerebral aneurysm, its growth and subsequent rupture is of importance in clinical diagnosis and treatment planning. Aneurysm Geometric models, developed for the CFD (Computational Fluid Dynamics) studies do not include the patient-specific wall thickness details, since discerning wall information is not possible through CT scans. Hence, associated fluid-structure interaction studies will have limitations in the estimation of rupture risk, which is of clinical interest. Currently available imaging modalities are fettered by the resolution limit placed by their hardware in discerning the wall thickness information around the blood-flow domain enclosed by the aneurysm. Micro CT image data of an aneurysm wall, post its surgical resection enables us to procure wall thickness details accurately but the deflation underwent by the wall needs a reference model in-order to be inflated as it existed in vivo. Pre-surgical CT Angiographic images taken could provide the blood-flow profile enclosed by the aneurysm wall in its inflated native state. A Point-cloud based 3D image registration methodology could aid in obtaining the inflated aneurysm wall model that enables to perform a reliable FSI (Fluid Structure Interaction) study rather than the traditional CFD to understand the biofluid mechanics of the aneurysm.

Results: The point-cloud of the aneurysm wall extracted from the Micro CT image data is inflated according to the pointcloud of the blood-flow domain extracted from the CT Angiogram images, using coherent point drift algorithm for nonrigid registration of point-clouds. The proposed methodology comprehensively combines the 3D images of the wall and lumen from multimodal image data to obtain a complete 3D model, coupling the wall with its enclosed lumen, as it existed in vivo.
Conclusion: A 3D inflated geometric model was obtained for the surgically resected, deflated aneurysm wall, as it existed in vivo prior to surgery, thereby providing a more realistic wall model for fluid structure interaction studies.

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Ren Imamura
NARA Institute of Science and Technology, Japan

Title: Energy-efficient 3D convolution using Interposed Memory Accelerator eXtension 2 for Medical Image Processing

Abstract:

Energy-efficient medical image processing is crucial in mobile or remote healthcare situations where traditional GPU-based solutions are not feasible. Recently, three-dimensional (3D) image processing has gained significant importance in fields like computer vision, machine learning, natural language processing, and medical diagnosis. 3D convolution neural networks (CNN) have outperformed state-of-the-art in many visual recognition tasks, such as medical imaging, video processing and analysis, and 3D Object recognition. 3D CNNs excel at feature extraction but impose a computational burden, mainly from convolution layers. Their cubic complexity growth hinders speed and overall performance, requiring complexity reduction in these layers, as they dominate 3D CNN calculations. To tackle these challenges, we introduce a novel energy-efficient computational solution of the Interposed Memory Accelerator eXtension 2 (IMAX2), a Coarse-Grained Linear Array (CGLA) developed in our laboratory, which outperforms the RTX3090 by achieving 7.37 times the efficiency in Tops/W for 3D CNNs. Unlike fixed Application-Specific Integrated Circuits, IMAX2 offers remarkable flexibility for computations, making it a versatile choice for complex tasks. Specifically, we optimized the computational bottleneck of 3D convolutions within the U-Net architecture, a specialized CNN model designed for segmentation tasks. Our initial findings demonstrate that IMAX2 empowers medical image analysis with 3D CNNs while achieving superior energy efficiency. This study opens up new possibilities for Computer-Aided Diagnosis and AI-driven medical imaging solutions in settings where conventional high-power systems are impractical.

Dec. 10 In person

Oral Presentations (in chronological order)

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Andrew Neil Davidson
University of Canterbury, New Zealand

Title: Grey Level Texture Features for Segmentation of Chromogenic Dye RNAscope From Breast Cancer Tissue

Abstract:

Chromogenic RNAscope dye and haematoxylin staining of cancer tissue facilitates diagnosis of the cancer type and subsequent treatment, and fits well into existing pathology workflows. However, manual quantification of the RNAscope transcripts (dots), which signify gene expression, is prohibitively time consuming. In addition, there is a lack of verified supporting methods for quantification and analysis. This paper investigates the usefulness of gray level texture features for automatically segmenting and classifying the positions of RNAscope transcripts from breast cancer tissue. Feature analysis showed that a small set of gray level features, including Gray Level Dependence Matrix and Neighbouring Gray Tone Difference Matrix features, were well suited for the task. The automated method performed similarly to expert annotators at identifying the positions of RNAscope transcripts, with an F1-score of 0.571 compared to the expert inter-rater F1-score of 0.596. These results demonstrate the potential of gray level texture features for automated quantification of RNAscope in the pathology workflow.

