Second IAPR International Conference

on

Discrete Geometry and Mathematical Morphology

Organizing Committee:

Benoît Naegel

Étienne Baudrier

Adrien Krähenbühl

Étienne Le Quentrec

Mohamed Tajine

Université de Strasbourg

ICUBE

IAPR

IRMIA++

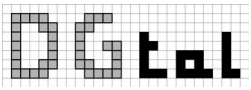
Strasbourg, France

Monday 24

Registration – *8:30 to 10:30*

Opening – *9:00*

Tutorial I – *9:15 to 12:30*
by David Cœurjolly, Jacques-Olivier Lachaud, Tristan Roussillon and Bertrand Kerautret.



Coffee break - *10:30 to 11:00*

Lunch – *12:30 to 14:00*

Tutorial II – *14:00 to 17:00*
by Benjamin Perret.

Coffee break - *15:30 to 16:00*

Welcome cocktail – *18:00*
Art Café, 1 place Hans-Jean-Harp.
On the first floor inside the Contemporary Art Museum.

Tuesday 25

Keynote I – *9:00*

Hybrid artificial intelligence for knowledge representation and model-based medical image understanding - towards explainability

Isabelle Bloch, Sorbonne Université, France

Abstract: This presentation will focus on hybrid AI, as a step towards explainability, more specifically in the domain of spatial reasoning and image understanding. Image understanding benefits from the modeling of knowledge about both the scene observed and the objects it contains as well as their relationships. We show in this context the contribution of hybrid artificial intelligence, combining different types of formalisms and methods, and combining knowledge with data. Knowledge representation may rely on symbolic and qualitative approaches, as well as semi-qualitative ones to account for their imprecision or vagueness. Structural information can be modeled in several formalisms, such as graphs, ontologies, logical knowledge bases, or neural networks, on which reasoning will be based. Image understanding is then expressed as a problem of spatial reasoning. These approaches will be illustrated with examples in medical imaging, illustrating the usefulness of combining several approaches.

Session 1 – Learning Based Morphology

10:00 – Component tree loss function: definition and optimization
Benjamin Perret and Jean Cousty

10:30 – Logarithmic morphological neural nets robust to lighting variations
Guillaume Noyel, Emile Barbier-Renard, Michel Jourlin and Thierry Fournel

Coffee break – *11:00 to 11:30*

Honor talk – *11:30 to 12:30*

Reflections on a scientific career and its possible legacy

Christian Ronse, University of Strasbourg, France

Abstract: I give the history of my research career, its evolving scientific topics, my main results, and how the computer science and image processing community reacted to them. I briefly describe my current research on generalized flat morphology based on threshold summation. I finally discuss possible future developments arising from my works, to be pursued by a new generation.

Lunch – *12:30 to 14:00*

Session 2 – Discrete and Combinatorial Topology I

14:00 – Completions and ramifications
Gilles Bertrand

14:30 – Full convexity for polyhedral models in digital spaces
Fabien Feschet and Jacques-Olivier Lachaud

15:00 – Algorithms for pixelwise shape deformations preserving digital convexity
Lama Tarsissi, Yukiko Kenmochi, Hadjer Djerroumi, David Coeurjolly, Pascal Romon and Jean-Pierre Borel

15:30 – Topological analysis of simple segmentation maps
Maria-Jose Jimenez and Belen Medrano-Garfia

IAPR TC18 communication – *16:00 to 16:15*

Teasers for posters – *16:15 to 16:30*

Posters & Coffee break – *16:30 to 17:30*

Batorama tour – *18:30 to 19:30*

Embarcadère BATORAMA Cathédrale, Place du Marché aux Poissons

Wednesday 26

Keynote II – *9:00*

Digital geometry, mathematical morphology, and discrete optimization: a survey
christer kiselman, uppsala university, sweden

Abstract: Discretization is an important procedure in contemporary mathematics. Discrete objects, like carpets and mosaics, have been around for thousands of years, but now the presence of computers and digital cameras have made them ubiquitous. Mathematical morphology was created in the 1960s and can be characterized as the science of shape description. It grew out from a desire to make Boolean algebra more precise. Finally, discrete optimization is a natural modification of optimization using real variables when we live in a discrete setting.

Session 3 – **Discrete and Combinatorial Topology II**

10:00 – Gradient vector fields of discrete morse functions and watershed-cuts
Nicolas Boutry, Gilles Bertrand and Laurent Najman

10:30 – A heuristic for short homology basis of digital objects
Aldo Gonzalez-Lorenzo, Alexandra Bac and Jean-Luc Mari

Coffee break – *11:00 to 11:30*

Session 4 – **Digital Geometry: Models, Transforms, and Visualization I**

11:30 – A simple discrete calculus for digital surfaces
David Coeurjolly and Jacques-Olivier Lachaud

12:00 – Exact and optimal conversion of a hole-free 2D digital object into a union of balls in polynomial time
Isabelle Sivignon

Lunch – *12:30 to 14:00*

Session 5 – **Hierarchical and Graph-Based Models, Analysis and Segmentation I**

14:00 – Component-tree simplification through fast alpha cuts
Michael H.F. Wilkinson

