

PROCEEDINGS OF SPIE

14th International Symposium on Medical Information Processing and Analysis

Eduardo Romero
Natasha Lepore
Jorge Brieva
Editors

24–26 October 2018
Mazatlán, Mexico

Organized by
SIPAIM Foundation
Universidad Politécnica de Sinaloa (Mexico)
Universidad Panamericana (Mexico)

Sponsored by
SIPAIM Foundation
Universidad Politécnica de Sinaloa (Mexico)
Universidad Panamericana (Mexico)
INAPI Sinaloa (Mexico)
MICCAI—Medical Image Computing and Computer Assisted Intervention

Published by
SPIE

Volume 10975

Proceedings of SPIE 0277-786X, V. 10975

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

14th International Symposium on Medical Information Processing and Analysis,
edited by Eduardo Romero, Natasha Lepore, Jorge Brieva, Proc. of SPIE Vol. 10975,
1097501 · © 2018 SPIE · CCC code: 0277-786X/18/\$18 · doi: 10.1117/12.2524856

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 SPIEDigitalLibrary.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 *14th International Symposium on Medical Information Processing and Analysis*, edited by Eduardo Romero, Natasha Lepore, Jorge Brieva, Proceedings of SPIE Vol. 10975 (SPIE, Bellingham, WA, 2018) Seven-digit Article CID Number.

ISSN: 0277-786X

ISSN: 1996-756X (electronic)

ISBN: 9781510626058

ISBN: 9781510626065 (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 © 2018, 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 \$18.00 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/18/\$18.00.

Printed in the United States of America.

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



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

BIOSIGNALS I

10975 02	Parkinsonian gait characterization from regional kinematic trajectories [10975-32]
10975 03	Parkinsonian hand tremor characterization from magnified video sequences [10975-43]
10975 04	Non-contact breathing rate monitoring system based on a Hermite video magnification technique [10975-48]

BIOSIGNALS II

10975 05	A benchmark of heart sound classification systems based on sparse decompositions [10975-14]
10975 06	Emotion detection through biomedical signals: a pilot study [10975-36]
10975 07	Induced EEG activity during the IAPS tests and avEMT in intimate partner violence against women [10975-37]
10975 08	Analysis of biological signals through LabVIEW software with possible application in the measurement of variables related to sleep apnea syndrome [10975-42]

E-HEALTH AND REHABILITATION

10975 09	An intelligent ecosystem to improve the information access and knowledge development about sexual and reproductive health on deaf women in Cuenca, Ecuador [10975-5]
10975 0A	IS²MoD: an interactive system based on expert systems and Kinect devices to support the motor rehabilitation and development of children with disabilities [10975-13]
10975 0B	Classification of abdominal ECG recordings for the identification of fetal risk using random forest and optimal feature selection [10975-26]

10975 0C **Thoughts and emotion assimilation and detonation through VR for people with ASD** [10975-45]

MEDICAL IMAGING I

- 10975 0D **Flexible automatic algorithm for comet assay analysis** [10975-16]
- 10975 0E **Automatic detection of colorectal polyps larger than 5 mm during colonoscopy procedures using visual descriptors** [10975-31]
- 10975 0F **Extracting multiscale patterns for classification of non-small cell lung cancer in CT images** [10975-46]
- 10975 0G **An automatic system for spermiogram analysis based on image processing techniques and support vector machines** [10975-49]

MEDICAL IMAGING II

- 10975 0H **LungAIR: an automated technique to predict hospitalization due to LRTI using fused information** [10975-15]
- 10975 0I **3D deep convolutional neural network for predicting neurosensory retinal thickness map from spectral domain optical coherence tomography volumes** [10975-35]
- 10975 0J **MR fat segmentation and quantification for abdominal volumetric and composition analysis** [10975-50]

BRAIN IMAGING I

- 10975 0K **Fine tuning VBM for mouse brain analysis: model adjustment using atrophy simulation** [10975-3]
- 10975 0L **Voxelwise meta-analysis of brain structural associations with genome-wide polygenic risk for Alzheimer's disease** [10975-6]
- 10975 0M **Robust automatic corpus callosum analysis toolkit: mapping callosal development across heterogeneous multisite data** [10975-7]
- 10975 0N **Intrapatient multimodal medical image registration of brain CT-MRI 3D: an approach based on metaheuristics** [10975-8]
- 10975 0O **Ranking diffusion tensor measures of brain aging and Alzheimer's disease** [10975-9]
- 10975 0P **ENIGMA pediatric msTBI: preliminary results from meta-analysis of diffusion MRI** [10975-12]