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Yordan Spirdonov
Medical University of Sofia, Bulgaria

Title: Modified technique “Modus Spirdonov 1” in fine-needle aspiration biopsy under ultrasonographical control

Abstract:

Fine-needle aspiration biopsy (FNAB) is one of the most used techniques for obtaining cytological material for further evaluation. The authors have developed a different technique in order to obtain a larger amount of biopsy material. Methods: Over a period of 6 years (2016-2022) more than 900 FNABs of mammary glands under US control and local anesthesia were performed at University Hospital “Queen Joanna – ISUL”, Medical University of Sofia, Bulgaria with a new developed hybrid technique – “Modus Spirdonov 1”. In order to statistically confirm the superiority of the team conducted an experiment. For the purpose of the experiment porcine liver and longissimus dorsi muscle were selected as target tissues sampled by standard method with direct grip (n = 60), by using CAMECO syringe pistol (n = 60) and by applying the new modified technique “Modus Spirdonov 1” (n = 60). A comparative analysis of the weight of the samples was performed. Results: The processed results show that the amount of biological material taken with FNAB "Modus Spirdonov 1" weighs 5.53 times more, which is equivalent to an increase of 452.7 %. The modified method “Modus Spirdonov 1” significantly exceeds the other two techniques ($p<0,001$) according to the quantity of the obtained material. The gathered material is visually significantly richer, including ductal epithelial complexes, abundance of stromal cells, calcifications, detritus, giant cells and macrophages. Conclusion: The described modified technique is a viable alternative to the currently used FNAB and could increase the diagnostic value of the preoperative biopsy in a number of diseases.

Dec. 10 In person

Oral Presentations (in chronological order)

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Yordan Spirdonov
Medical University of Sofia, Bulgaria

Title: Customized position with a breast pad for MDCT – A Single-Institution experience for breast cancer staging

Abstract:

Precise breast cancer (BC) staging, according to TNM classification, is essential for the adequate treatment of every patient. Magnetic Resonance Imaging (MRI) is a method of choice for staging in patients with unclear local status. In some cases, however, a diagnostic and technological difficulties appear when MRI is contraindicated or impossible to perform due to an absolute, anatomical or conditional reasons. Methods: We introduced the prone position for scanning on a specially designed CT breast pad (RCD-008478879-0001 and RCD-008478879-0002) that was used on 131 patients with verified BC, successfully diagnosed and treated at the Breast Unit of University Hospital "Queen JoannaISUL", Medical University of Sofia, Bulgaria. The women were assessed as ASA I-IV and contraindicated for MRI. Results: Measurements along the midclavicular line in 130 women (99,24%) showed reduction of the anteroposterior mammary gland diameter from 2 to 7 times when comparing supine CT scanning with prone (modus Spirdonov) with lateral deviation of the mammilla up to 105^{o}. We've calculated that in 19.6% of cases the standard MDCT protocol was inaccurate in determining the local BC staging. In a comparative group of 19 patients who had both MRI and CT (modus Spirdonov) performed, the results were fully concordant with minimal measurement differences. Conclusions: The new body position (modus Spirdonov) performed on a CT breast pad exceeds the standard supine position in determining BC lesion's location, size and relation to the surrounding tissues in some patients. We believe that it is a true alternative to MRI when the latter is contraindicated or impossible to perform.

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Abdalrahman Hmod Alblwi
University of Delaware, United States

Title: A Data Augmentation Approach to Enhance Breast Cancer Segmentation

Abstract:

The early detection of breast tumors is a critical concern for healthcare professionals, including oncologists and radiologists. While Artificial Intelligence (AI) has demonstrated potential in early breast cancer diagnosis, the efficacy of these models is often constrained by the limited size and lack of diversity in medical training sets. Although data augmentation techniques are explored to enlarge and enhance training sets, many such methods neglect the crucial aspect of sample diversity, leading to suboptimal tumor identification. Among the prevalent data augmentation techniques, the MixUp method is commonly employed to increase the size and diversity of data sets. However, its application in ultrasound image enhancement can introduce extraneous noise and may result in the loss of vital image features. This paper presents a novel data augmentation strategy termed Cluster and MixUP (Cluster MixUP) Augmentation, designed to enrich the diversity of training data while retaining essential image features. The approach combines K-means clustering with the MixUp Augmentation technique to group and mix images effectively. The efficacy of the proposed strategy is validated using the Breast Ultrasound Images database (BUSI), demonstrating superior performance and generalizability in breast cancer detection relative to existing data augmentation methods.

