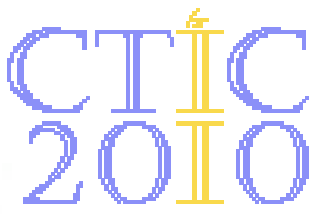
Rocío González Díaz
Pedro Real Jurado (Eds.)

3rd International Workshop on Computational Topology in Image Context

November 2010, Chipiona, Spain
Proceedings



Proceedings of the

Workshop on Computational Topology in Image Context 2010

November 12-15, Chipiona, Spain

Rocío González Díaz and Pedro Real (eds.)

CTIC 2010

Proceedings of the 3rd
Workshop on Computational Topology in Image Context

Chipiona 12-15, 2010
Chipiona, Spain

Rocío González-Díaz and Pedro Real (eds.)

Research Group on Computational Topology and Applied Mathematics
University of Seville
Seville 2010

ISSN: 1885-4508

Preface

It has been an honor and a pleasure to organize the 3rd International Workshop on Computational Topology in Image Context, CTIC 2010, in Chipiona (Spain), this year, after it was held in Poitiers (France) in 2008 and in Saint Kathrein (Austria) in 2009.

Our aim has been to continue the tradition of CTIC in providing a forum for scientific exchange in Topology and Computation in Image Context at a high quality level. This year, 26 scientific papers have been accepted, based on the scientific reviews, for their presentation during the conference. We are glad to check that the number of participants has reached a maximum in this edition, so we feel very grateful to them for their efforts.

Two internationally recognized speakers accepted our invitation to present stimulating research talks this year: Claudia Landi, Bolonia University, Italy and Herbert Edelsbrunner from Duke University, USA.

We would like to thank all the program committee members and additional reviewers for their valuable feedback, enabling the authors to further improve the quality of their work.

We are grateful to our sponsors, Ministry of Science of Spain, the Spaniard Topology Network (RET), FIDETIA Foundation, Applied Math (I) Department, Mathematics Institute of the Seville University (IMUS), Junta de Andaluca and the University of Seville for their funding.

We also would like to thank our local support team, Ainhoa Berciano, Daniel Daz Pernil, Javier Carnero, Daniel Gutierrez, Mara Jos Jimnez, Belen Medrano, Helena Molina-Abril, Regina Poyatos, Ana-Mara Pacheco, for their hard work in the organization of this event.

Finally, we are grateful to 50 participants registered in this congress by their 31 papers submitted, where 26 have been accepted. See you in Chipiona!!!.

Rocío González-Díaz and Pedro Real
Chipiona, 2010

Workshop Chairs

Rocío González Díaz, US
Pedro Real, US

Invited Speaker

Herbert Edelsbrunner, Institute of Science and Technology of Austria
Claudia Landi, University of Modena and Reggio Emilia

Program Committee

Sylvie Alayrangues
Antonio Bandera
Michel Couprie
Guillaume Damiand
Leila De Floriani
Daniel Díaz-Pernil
Herbert Edelsbrunner
Massimo Ferri
Angel Francés
Patrizio Frosini
Laurent Fuchs
Edel García-Reyes
Antonio Giraldo
Rocío González-Díaz
Yll Haxhimusa
Adrian Ion
María-José Jiménez
Reinhard Klette
Walter Kropatsch
Remy Malgouyres
Jean-Luc Mari
Jacques-Olivier Lachaud
Claudia Landi
Pascal Lienhardt
Marian Mrozek
Darian Onchis-Moaca
Nicolas Passat
Samuel Peltier
Pawel Pilarczyk
Pedro Real
Peer Stelldinger
Pol Vanhaecke
José-Antonio Vilches

Local Organization

Ainhoa Berciano-Alcaraz, UPV
Javier Carnero, US
Daniel Díaz Pernil, US
Rocío González Díaz, US
Maria José Jiménez, US
Belén Medrano, US
Helena Molina Abril, VUT, US
Ana María Pachecho, US
Regina Poyatos, US
Pedro Real, US

Table of Contents

Persistent Homology and Partial Matching of Shapes (Invited Speaker) **13**
C. Landi

Point Calculus for Interlevel Homology (Invited Speaker) **17**
H. Edelsbrunner

Perfect Discrete Morse Functions on 2-Complexes **19**
R. Ayala, D. Fernández-Ternero, J.A. Vilches

Tracking Features in Image Sequences using Discrete Morse Functions **27**
G. Jerse, N.M. Kosta

Towards Optimality in Discrete Morse Theory through Chain Homotopies **33**
H. Molina-Abril, P. Real

The Efficiency of a Homology Algorithm based on Discrete Morse Theory and Coreductions **41**
S. Harker, K. Mischaikow, M. Mrozek, V. Nanda, H. Wagner, M. Juda, P. Dłotko

Counting Excellent Discrete Morse Functions on Compact Orientable Surfaces **49**
R. Ayala, D. Fernández-Ternero, J.A. Vilches

Obtaining Cell Complexes Associated to Four Dimensional Digital Objects **57**
A. Pacheco, J. Mari, P. Real

On the Recognition of Tori Embedded in $\mathbf{R}^3$ **65**
H. Arnaud

Strong Separating $(k\,\overline{k})$-Surfaces on $\mathbf{Z}^3$ **73**
J. C. Ciria, E. Domínguez, A. R. Francés, A. Quintero

Improved Locally Adaptive Sampling Criterion for Topology Preserving Reconstruction of Multiple Regions **81**
L. Tcherniavski, C. Bähnisch and H. Meine

Topology-Preserving Perceptual Segmentation using the Combinatorial Pyramid **89**
E. Antúnez, R. Marfil, A. Bandera

Combining Regular Decimation and Dual Graph Contraction for Hierarchical Image Segmentation **97**
F. Torres, R. Marfil, Y. Haxhimusa, A. Bandera

Invariant Spectral Hashing of Image Saliency Graph **105**
M. Taquet, L. Jacques, C. De Vleeschouwer, B. Macq

Human Gait Recognition Using Topological Information **113**
J. Lamar León, E. García Reyes, R. González-Díaz

Algorithm to Compute a Minimal Length Basis of Representative Cocycles of Cohomology Generators **121**
M. Iglesias-Ham, E. García-Reyes, W. G. Kropatsch, R. González-Díaz

A Fast Algorithm to Compute Cohomology Group Generators of Orientable 2-Manifolds **129**
P. Dłotko

Computing The Cubical Cohomology Ring **137**
T. Kaczynski, P. Dłotko, M. Mrozek

Image Segmentation Inspired by Cellular Models using Hardware Programming 143
J. Carnero, D. Daz-Pernil, H. Molina-Abril, P. Real

Mereotopological Patterns for Ontology Evolution and Debugging 151
G. A. Aranda-Corral, J. Borrego Díaz, A. M. Chávez-González

Gabor frames and topology-based strategies for astronomical images 159
D.M. Onchis, P. Real, G.R. Gillich