

PROCEEDINGS OF SPIE

15th International Symposium on Medical Information Processing and Analysis

**Eduardo Romero
Natasha Lepore
Jorge Brieva**
Editors

**6–8 November 2019
Medellín, Colombia**

Organized by
SIPAIM Foundation
Instituto Tecnológico Metropolitano (Colombia)
Universidad Nacional de Colombia (Colombia)

Sponsored by
SIPAIM Foundation
Instituto Tecnológico Metropolitano (Colombia)
Universidad Nacional de Colombia (Colombia)

Endorsed by
MICCAI—The Medical Image Computing and Computer Assisted Intervention Society

Cosponsor and Publisher
SPIE

Volume 11330

Proceedings of SPIE 0277-786X, V. 11330

SPIE is an international society advancing an interdisciplinary approach to the science and application of light.

15th International Symposium on Medical Information Processing and Analysis,
edited by Eduardo Romero, Natasha Lepore, Jorge Brieva, Proc. of SPIE Vol. 11330,
1133001 · © 2020 SPIE · CCC code: 0277-786X/20/\$21 · doi: 10.1117/12.2565934

Proc. of SPIE Vol. 11330 1133001-1

The papers in this volume were part of the technical conference cited on the cover and title page. Papers were selected and subject to review by the editors and conference program committee. Some conference presentations may not be available for publication. Additional papers and presentation recordings may be available online in the SPIE Digital Library at SPIDigitalLibrary.org.

The papers reflect the work and thoughts of the authors and are published herein as submitted. The publisher is not responsible for the validity of the information or for any outcomes resulting from reliance thereon.

Please use the following format to cite material from these proceedings:

Author(s), "Title of Paper," in *15th International Symposium on Medical Information Processing and Analysis*, edited by Eduardo Romero, Natasha Lepore, Jorge Brieva, Proceedings of SPIE Vol. 11330 (SPIE, Bellingham, WA, 2020) Seven-digit Article CID Number.

ISSN: 0277-786X
ISSN: 1996-756X (electronic)

ISBN: 9781510634275
ISBN: 9781510634282 (electronic)

Published by

SPIE

P.O. Box 10, Bellingham, Washington 98227-0010 USA
Telephone +1 360 676 3290 (Pacific Time) · Fax +1 360 647 1445
SPIE.org

Copyright © 2020, Society of Photo-Optical Instrumentation Engineers.

Copying of material in this book for internal or personal use, or for the internal or personal use of specific clients, beyond the fair use provisions granted by the U.S. Copyright Law is authorized by SPIE subject to payment of copying fees. The Transactional Reporting Service base fee for this volume is \$21.00 per article (or portion thereof), which should be paid directly to the Copyright Clearance Center (CCC), 222 Rosewood Drive, Danvers, MA 01923. Payment may also be made electronically through CCC Online at copyright.com. Other copying for republication, resale, advertising or promotion, or any form of systematic or multiple reproduction of any material in this book is prohibited except with permission in writing from the publisher. The CCC fee code is 0277-786X/20/\$21.00.

Printed in the United States of America by Curran Associates, Inc., under license from SPIE.

Publication of record for individual papers is online in the SPIE Digital Library.

**SPIE. DIGITAL
LIBRARY**

SPIDigitalLibrary.org

Paper Numbering: *Proceedings of SPIE* follow an e-First publication model. A unique citation identifier (CID) number is assigned to each article at the time of publication. Utilization of CIDs allows articles to be fully citable as soon as they are published online, and connects the same identifier to all online and print versions of the publication. SPIE uses a seven-digit CID article numbering system structured as follows:

- The first five digits correspond to the SPIE volume number.
- The last two digits indicate publication order within the volume using a Base 36 numbering system employing both numerals and letters. These two-number sets start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B ... 0Z, followed by 10-1Z, 20-2Z, etc. The CID Number appears on each page of the manuscript.