Poster Presentations

Dec. 10 In person

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Biao Huang
Shanghai Jiaotong University, China

Title: Evaluation of left main bifurcation ostial area by main vessel intravascular ultrasound

Abstract:

Assessment of ostium of circumflex artery (Cx) in the main vessel (MV) intravascular ultrasound (IVUS) imaging pullback is prone to measurement error as the scan plane is not perpendicular to the Cx centerline. This study aimed to validate a new automatic approach to assess the side branch (SB) ostium in IVUS pullbacks performed in the MV. A total of 88 pairs of IVUS pullbacks, were performed both in the MV and SB of the left main bifurcation, from 42 patients enrolled in the study. The ostial area of the SB measured in the MV pullback was automatically obtained by a cut-plane analysis. The ostial area of the SB ostium measured in the corresponding SB pullback was used as a reference. The ostial area obtained from the MV pullbacks showed good agreement with the area obtained from the SB pullbacks ($r=0.86$, $p<0.001$), with an average bias of 0.60 ± 1.22 mm^2.

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Yidong Zhang
Queen's University Belfast, UK

Title: Diagnostic Genes Identification and Molecular Classification Patterns Based on Oxidative Stress-Related Genes in Ischemic Stroke

Abstract:

Ischemic Stroke (IS) has been ever-threatening to public health. Oxidative stress participated in the IS process and induced neuron death, lacking pathological elucidation and clinical diagnosis. Acquiring data from Gene Expression Omnibus (GEO) and Gene Set Enrichment Analysis (GSEA) database, we screened differently expressed genes and selected candidate diagnosis related genes via random forest and SVM-RFE method. Subsequently we established a corresponding diagnosis model and eventually conducted the immune infiltration analysis. Parallelly, we conducted the consensus clustering and performed weighted gene co-expression network analysis (WGCNA) to figure out co-expressed gene modules in clusters respectively. Then we conducted functional enrichment for featured pathways of each cluster, and presented the KEGG pathways on the proteomic level. Eventually, the single-cell analysis was conducted to further explore the oxidative stress in IS, including pseudo-time analysis and cell-cell communication. Through machine learning algorithms, 9 key hub genes were selected and a diagnosis prediction model was conducted. The immune infiltration analysis revealed correlations between immune cells, inflammatory factors and differently expressed genes. The clusters obtained by consensus clustering indicated different functional pathways. The single-cell analysis revealed that endothelial cells were obviously affected by oxidative stress in IS. Associations between oxidative stress-induced and IS was clarified. New perspectives were provided for IS pathological elucidation, diagnosis and treatment usage.

Poster Presentations

Online

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[2] First Medical Center of Chinese People's Liberation Army (PLA) General Hospital, Beijing, China.

Title: Predicting Central Cervical Lymph Node Metastasis of Papillary Thyroid Carcinomas using Multi-view Ultrasound Images

Abstract:
Thyroid nodule classification in ultrasound images is an important task for central cervical lymph node metastasis (CLNM) of papillary thyroid carcinomas (PTC). Clinically, a nodule is commonly evaluated from both transverse and longitudinal views using thyroid ultrasound. Due to the low contrast, high noise, and individual differences of ultrasound images, it has become a challenging problem. To address these, we propose a method to assist in diagnosing CLNM of PTC using multi-view ultrasound images and patient information. Our network consists of two modules, ROI extraction and multi-view classification network. First, we employ the popular semantic segmentation network, U2-Net, on our clinical dataset and use the results to identify the region of interest (ROI). Then we design the parallel ResNet-50 network to complete the classification task from multi-view information. Experimental results show that our method can provide useful information for clinical diagnosis and lay a technical foundation for the classification of ultrasound images.

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Ranran Dai[1,2], Wenxian Peng[2]
[1] College of Health Science and Engineering, University of Shanghai for Science and Technology, China
[2] College of Medical Imaging, Shanghai University of Medicine and Health Sciences, China

Title: Research progress of deep learning in thyroid nodule imaging examination

Abstract:

Deep learning can extract high-throughput information that is difficult for human eyes to detect in images and can learn autonomously. In recent years, it has been widely used in the field of medical image recognition. Research based on deep learning can help doctors improve their ability to detect small lesions in images, reducing the impact of misdiagnosis or missed diagnoses on patients. Accurate diagnosis of thyroid nodules is a difficult problem in clinical treatment. Although the malignant probability of thyroid nodules is low, early neglect of diagnosis and treatment can lead to the deterioration of thyroid nodules and even thyroid cancer, which affects human life safety. This paper first introduces the application and research progress of deep learning in medical imaging, summarizes the current medical image processing algorithms, and then discusses and summarizes the development process and current limitations of deep learning in different imaging diagnosis of thyroid nodules, so as to provide a reference for researchers to further study this field.