14:30 – Join, select and insert: efficient out-of-core algorithms for hierarchical segmentation trees
Josselin Lefèvre, Jean Cousty, Benjamin Perret and Harold Phelippeau

15:00 – Fast and effective superpixel segmentation using accurate saliency estimation
Felipe Belém, Isabela Borlido, Leonardo João, Benjamin Perret, Jean Cousty, Silvio Guimaraes and Alexandre Falcão

15:30 – A topological tree of shapes
Nicolas Passat and Yukiko Kenmochi

DGMM brainstorming – *16:00 to 16:30*

Posters & Coffee break – *16:30 to 17:30*

Banquet – *20:00*
Maison Kammerzell, 16 Place de la Cathédrale
with **Best Student Paper** award.

Thursday 27

Keynote III – *9:00*

Sliced wasserstein on manifolds: spherical and hyperbolical cases
Nicolas Courty, University Bretagne Sud, France

Abstract: Optimal transport has received a lot of attention into the machine learning and computational geometry communities recently. Many variants of the associated Wasserstein distance have been introduced to reduce its original computational burden. In particular the Sliced-Wasserstein distance (SW), which leverages one-dimensional projections for which a closed-form solution of the Wasserstein distance is available, has received a lot of interest. Yet, it is restricted to data living in Euclidean spaces, while the Wasserstein distance has been studied and used recently on manifolds. In this talk I will discuss novel methodologies to transpose SW to the Riemannian manifold case. By appropriately choosing a proper Radon transform, we show how fast and differentiable algorithms can be designed in two cases: Spherical and Hyperbolic manifolds. After discussing some of the theoretical properties of those novel discrepancies, I will showcase applications in machine learning problems, where data naturally live on those spaces.

Session 6 – **Multivariate and PDE-Based Mathematical Morphology**

10:00 – Morphological counterpart of Ornstein-Uhlenbeck semigroups and PDEs
Jesus Angulo

10:30 – Equivariance-based analysis of PDE evolutions related to multivariate medians
Martin Welk

Coffee break – *11:00 to 11:30*

Session 7 – **Discrete Tomography and Inverse Problems**

11:30 – On the decomposability of homogeneous binary planar configurations with respect to a given exact polyomino
Michela Ascolese and Andrea Frosini

12:00 – Properties of SAT formulas characterizing convex sets with given projections
Niccolo Di Marco and Andrea Frosini

Lunch – *12:30 to 14:00*

Session 8 – **Digital Geometry: Models, Transforms, and Visualization II**

14:00 – Introduction to discrete soft transforms
Bastien Laboureix, Eric Andres and Isabelle Debled-Rennesson

14:30 – Density functions of periodic sequences
Olga Anosova and Vitaliy Kurlin

15:00 – Approximation of digital surfaces by a hierarchical set of planar patches
Jocelyn Meyron and Tristan Roussillon

15:30 – On the validity of the two raster sequences distance transform algorithm
Edouard Thiel

Closing – *16:00*

Coffee break – *16:15 to 17:00*

Poster sessions

Teasers – *Tuesday 25, 16:15*

Main session – *Tuesday 25 & Wednesday 26, 16:30*

P01 – Towards topological analysis of non-symmetric tensor fields via complexification
Bernhard Burgeth, Andreas Kleefeld, Eugene Zhang and Yue Zhang

P02 – Tangential cover for 3D irregular noisy digital curves
Phuc Ngo and Isabelle Debled-Rennesson

P03 – A curious invariance property of certain perfect Legendre arrays: stirring without mixing
Timothy Petersen, Matthew Ceko, David Paganin and Imants Svalbe

P04 – Morphological adjunctions represented by matrices in max-plus algebra for signal and image processing
Samy Blusseau, Santiago Velasco-Forero, Jesús Angulo and Isabelle Bloch

P05 – Distance-driven curve-thinning on the face-centered cubic grid
Gábor Karai

P06 – A novel approach for computation of morphological operations using the number theoretic transform
Vivek Sridhar and Michael Breuß

P07 – MorphoActivations: Generalizing ReLU activations by mathematical morphology
Santiago Velasco-Forero and Jesús Angulo

P08 – A new lattice-based plane-probing algorithm
Jui-Ting Lu, Tristan Roussillon and David Coeurjolly

P09 – Differential oriented image foresting transform segmentation by seed competition
Marcos A.T. Condori and Paulo A.V. Miranda

P10 – Graph-based image segmentation with shape priors and band constraints
Caio de Moraes Braz, Luiz Felipe D. Santos and Paulo A.V. Miranda

P11 – Implicit encoding and simplification/reduction of nGmaps
Florian Bogner, Jiri Hladuvka and Walter G. Kropatsch

Supplementary posters

Open session – *Tuesday 25 & Wednesday 26, 16:30*

O1 – Morpholayers
Santiago Velasco-Forero

O2 – Live extraction of curvilinear structures from LiDAR raw data
Philippe Even and Phuc Ngo