Contents

vii	<i>Authors</i>
ix	<i>Conference Committee</i>
xiii	<i>Introduction</i>

ULTRASOUND II

11330 02	Feasibility of Nakagami parametric image for texture analysis [11330-6]
11330 03	Analysis and classification of lung tissue in ultrasound images for pneumonia detection [11330-48]
11330 04	A low-cost multi-modal medical imaging system with fringe projection profilometry and 3D freehand ultrasound [11330-49]
11330 05	Speckle noise reduction in echocardiography using a bank of filters based on oriented structuring elements [11330-57]

DIGITAL PATHOLOGY I

11330 06	Histopathology color image processing in prostate carcinoma [11330-16]
11330 07	Cell density features from histopathological images to differentiate non-small cell lung cancer subtypes [11330-17]
11330 08	Nuclear density analysis in microscopic images for the characterization of retinal geographic atrophy [11330-11]
11330 09	Differentiating clear cell renal cell carcinoma from oncocytoma using curvelet transform analysis of multiphase CT: preliminary study [11330-1]
11330 0A	An exploratory study of one-shot learning using Siamese convolutional neural network for histopathology image classification in breast cancer from few data examples [11330-56]

BODY IMAGING I

11330 0B	Adaptive frequency saliency model based on convolutional neural networks: a case study for prostate cancer MRI [11330-36]
----------	--

- 11330 OC **A K^{trans} deep characterization to measure clinical significance regions on prostate cancer**
[11330-44]
- 11330 OD **An inception deep architecture to differentiate close-related Gleason prostate cancer scores**
[11330-66]
- 11330 OE **An empirical study on global bone age assessment** [11330-18]
- 11330 OF **Precise human pose estimation based on two-dimensional images for kinematic analysis**
[11330-24]

BRAIN AND OCULAR IMAGING

- 11330 OG **Learning to segment brain tumors** [11330-31]
- 11330 OH **Morphometric Gaussian process for landmarking on grey matter tetrahedral models** [11330-23]
- 11330 OI **Enhancing DW images spatial resolution using correlated gradient information** [11330-26]
- 11330 OJ **Hypothalamus fully automatic segmentation from MR images using a U-Net based architecture**
[11330-40]
- 11330 OK **A lightweight deep learning model for mobile eye fundus image quality assessment** [11330-67]

BRAIN IMAGING

- 11330 OL **Radiomics-based differentiation of pleomorphic adenomas and Warthin tumors of salivary glands** [11330-68]
- 11330 OM **Sulci characterization to predict progression from mild cognitive impairment to Alzheimer's disease** [11330-5]
- 11330 ON **Long-term neuroanatomical effects of germ cell tumors after cranial radiation therapy**
[11330-70]
- 11330 OO **Characterizing local brain aging patterns in healthy subjects in structural magnetic resonance images** [11330-32]

BIOSIGNALS

- 11330 OP **Non-contact breathing rate monitoring system using a magnification technique and convolutional networks** [11330-15]
- 11330 OQ **A deblurring model for super-resolution MRI interpolated images** [11330-39]

- 11330 OR **Dynamic low-frequency fluctuations of resting brain in attention deficit hyperactivity disorder** [11330-45]
- 11330 OS **Hidden Markov model-based heartbeat detector using different transformations of ECG and ABP signals** [11330-58]

ULTRASOUND I

- 11330 OT **A regularized quantitative ultrasound method for simultaneous calculation of backscatter and attenuation coefficients** [11330-19]
- 11330 OU **A novel portable device for crawling waves sonoelastography: experimental study** [11330-22]
- 11330 OV **Validation of high-frequency ultrasound crawling waves sonoelastography** [11330-46]

DIGITAL PATHOLOGY II

- 11330 OW **Analysis of cutaneous leishmaniasis hyperspectral images by means of an inverse modeling procedure** [11330-13]
- 11330 OX **Slope-chain-code-based characterization of Trypanosoma cruzi in blood smear images** [11330-10]
- 11330 OY **Supervised learning for semantic segmentation of human spermatozoa** [11330-21]

