Lecture Notes in Computer Science 13565

Founding Editors

Gerhard Goos
Karlsruhe Institute of Technology, Karlsruhe, Germany

Juris Hartmanis
Cornell University, Ithaca, NY, USA

Editorial Board Members

Elisa Bertino
Purdue University, West Lafayette, IN, USA

Wen Gao
Peking University, Beijing, China

Bernhard Steffen
TU Dortmund University, Dortmund, Germany

Moti Yung
Columbia University, New York, NY, USA

More information about this series at https://link.springer.com/bookseries/558

Stephen Aylward · J. Alison Noble · Yipeng Hu ·
Su-Lin Lee · Zachary Baum · Zhe Min (Eds.)

Simplifying Medical Ultrasound

Third International Workshop, ASMUS 2022
Held in Conjunction with MICCAI 2022
Singapore, September 18, 2022
Proceedings

Springer

Editors
Stephen Aylward
Kitware Inc.
Carrboro, NC, USA

J. Alison Noble
University of Oxford
Oxford, UK

Yipeng Hu
University College London
London, UK

Su-Lin Lee
University College London
London, UK

Zachary Baum
University College London
London, UK

Zhe Min
University College London
London, UK

ISSN 0302-9743 ISSN 1611-3349 (electronic)
Lecture Notes in Computer Science
ISBN 978-3-031-16901-4 ISBN 978-3-031-16902-1 (eBook)
https://doi.org/10.1007/978-3-031-16902-1

© The Editor(s) (if applicable) and The Author(s), under exclusive license
to Springer Nature Switzerland AG 2022
Chapters "Efficient Pix2Vox++ for 3D Cardiac Reconstruction from 2D Echo Views" and "Left Ventricle Contouring of Apical Three-Chamber Views on 2D Echocardiography" are licensed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/). For further details see license information in the chapters.
This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.
The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.
The publisher, the authors, and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

This is an exciting era for medical ultrasound! Recent developments in deep learning (artificial intelligence) and medical robotics are producing clinically measurable improvements in the speed, accuracy, and reproducibility of numerous ultrasound examinations and interventions. Additionally, these developments are expanding ultrasound's role into nearly every aspect of patient care.

ASMUS 2022, the Third International Workshop of Advances in Simplifying Medical Ultrasound, provided a forum for ultrasound researchers, application developers, and medical professions to give presentations and live demonstrations that spanned ongoing work, recent accomplishments, open-source code, and shared data. ASMUS inspires new collaborations and aids in the identification new challenges in ultrasound computing, computer-assisted interventions, robotics, and clinical applications. ASMUS is the official workshop of the MICCAI Special Interest Group on Medical Ultrasound.

This year, we received a total of 23 high-quality submissions. Each submission was reviewed using a double-blind process, with at least two outside reviewers and one organizing committee member providing written reviews. These reviews were used by the area chairs to make recommendations to the Program Committee, who then made the final decisions. The quality of the reviews was evident in the consistency of the reviewers' recommendations. Ultimately, 18 papers were accepted based on their scientific contribution, innovation, rigor, and clinical impact.

The accepted papers are a tour de force for medical ultrasound. Clinical applications featured in the papers span the fields of obstetrics, cardiology, interventional radiology, and organ transplant surgery. AI and traditional image analysis methods for ultrasound image reconstruction, localization, segmentation, and registration are presented. The challenges and opportunities associated with robotics, AI training using synthetic data, and overcoming noise are also addressed. New investigators and seasoned ultrasound professionals were well represented at ASMUS 2022, both as authors and attendees.

We are very grateful to the many reviewers, committee members, authors, and attendees who shared their time, research, and expertise to make this workshop so successful. We look forward to this workshop inspiring many new collaborations and exciting developments for the next several years in this exciting era for medical ultrasound.