BRAIN IMAGING II

- 10975 0Q **A study of single subject VBM and DARTEL on healthy subjects** [10975-20]
- 10975 0R **Description of brain volumetric changes in Alzheimer disease using region-based morphometry** [10975-22]
- 10975 0S **Automatic classification of cortical thickness patterns in Alzheimer's disease patients using the Louvain modularity clustering method** [10975-30]
- 10975 0T **Sulcal-based morphometry in Parkinson's disease: a study of reliability and disease effects** [10975-33]
- 10975 0U **Alternative diffusion anisotropy measures for the investigation of white matter alterations in 22q11.2 deletion syndrome** [10975-51]
- 10975 0V **Treatment related DTI changes in the posterior thalamic radiation in survivors of childhood posterior fossa tumors** [10975-52]

DIGITAL PATHOLOGY

- 10975 0W **A comparative analysis of sensitivity of convolutional neural networks for histopathology image classification in breast cancer** [10975-39]
- 10975 0X **A method to detect glands in histological gastric cancer images** [10975-41]
- 10975 0Y **Supervised online matrix factorization for histopathological multimodal retrieval** [10975-47]
- 10975 0Z **A visualization, navigation, and annotation system for dermatopathology training** [10975-38]

ULTRASOUND

- 10975 11 **Characterization of uterine-cervix phantoms' elasticity using texture features extracted from US images** [10975-10]
- 10975 12 **Fully automatic segmentation and measurement of the fetal femur** [10975-23]
- 10975 13 **Segmentation and motion estimation applied to fetal heart analysis using a multi-texture active appearance model and an optical flow approach** [10975-44]
- 10975 14 **Shape model and Hermite features for the segmentation of the cerebellum in fetal ultrasound** [10975-17]

CARDIAC IMAGING

- 10975 15 **Automatic segmentation of the left ventricle myocardium in congenital heart diseases by saliency features** [10975-25]
- 10975 16 **Automatic centerline extraction of left coronary artery from x-ray rotational angiographic images** [10975-27]
- 10975 17 **A new binary descriptor for the automatic detection of coronary arteries in x-ray angiograms** [10975-29]
- 10975 18 **A local multiscale variational approach for left ventricle analysis in cardiac images** [10975-34]

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.