MOTION AND GAIT ANALYSIS

- 11330 OZ **Retraining random forest algorithm for lower limb prosthesis tracking using an RGB-D camera** [11330-25]
- 11330 10 **Characterizing the gait dynamic by estimating Lyapunov exponents on gait kinematic trajectories in Parkinson's disease** [11330-33]
- 11330 11 **Biomechanical influence of a cane as an assistive device for a drop foot patient** [11330-41]
- 11330 12 **Biomechanical evaluation of a plantar orthosis for a Linear Morphea patient** [11330-53]
- 11330 13 **Discriminating cerebral palsy by quantifying ocular motion** [11330-34]

E-HEALTH

- 11330 14 **Modeling of motion artifacts on PPG signals for heart-monitoring using wearable devices** [11330-7]
- 11330 15 **Organizational behavior: psychophysiology assessment of leadership and management in team work and conflict resolution** [11330-62]
- 11330 16 **Towards a machine learning-based approach to forecasting Dengue virus outbreaks in Colombian cities: a case-study: Medellin, Antioquia** [11330-63]

BODY IMAGING II

- 11330 17 **Automatic polyp localization by low level superpixel features** [11330-38]
- 11330 18 **Melanoma detection on dermoscopic images using superpixels segmentation and shape-based features** [11330-54]
- 11330 19 **Design of a multilayer neural network for the classification of skin ulcers' hyperspectral images: a proof of concept** [11330-14]
- 11330 1A **Automatic segmentation of the left ventricle myocardium by a multi-view deformable model** [11330-37]
- 11330 1B **A novel method for the design of convolutional gray-level templates for the automatic detection of coronary arteries** [11330-27]
- 11330 1C **Inter-hemispheric asymmetry patterns in the ADHD brain: a neuroimaging replication study** [11330-61]

Authors

Numbers in the index correspond to the last two digits of the seven-digit citation identifier (CID) article numbering system used in Proceedings of SPIE. The first five digits reflect the volume number. Base 36 numbering is employed for the last two digits and indicates the order of articles within the volume. Numbers start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B...0Z, followed by 10-1Z, 20-2Z, etc.