September 2022

Stephen Aylward
J. Alison Noble
Yipeng Hu
Su-Lin Lee
Zachary Baum
Zhe Min

Organization

Organizing Chairs

Stephen Aylward	Kitware, USA
J. Alison Noble	University of Oxford, UK
Yipeng Hu	University College London, UK

Program Chairs

Zhe Min	University College London, UK
Su-Lin Lee	University College London, UK
Zachary Baum	University College London, UK

Demonstration Chair

Zachary Baum	University College London, UK

Organizing Committee

Ana Namburete	University of Oxford, UK
Andrew King	King's College London, UK
Bernhard Kainz	Imperial College London, UK
Dong Ni	Shenzhen University, China
Ekaterina Zilonova	KU Leuven, Belgium
Emad Boctor	Johns Hopkins University, USA
Parvin Mousavi	Queen's University, Canada
Purang Abolmaesumi	University of British Columbia, Canada
Thomas van den Heuvel	Radboud University Medical Center, The Netherlands
Wolfgang Wein	ImFusion GmbH, Germany

Advisory Committee

Chris de Korte	Radboud University Nijmegen, The Netherlands
Gabor Fichtinger	Queen's University, Canada
Jan d'Hooge	KU Leuven, Belgium
Kawal Rhode	King's College London, UK
Nassir Navab	Technical University of Munich, Germany
Russ Taylor	Johns Hopkins University, USA

Program Committee

Su-Lin Lee	University College London, UK
Yipeng Hu	University College London, UK
Iani Gayo	University College London, UK
Francisco Vasconcelos	University College London, UK
Qianye Yang	University College London, UK
Marek Wodzinski	AGH University of Science and Technology, Poland
Stephen Aylward	Kitware, USA
Piotr Woźnicki	University Hospital Würzburg, Germany
Alexander Gleed	University of Oxford, UK
Matthew Holden	Carleton University, Canada
Wolfgang Wein	ImFusion GmbH, Germany
Zhen Yuan	King's College London, UK
Zachary Baum	University College London, UK
Zhenyuan Ning	Southern Medical University, China
Wietske Bastiaansen	Erasmus MC, The Netherlands
Yipei Wang	University of Oxford, UK
Liam Chalcroft	University College London, UK
Jeremy Tan	Imperial College London, UK
Shaheer Ullah Saeed	University College London, UK
Shuangyi Wang	Chinese Academy of Sciences, China
Clare Teng	University of Oxford, UK
Alberto Gomez	King's College London, UK
Lauren Erdman	University of Toronto, Canada
Wen Yan	University College London, UK
Emad Boctor	Johns Hopkins University, USA
Nina Montana-Brown	University College London, UK
Wufeng Xue	Shenzhen University, China
Xin Yang	Shenzhen University, China
Dong Ni	Shenzhen University, China
Bernhard Kainz	Imperial College London, UK
Hadrien Reynaud	Imperial College London, UK
Andrew King	King's College London, UK
Keshav Bimbraw	Worcester Polytechnic Institute, USA
Qian Li	University College London, UK
J. Alison Noble	University of Oxford, UK
Parvin Mousavi	Queen's University, Canada
Baichuan Jiang	Johns Hopkins University, USA
Qingjie Meng	Imperial College London, UK
Yunguan Fu	University College London, UK
Andrew Gilbert	GE Healthcare, Norway

Tom Ginsberg	University of Toronto, Canada
Thomas Day	King's College London, UK
Shu Zhang	Northwestern Polytechnical University, China
Zhe Min	University College London, UK

Sponsors

ThinkSono Ltd.

Ultromics Ltd.

Wellcome/EPSRC Centre for Interventional and Surgical Sciences (WEISS)

Contents

Classification and Detection

Rapid Lung Ultrasound COVID-19 Severity Scoring with Resource-Efficient Deep Feature Extraction 3
Pierre Raillard, Lorenzo Cristoni, Andrew Walden, Roberto Lazzari, Thomas Pulimood, Louis Grandjean, Claudia A. M. Gandini Wheeler-Kingshott, Yipeng Hu, and Zachary M. C. Baum

Spatio-Temporal Model for EUS Video Detection of Pancreatic Anatomy Structures 13
Adrien Meyer, Antoine Fleurentin, Julieta Montanelli, Jean-Paul Mazellier, Lee Swanstrom, Benoit Gallix, Georgios Exarchakis, Leonardo Sosa Valencia, and Nicolas Padoy