- | | |
|--|--|
| Acero Triviño, María Paula, 07 | Corlier, Fabian W., 0S |
| Agudelo-Otálora, Luis M., 08 | Corredor, Germán, 0X, 0Z |
| Alba Ferrara, Lucia, 0Q | Craig, Michael, 0U |
| Alfonso, Sunny, 0X | Cruz-Aceves, Ivan, 17 |
| Alonso-Arévalo, Miguel A., 05 | Cruz-Roa, Angel, 0W |
| Alvarez Jimenez, Charlems, 0F | Cuervo-Rayó, Fernando A., 08 |
| Amini, Armand, 0M, 0T | Cunningham, Adam C., 0U |
| Antshel, Kevin M., 0U | Daly, Eileen, 0U |
| Arámbula Cosío, Fernando, 14 | Delrieux, Claudio A., 0G |
| Arias, Viviana, 0Z | Dennis, Emily L., 0P |
| Asarnow, Robert F., 0P | Ding, Linda, 0L |
| Atehortúa, Angélica, 15 | Doherty, Joanne, 0U |
| Auzias, Guillaume, 0T | Domínguez-Jiménez, J. A., 06 |
| Babikian, Talin, 0P | Dorothee, Guillaume, 0S |
| Bakker, Geor, 0U | Duarte, Juan, 0R |
| Barba-J., Leiner, 18 | Duddalwar, Vinay A., 0J |
| Barbeito-Andrés, Jimena, 0K | Durdle, Courtney A., 0U |
| Baron Nelson, M., 0V | Emanuel, Beverly, 0U |
| Barrera, Cristian R., 0X | Escalante-Ramírez, Boris, 0B, 13, 14, 18 |
| Bearden, Carrie E., 0U | Espitia, Catalina, 07 |
| Beltran, Miguel A., 15 | Faicán-Ulloa, M. B., 0A |
| Bendersky, Mariana, 0Q | Faskowitz, Joshua I., 0L, 0T |
| Bermúdez, Valmore, 16 | Forsyth, Jennifer K., 0U |
| Bernstein, Matthew A., 0O | Fremont, Wanda, 0U |
| Bertin, Nancy, 05 | Gajawelli, N., 0V |
| Bocanegra Pérez, Álvaro J., 0D | Galán-Montesdeoca, J., 09 |
| Borowski, Bret, 0O | García Segundo, Crescencio, 11 |
| Bottlaender, Michel, 0S | Garnica, Daniel Colín, 12 |
| Braggio, Delfina, 0K, 0Q | Giménez, Gabriel A., 0N |
| Braskie, Meredith N., 0S | Giraldo, Diana L., 0R |
| Bravo, Antonio, 16 | Giraldo-Cadavid, Luis F., 08 |
| Bravo, Diego, 0E | Giza, Christopher C., 0P |
| Brieva, Jorge, 04, 0C, 13 | Gómez, Martín, 0E |
| Caeyenberghs, Karen, 0P | González, Fabio A., 0I, 0Y |
| Camargo Marín, Lisbeth, 0B, 11, 12, 13 | Gonzalez, Paula, 0K |
| Campbell, Linda E., 0U | González-Álvarez, Alexandra, 07 |
| Campo-Landines, K. C., 06 | González-José, Rolando, 0G |
| Cañete Alavez, Mariela, 0C | Goodrich-Hunsaker, Naomi J., 0U |
| Cano, Fabian, 0W | Guayacán, Luis C., 02 |
| Cárdenas-Poveda, D. Carolina, 07 | Gudbrandsen, Maria, 0U |
| Castro-Benavides, Adolfo, 08 | Guillén-Ramírez, Hugo A., 05 |
| Castro-Sigüenza, M., 0A | Gur, Raquel E., 0U |
| Cervantes-Sánchez, Fernando, 17 | Guzmán Huerta, Mario, 0B, 11, 12, 13 |
| Cespedes, Pedro P., 0N | Håberg, Asta, 0L |
| Chacón, Gerardo, 16 | Hansen, Laura, 0U |
| Ching, Christopher R. K., 0U | Hernández-González, Martha A., 17 |
| Contreras, Sergio, 03 | Hernandez-Mosti, Juan P., 0C |
| Contreras, Victor H., 0Y | Hwang, Darryl H., 0J |
| Contreras-Ortiz, S. H., 06 | Ibarra-Hernández, Roilhi F., 05 |