Altuve, Miguel, 0S
Alvarez-Jimenez, Charlems, 07, 0B
Ancajima, Pedro A., 0U
Anderson, Ariana, 1C
Arámbula Cosío, Fernando, 04
Arbeláez, Pablo, 0E, 0F, 0G
Areiza-Laverde, Henry J., 0L
Arevalo, John, 0C
Aron, Manju, 09
Atehortúa, Angélica, 05, 1A
Baron Nelson, Mary, 0N
Beltran, Miguel A., 1A
Botina-Monsalve, Deivid, 0W
Branch-Bedoya, John W., 16, 18
Bravo, Diego, 17
Brea, Beatriz, 0L
Bribiesca, Ernesto, 0X
Brieva, Jorge, 08, 0P
Cajas, Sebastián Andrés, 14
Cano, Fabian, 0A
Carmona Jaramillo, Daniel, 19
Caro, Miguel, 0O
Carrillo-Bermejo, Angel, 0X, 0Z
Castañeda, Benjamín, 0U, 0V
Castro-Ospina, Andrés E., 0L
Ceballos-Arroyo, Alberto M., 16, 18
Cen, Steven Y., 09
Cervantes-Sanchez, Fernando, 1B
Chang, Michael, 02
Chapman, Nicholas, 0N
Christov-Moore, Leonardo, 1C
Ciuderis, Karl, 16
Coila, Andres, 0T
Comach, Guillermo, 16
Contreras-Ojeda, Sara, 03, 04
Contreras-Ortiz, Sonia H., 03, 04
Coral-Vazquez, Ramon, 08
Cruz-Aceves, Ivan, 1B
Cruz-Roa, Angel, 0A
Daza, Laura, 0E, 0G
Delrieux, Claudio A., 0Y
Desai, Mihir, 09
Díaz, Gloria M., 0L
Domínguez-Jiménez, J. A., 03
Douglas, Pamela K., 1C
Duddalwar, Vinay A., 02, 09
Dutta, Cintya Nirvana, 1C
Escobar, John E., 19
Escobar, María Camila, 0E
Estrada-Mena, Francisco J., 08
Fan, Yonghui, 0H
Franca, Marcondes, 0J
Fuentes, José, 0Q
Gajawelli, Niharika, 0N
Galeano, July, 0W, 19
Garzón, Johnson, 0W
Giraldo, Diana L., 0M, 0O
Gómez Hernández, Marina, 11
Gómez, Catalina, 0G
Gómez, Martín, 17
Gómez-Mendoza, Juan Bernardo, 06
González, Cristina, 0E
Gonzalez, Eduardo A., 0U
González, Fabio A., 0B, 0K
González, July, 13
González-José, Rolando, 0Y
Gonzalez-Mejia, Emilio, 0X
Gunter, Jamie, 02
Gutiérrez, Yesid, 0C
Haro, Paulina, 0X
Hernández-Aguirre, Arturo, 1B
Hernandez, Ana Luisa, 0J
Hernández-González, Martha A., 1B
Hernandez-Ortiz, Juan P., 16
Herrera, Diana Sofia, 0F
Hevia-Montiel, Nidiyare, 0X, 0Z
Huegel, Joel C., 0Z
Hwang, Darryl H., 02, 09
Ibarguen, Y. S., 12
Jara-Hurtado, Jorge Daniel, 05
Jog, Chinmay, 09
Kaur, Pashmeen, 1C
Koch, Zane, 1C
Landínez, María Alejandra, 14
Lavarello, Roberto J., 0T
Lee, Kwang J., 02
León, Fabian, 0D
Lepore, Natasha, 0H, 0N
Lira-Romero, Esmeralda, 08
Londoño Márquez, Diana M., 11
Londoño, S., 12
López, A., 12
López, Diego Mauricio, 14
Lopez, Juan M., 15
Lopez-Bueno, J., 03
Maldonado-Perez, Daniel, 16
Malpica-González, Norberto, 0L
Marrugo, Andrés G., 04

Martínez, Fabio, 0C, 0D
 Marzani, Franck, 0W
 Mesa-Yepes, Hugo, 16
 Meza, Jhacson, 04
 Monroy, Nelson F., 0S
 Moreno, Jesús E., 15
 Mosquera-Zamudio, Andres, 07
 Moya-Albor, Ernesto, 08, 0P
 Múnera Garzón, Nicolás, 0B
 Murillo, Javier, 0W
 Nelson, Marvin D., 0N
 Ochoa Gómez, John Fredy, 0R
 Olaya Mira, Natali, 11
 Olch, Arthur, 0N
 Ortíz Dávila, Carlos Alberto, 05
 Osorio-Benitez, Jorge E., 16
 Patiño, Diego, 18
 Pava-Marín, Rafael, 06
 Pava-Ripoll, Álex Enrique, 06
 Peralta-Ildfonso, Martha J., 08
 Perdomo, Oscar, 0K
 Pérez, Andrés D., 0K
 Perez, Laura, 16
 Perez-Gonzalez, Jorge, 0X, 0Z
 Perez-Ortiz, Andric C., 08
 Pineda, Gustavo, 10, 13
 Plazas, Miguel, 0D
 Ponce, Hiram, 0P
 Puche, Aura C., 0R
 Pulido, Sergio D., 15
 Revollo, Natalia V., 0Y
 Rezende, Thiago, 0J
 Ricaurte, David, 10
 Rittner, Leticia, 0J
 Robledo, Sara M., 0W
 Rodrigues, Livia, 0J
 Rodriguez Z., Keveen, 0R
 Rodriguez-Rodriguez, Jairo A., 18
 Rojas Martínez, Sara, 0F
 Roldán, Nicolas, 15
 Romero, Eduardo, 05, 07, 0B, 0I, 0M, 0O,
 10, 13, 17, 1A
 Romero, Lenny A., 04
 Romero, Stefano E., 0T, 0U, 0V
 Rosado-Vallado, Miguel, 0X
 Ruano, Josué, 17
 Ruiz, Jorge Mauricio, 0Q
 Saavedra, Ana C., 0V
 Salguero, Jennifer, 0I
 Sanchez-Torres, German, 18
 Sandino, Álvaro Andrés, 05, 07
 Serrano Delgado, Daya, 15
 Silva, Santiago, 0M, 13
 Simarra, Pedro, 04
 Solorio-Meza, Sergio, 1B
 Soto Cardona, Isabel C., 11
 Suárez Patiño, Laura V., 11
 Tanedo, Jeffrey, 0N
 Tecse, Aldo, 0V
 Thomsen, Felix S. L., 0Y
 Toro-Castaño, Paula Andrea, 06
 Toro-García, Nicolás, 06
 Torres, Felipe, 0E
 Torres-Madronero, María C., 0W, 19
 Triana, Gustavo, 0E
 Tsao, Sinchai, 0N
 Valdes-Burgos, L., 03
 Valencia Cadena, Sebastián, 11
 Vargas-López, Julián David, 06
 Varghese, Bino A., 02, 09
 Vasheghani-Farahani, Farzad, 1C
 Velasco, Nelson, 0I
 Viloria, C., 12
 Viswanath, Satish E., 07
 Wang, Yalin, 0H
 Wong, Kenneth, 0N
 Zanesco, Ariane, 0J
 Zarzycki, Artur, 0W