O3 – Mathematical morphology tool for exploring the conduction paths in scanning probe microscopy images
Mian Li, Jan Rieck, Beatriz Noheda, Jos B.T.M. Roerdink and Michael H.F. Wilkinson

O4 – MMTO: Connected component correlation on multiple max-trees for multivariate image segmentation
Mohammad H. Faezi, Reynier Peletier and Michael H.F. Wilkinson

O5 – nnMorpho, a PyTorch library for mathematical morphology operators
Gonzalo Romero-Garcìa

O6 – On the connected thickness of arithmetical hyperplans
Bastien Laboureix and Éric Domenjoud

O7 – Binary morphological neural networks
Theodore Aouad and Hugues Talbot

O8 – On the number of digital straight segments centered in a square grid
Remi Decelle, Phuc Ngo and Isabelle Debled-Rennesson

O9 – Conjecture of the characterization of bijective digitized reflections and rotations
Stéphane Breuils, Yukiko Kenmochi, Eric Andres, Akihiro Sugimoto

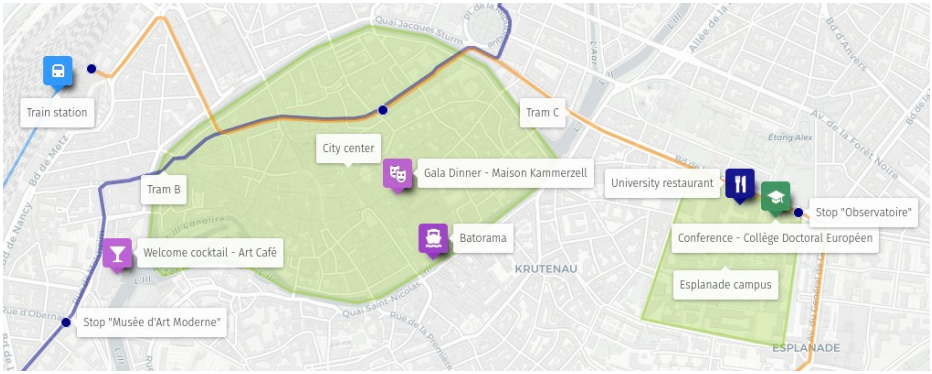
O10 – Run-length based mathematical morphology for processing of large 3D images of wheat grains
David Legland

Special track on Reproducible Research – *Tuesday 25 & Wednesday 26, 16:30*

RR1 – Forest road extraction using convolutional neural networks
Paul Georges, Phuc Ngo and Philippe Even

RR2 – Combining max-tree and CNN for segmentation of cellular FIB-SEM images
Cyril Meyer, Benoît Naegel, Etienne Baudrier and Patrick Schultz

Map of conference venues



Conference place

- Collège Doctoral Européen
  46 Boulevard de la Victoire
  67000 Strasbourg
- **Tram C**, stop “Observatoire” + 1min walk

Welcome cocktail

- Art Café
  1 Place Hans-Jean-Arp
  67000 Strasbourg
- **Tram B,** stop “Musée d’Art Moderne” + 3min walk

Batorama

- Embarcadère BATORAMA Cathédrale
  Place du Marché aux Poissons
  67000 Strasbourg
- **Tram C**, stop “Broglie” + 12min walk

Gala dinner

- Maison Kammerzell
  16 Place de la Cathédrale
  67000 Strasbourg
- **Tram C**, stop “Broglie” + 9min walk

	Monday 24	Tuesday 25	Wednesday 26	Thursday 27	
8:30	Registration	Registration			8:30
9:00	Opening	*Keynote 1* Isabelle Bloch	*Keynote 2* Christer Kiselman	*Keynote 3* Nicolas Courty	9:00
9:15	DGtal Tutorial				
10:00		S1 - Learning Based Morphology	S3 - Discrete and Combinatorial Topology II	S6 - Multivariate and PDE-Based Mathematical Morphology	10:00
10:30	Coffee break				
11:00	DGtal Tutorial	Coffee break	Coffee break	Coffee break	11:00
11:30		*Honor speaker* Christian Ronse	S4 - Digital Geometry: Models, Transforms, and Visualization I	S7 - Discrete Tomography and Inverse Problems	11:30
12:30	Lunch	Lunch	Lunch	Lunch	12:30
14:00	Higra Tutorial	S2 - Discrete and Combinatorial Topology I	S5 - Hierarchical and Graph-Based Models, Analysis and Segmentation I	S8 - Digital Geometry: Models, Transforms, and Visualization II	14:00
15:30	Coffee break				
16:00	Higra Tutorial	IAPR TC18 communication	DGMM brainstorming	Closing	16:00
		Teasers for posters		Coffee break	
16:30		Coffee break & Poster session	Coffee break & Poster session		16:30
17:00					17:00
17:30			*Steering committee meeting*		17:30
18:00					
18:30	Welcome cocktail *at Art Café* *in Modern Art Museum*	Tour *Batorama*			18:30
20:00			Banquet *at Maison Kammerzell*		20:00