- Ingavélez-Guerra, P., 09, 0A
 Izetta R., Javier, 0G
 Jack, Clifford R., Jr., 0O
 Jahanshad, Neda, 0L, 0M, 0O, 0P, 0T, 0U
 Jalbrzikowski, Maria, 0U
 Javier, Alma Delia, 12
 Jonas, Rachel K., 0U
 Kates, Wendy R., 0U
 Kochunov, Peter, 0P, 0T
 Kothapalli, Deydeep, 0U
 Kulsgaard, Hernan Claudio, 0Q
 Kushan, Leila, 0U
 Lagarde, Julien, 0S
 Lara, Juan S., 0Y
 Larrabide, Ignacio, 0K, 0Q
 Legal-Ayala, Horacio, 0N
 Lepore, Natasha, 0V
 Levin, Harvey, 0P
 Lin, Amy, 0U
 Linden, David E. J., 0U
 Linguraru, Marius George, 0H
 Londoño Hoyos, Francisco J., 0D
 López López, Juan M., 07, 0D
 Lopez, Lorenzo, 0N
 Madabhushi, Anant, 0W
 Madriz, Delia, 16
 Maglioni, Sebastian, 0R
 Mangin, Jean-François, 0T
 Mansoor, Awais, 0H
 Martínez, Fabio, 02, 03
 Martínez-León, V., 0A
 Martínez-Santos, J. C., 06
 McCabe, Kathryn L., 0U
 McDonald-McGinn, Donna, 0U
 Medina-Bañuelos, Verónica, 11, 12
 Mejía-Soto, Eliana, 07
 Mohamed, Passant, 0J
 Moncayo, Ricardo, 0X
 Mora-Gutiérrez, Román Anselmo, 0B
 Moscoso-Barrera, William D., 08
 Moss, Hayley, 0U
 Moya-Albor, Ernesto, 04, 0C, 13
 Moyer, Daniel, 0S, 0T
 Murphy, Clodagh, 0U
 Murphy, Declan, 0U
 Nino, Gustavo, 0H
 Nir, Talia M., 0O, 0U
 Olsen, Alexander, 0P
 Olveres, Jimena, 14
 Ondo Méndez, Alejandro O., 0D
 Orozco Flores, Mónica, 11
 Owen, Michael, 0U
 Oyola-Flores, C., 09
 Palmer, Suzanne L., 0J
 Perdomo, Oscar J., 0I, 0Y
 Perez, Geovanny, 0H
 Perez-Gonzalez, Jorge, 0B, 11, 12
 Pérez-Muñoz, Á., 0A
 Pesántez-Avilés, F., 09
 Pinto-Roa, Diego, 0N
 Pires, Ricardo, 0M
 Pizzagalli, Fabrizio, 0T
 Ponce, Hiram, 04
 Ponsich, Antonín, 0B
 Potier, Marie Claude, 0S
 Prado-Rivera, Mayerli Andrea, 07
 Prieto Rodríguez, Scarlet, 0B, 11, 12
 Pulido Castro, Sergio D., 0D
 Rashid, Faisal, 0T
 Reid, Robert I., 0O
 Revollo, Natalia V., 0G
 Reyes López, Misael, 14
 Reza Becerril, Diego, 0C
 Rios, Hernan A., 0I
 Rivas-Scott, Orlando, 04
 Rivière, Denis, 0T
 Rizo-Arévalo, Alejandra, 07
 Roalf, David, 0U
 Robles-Bykbaev, V., 09, 0A
 Robles-Bykbaev, Y., 09, 0A
 Rodríguez, Francisco J., 0I
 Rodríguez, Johel, 16
 Romero, Eduardo, 0E, 0F, 0R, 0X, 0Z, 15
 Ruano, Josué, 0E
 Ruparel, Kosha, 0U
 Salazar, Isail, 03
 Sanchez, Angel Y., 0X
 Sandino, Alvaro Andrés, 0F
 Sarazin, Marie, 0S
 Saremi, Arvin, 0L, 0M
 Schmitt, J. Eric, 0U
 Serrano Delgado, Daya, 0D
 Simon, Tony J., 0U
 Solórzano-Guerrero, P., 0A
 Sun, Daqiang, 0U
 Tanedo, J., 0V
 Tate, David, 0P
 Thomopoulos, Sophia I., 0O
 Thompson, Paul M., 0L, 0M, 0O, 0P, 0S, 0T, 0U
 Toro, Paula, 0X, 0Z
 Torres Robles, Fabián, 0B, 11
 Tsao, S., 0V
 Vaillard Martínez, Judith, 0C
 Vajdi, Ariana, 0U
 Valdés Cristerna, Raquel, 12
 Valenzuela, Brayan, 02
 Vallejo Venegas, Enrique, 18
 van Amelsvoort, Therese, 0U
 van den Bree, Marianne, 0U
 Vargas-Quintero, Lorena, 13
 Vazquez, Jose L., 0N
 Velasco, Nelson, 0R
 Velázquez-Perez, Jose Luis, 07
 Vera, Miguel, 16
 Villalon-Reina, Julio E., 0U
 Weiner, Michael W., 0O
 Wilde, Elisabeth, 0P
 Zavaliangos-Petropulu, Artemis, 0O
 Zhu, Alyssa H., 0L, 0M

Conference Committee

Conference Chairs

Eduardo Romero, University Nacional de Colombia (Colombia)
Natasha Lepore, Children's Hospital of Los Angeles, The University of Southern California (United States)
Jorge Brieva, Universidad Panamericana (Mexico)

Local Organizing Committee

Manuel Alejandro Lugo Villeda, Chair, Universidad Politécnica de Sinaloa (Mexico)
Juan Rodolfo Maestre Rendón, Universidad Politécnica de Sinaloa (México)
Arturo Alfonso Fernández Jaramillo, Universidad Politécnica de Sinaloa (Méjico)