Conference Committee

Conference Chairs

Eduardo Romero, Universidad Nacional de Colombia (Colombia)
Natasha Lepore, The University of Southern California (United States)
Jorge Brieva, Universidad Panamericana (Mexico)

Local Organizing Committee

Gloria M. Díaz, *Local Chair*, Instituto Tecnológico Metropolitano (Colombia)
Jairo José Espinosa, Universidad Nacional de Colombia (Colombia)
Eduardo Romero, Universidad Nacional de Colombia (Colombia)

Communication Chair

Marius Linguraru, Children's National Hospital (United States)

Sponsorships Chair

Mathieu Dehaes, Université de Montréal (Canada)

Program Committee

Eduardo Romero, Universidad Nacional de Colombia (Colombia)
Natasha Lepore, The University of Southern California (United States)
Jorge Brieva, Universidad Panamericana (Mexico)

Reviewers

Javier Adur, Universidad Nacional de Entre Ríos (Argentina)
Miguel Altuve, Universidad Pontificia Bolivariana (Colombia)
Antonio Bravo, Universidad Nacional Experimental del Táchira (Venezuela)
Jorge Brieva, Universidad Panamericana (Mexico)
Germán Castellanos, Universidad Nacional de Colombia (Colombia)
Patricia Cifuentes, Health Information Systems PAHO/WHO (United States)
Olivier Coulon, Aix-Marseille Université (France)
Germán Corredor, Case Western Reserve University (United States)
Angel Alfonso Cruz, Universidad de los Llanos (Colombia)
Mathieu Dehaes, CHU Sainte-Justine (Canada)
Gloria M. Díaz, Instituto Tecnológico Metropolitano (Colombia)
Niharika Gajawelli, The University of Southern California (United States)
Fabio A. González, Universidad Nacional de Colombia (Colombia)
Darryl H. Hwang, The University of Southern California (United States)
Nidiyare Hevia, Universidad Nacional Autónoma de México (Mexico)