RL Based Unsupervised Video Summarization Framework for Ultrasound Imaging 23
Roshan P. Mathews, Mahesh Raveendranatha Panicker, Abhilash R. Hareendranathan, Yale Tung Chen, Jacob L. Jaremko, Brian Buchanan, Kiran Vishnu Narayan, Kesavadas Chandrasekharan, and Greeta Mathews

Prediction of Kidney Transplant Function with Machine Learning from Computational Ultrasound Features 34
Ricky Hu, Rohit Singla, Cailin Ringstrom, Zoe Hu, Victoria Lessoway, Janice Reid, Timothy Murray, Christopher Nguan, and Robert N. Rohling

Differential Learning from Sparse and Noisy Labels for Robust Detection of Clinical Landmarks in Echo Cine Series 44
Mobina Mahdavi, Hooman Vaseli, Christina Luong, Nathan Van Woudenberg, Mohammad Jafari, Purang Abolmaesumi, and Teresa Tsang

End-to-End Myocardial Infarction Classification from Echocardiographic Scans 54
Mohamed Saeed and Mohammad Yaqub

View Classification of Color Doppler Echocardiography via Automatic Alignment Between Doppler and B-Mode Imaging 64
Jerome Charton, Hui Ren, Jay Khambhati, Jeena DeFrancesco, Justin Cheng, Anam A. Waheed, Sylwia Marciniak, Filipe Moura, Rhanderson Cardoso, Bruno B. Lima, Erik Steen, Eigil Samset, Michael H. Picard, Xiang Li, and Quanzheng Li

Segmentation and Reconstruction

AI-Enabled Assessment of Cardiac Systolic and Diastolic Function from Echocardiography 75
Esther Puyol-Antón, Bram Ruijsink, Baldeep S. Sidhu, Justin Gould, Bradley Porter, Mark K. Elliott, Vishal Mehta, Haotian Gu, Christopher A. Rinaldi, Martin cowie, Phil Chowienczyk, Reza Razavi, and Andrew P. King

Efficient Pix2Vox++ for 3D Cardiac Reconstruction from 2D Echo Views 86
David Stojanovski, Uxio Hermida, Marica Muffoletto, Pablo Lamata, Arian Beqiri, and Alberto Gomez

Left Ventricle Contouring of Apical Three-Chamber Views on 2D Echocardiography 96
Alberto Gomez, Mihaela Porumb, Angela Mumith, Thierry Judge, Shan Gao, Woo-Jin Cho Kim, Jorge Oliveira, and Agis Chartsias

Adnexal Mass Segmentation with Ultrasound Data Synthesis 106
Clara Lebbos, Jen Barcroft, Jeremy Tan, Johanna Müller, Matthew Baugh, Athanasios Vlontzos, Srdjan Saso, and Bernhard Kainz

Self-Knowledge Distillation for First Trimester Ultrasound Saliency Prediction 117
Mourad Gridach, Elizaveta Savochkina, Lior Drukker, Aris T. Papageorghiou, and J. Alison Noble

A Universal End-to-End Description of Pulse-Echo Ultrasound Image Reconstruction 128
Dongwoon Hyun

Assessment, Guidance and Robotics

Learning Generalized Non-rigid Multimodal Biomedical Image Registration from Generic Point Set Data 141
Zachary M. C. Baum, Tamas Ungi, Christopher Schlenger, Yipeng Hu, and Dean C. Barratt

Contact Force Prediction for a Robotic Transesophageal Ultrasound Probe via Operating Torque Sensing 152
Yiping Xie, Xilong Hou, Hongbin Liu, James Housden, Kawal Rhode, Zeng-Guang Hou, and Shuangyi Wang

Meta-registration: Learning Test-Time Optimization for Single-Pair Image Registration 162
Zachary M. C. Baum, Yipeng Hu, and Dean C. Barratt

Automatic Quality Assessment of First Trimester Crown-Rump-Length Ultrasound Images 172
Sevim Cengiz, Ibraheem Hamdi, and Mohammad Yaqub

Towards Multi-modal Self-supervised Video and Ultrasound Pose Estimation for Laparoscopic Liver Surgery 183
Nina Montaña-Brown, João Ramalhinho, Bongjin Koo, Moustafa Allam, Brian Davidson, Kurinchi Gurusamy, Yipeng Hu, and Matthew J. Clarkson

Author Index 193