Program Committee

Eduardo Romero, University Nacional de Colombia (Colombia)
Natasha Lepore, Children's Hospital of Los Angeles, 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)
Fernando Arámbula, Universidad Nacional Autónoma de Mexico (Mexico)
Antonio Bravo, Universidad Nacional Experimental del Táchira (Venezuela)
Jorge Brieva, Universidad Panamericana (Mexico)
Germán Castellanos, Universidad Nacional de Colombia (Colombia)
Alexander Cerquera, Universidad Antonio Nariño (Colombia)
Julie Coloigner, The University of Southern California (United States)
Olivier Coulon, Aix-Marseille Université (France)
Angel Alfonso Cruz, Universidad de Los Llanos (Colombia)
Boris Escalante-Ramírez, Universidad Nacional Autónoma de México (Mexico)
Alejandro Frangi, University of Leeds (United Kingdom)
Juan David García, Universidad Nacional de Colombia (Colombia)
Edgar Garduño, Universidad Nacional Autónoma de México (Méjico)

Diego Gomez, Universidad Antonio Nariño (Colombia)
Fabio González, Universidad Nacional de Colombia (Colombia)
Ricardo Gutiérrez, Universidad Nacional de Colombia (Colombia)
Alfredo Hernández, Université de Rennes 1 (France)
Nidiyare Hevia, Universidad Nacional Autónoma de Mexico (Mexico)
Marcela Iregui, Universidad Militar Nueva Granada (Colombia)
Yi Lao, The University of Southern California (United States)
Ignacio Larrabide, Universidad Nacional del Centro de la Provincia de Buenos Aires (Argentina)
Natasha Lepore, Children's Hospital of Los Angeles, The University of Southern California (United States)
José Vicente Manjón, Universidad Politécnica de València (Spain)
Fabio Martínez, Universidad Industrial de Santander (Colombia)
Ernesto Moya-Albor, Universidad Panamericana (Mexico)
Natacha Paquette, Children's Hospital Los Angeles (United States)
Gian Franco Passariello, Universidad Simón Bolívar (Venezuela)
Daniel Racoceanu, Pontifical Catholic University of Peru (Peru)
Oscar David Robles, Universidad Rey Juan Carlos (Spain)
Luis Eduardo Rodríguez, Escuela Colombiana de Ingeniería Julio Garavito (Colombia)
Eduardo Romero, Universidad Nacional de Colombia (Colombia)
David Romo, Universidad Nacional de Colombia (Colombia)
Mathieu Rubeaux, KEOSYS Medical Imaging (France)
Andrea Rueda, Pontificia Universidad Javeriana (Colombia)
Olivier Salvado, CSIRO (Australia)
Sinchai Tsao, University of Washington (United States)
Ramiro Velazquez, Universidad Panamericana (Mexico)
Satish Viswanath, Case Western Reserve University (United States)
María Zuluaga, University College London (United Kingdom)

Session Chairs

- 1 Biosignals 1
Eduardo Romero, Universidad Nacional de Colombia (Colombia)
- 2 Medical Imaging 1
Darryl Hwang, The University of Southern California (United States)
- 3 E-health and Rehabilitation
Alfonso Gastelum, Universidad Autónoma de México (Mexico)
- 4 Brain Imaging 1
Sean Deoni, Brown University (United States)
- 5 Digital Pathology
Eduardo Romero, Universidad Nacional de Colombia (Colombia)

- 6 Biosignals 2
Matt Lallas, Keck School of Medicine of USC (United States)
- 7 Ultrasound
Armin Schwartzman, University of California San Diego (United States)
- 8 Cardiac Imaging
Jorge Brieva, Universidad Panamericana (Mexico)
- 9 Brain Imaging 2
Franco Lepore, Université de Montréal (Canada)
- 10 Medical Imaging 2
Marius Linguraru, Children's National Health System, The George Washington University School of Medicine and Health Sciences (United States)

Introduction

The papers in this volume were part of those submitted to the 14th International Symposium on Medical Information Processing and Analysis - SIPAIM 2018. The event, that was to be held for the first time in Mazatlán, Mexico, has evolved from a small meeting to an international symposium in which researchers from Latin America meet and interact with each other and with their peers from around the world. Unfortunately, this year, the main conference had to be cancelled due to the emergency generated by hurricane Willa. In spite of this, and to honor the many high-quality contributions of our authors, we have been working with SPIE to publish papers that were to be presented at the conference.

SIPAIM is mainly 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. 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 six internationally recognized experts in computer simulation, magnetic resonance imaging, signal and image analysis, computational anatomy and cognitive neuroimaging.

We had 45 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 sponsoring has improved the quality and visibility of the SIPAIM proceedings year after year. Finally, for the first time this year, 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**