Marcela Guerrero, Universidad Militar Nueva Granada (Colombia)
Andrew Janowczyk, Case Western Reserve University (United States)
Alexandra La Cruz, Universidad Simón Bolívar (Venezuela)
Ignacio Larrabide, University Nacional del Centro de la Provincia de Buenos Aires (Argentina)
Natasha Lepore, The University of Southern California (United States)
Marius Lingurar, Children's National Medical Center (United States)
Norberto Malpica, Universidad Rey Juan Carlos (Spain)
Antoine Manzanera, ENSTA Paris Tech (France)
Fabio Martínez, Universidad Industrial de Santander (Colombia)
Ernesto Moya Albor, Universidad Panamericana (Mexico)
Mohammadreza Negahdar, IBM (United States)
Gian Franco Passariello, Universidad Simón Bolívar (Venezuela)
Angelica Perez Fornos, University of Geneva (Switzerland)
Prateek Prasanna, Case Western Reserve University (United States)
Katya Rodríguez-Vázquez, Universidad Nacional Autónoma de México (Mexico)
Eduardo Romero, Universidad Nacional de Colombia (Colombia)
David Romo, Medical University of Vienna (Austria)
Mathieu Rubeaux, KEOSYS Medical Imaging (France)
Olivier Salvado, CSIRO (Australia)
Cristina Santa Marta, National Distance Education University (Spain)
Emanuele Schiavi, Universidad Rey Juan Carlos (Spain)
Rakesh Shiradkar, Case Western Reserve University (United States)
Jeffrey Tanedo, The University of Southern California (United States)
Pallavi Tiwari, Case Western Reserve University (United States)
Ramiro Velazquez, Universidad Panamericana (Mexico)
Satish Viswanath, Case Western Reserve University (United States)
María Zuluaga, EURECOM (France)

Session Chairs

- 1 Ultrasound II
Juan David Martínez, Instituto Tecnológico Metropolitano (Colombia)
- 2 Digital Pathology I
Maria Constanza Torres, Instituto Tecnológico Metropolitano (Colombia)
- 3 Body Imaging I
Jorge Brieva, Universidad Panamericana (Mexico)
- 4 Brain and Ocular Imaging
Darryl H. Hwang, The University of Southern California (United States)
- 5 Brain Imaging
Sean Deoni, Brown University (United States)

- 6 Biosignals
 Darryl H. Hwang, The University of Southern California (United States)
- 7 Digital Pathology I
 Angel Alfonso Cruz, Universidad de los Llanos (Colombia)
- 8 Ultrasound I
 Ernesto Moya Albor, Universidad Panamericana (Mexico)
- 9 Motion and Gait Analysis
 Fabio Martínez, Universidad Industrial de Santander (Colombia)
- 10 E-Health
 Eduardo Romero, Universidad Nacional de Colombia (Colombia)
- 11 Body Imaging II
 Letícia Rittner, Universidade Estadual de Campinas (Brazil)

Introduction

The papers in this volume were part of those submitted to the 15th International Symposium on Medical Information Processing and Analysis (SIPAIM 2019). The event, which was held in Medellín, Colombia, has evolved from a small meeting to an international symposium in which researchers from Latin America interact with each other and with their peers from around the world.

SIPAIM is focused on bringing together the Latin American medical image analysis and information processing communities, and on creating a forum in which to discuss recent results, ongoing research and future projects and collaborations, both within Latin America, and with researchers around the world. SIPAIM is addressed to researchers, students and professionals in a wide range of disciplines including engineering, physics, mathematics, computer science, biology and health sciences. This year's meeting was to include keynote lectures by four recognized experts in pattern recognition, image analysis, data mining, magnetic resonance imaging, and clinical pathology.

We had 47 papers accepted for oral presentations this year after being reviewed by experts in the area. The wide array of subjects, ranging from digital pathology to gait analysis and from e-health to fetal and pediatric brain imaging, bears witness to the growing importance of medical and biomedical research among the region's researchers, and points to many opportunities for international collaborations.

The editors would like to thank the authors, reviewers, and committee members, without whom the present volume would not have been possible. Likewise, we would like to thank SPIE whose role as cosponsor has improved the quality and visibility of the SIPAIM proceedings year after year. Finally, we were also endorsed by the MICCAI society, and would like to thank them for their help in publicizing the conference.

Eduardo Romero
Natasha Lepore
Jorge Brieva

