

# **Final Report on IAPR TC18**

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# **1. TC Background Information**

# 1.1. TC Aim and Scope

The aim of this IAPR-Technical Committee is to promote interactions and collaborations between researchers working on Discrete Geometry and Mathematical Morphology. The TC is involved in the organization of conferences and workshops in the domain. The TC maintains a website giving an overall presentation of the scope of the TC, its organization, its activities and the main projects of the community. We also draw a particular attention on the reproducibility aspect to ease the diffusion of the results of the community.

# 1.2 TC Structure and Organization

#### Leadership Team

The TC board has been renewed at the beginning of the term, inactive board members have been replaced by new members. Beyond the two Chairs, the new members are: Reneta Barneva (Fredonia, State University of New York), Paulo Miranda (Computer Vision Research Group, Universidade de São Paulo, Brazil). Bertrand Kerautret who was the previous Chair remained as a board member with a double mission to ensure the continuity of the activities and to run the twitter account of the TC.

- Chair: Sara Brunetti
- Vice-chair: Benjamin Perret
- Secretary: Phuc Ngo (in charge of new inscriptions, communication help and website update)
- Webmaster: (optional)
- Communications officer: Bertrand Kerautret (social media)
- Educational officer: (optional)
- Reproducible research: Miguel Colom
- Dataset curator: (optional)
- Advisory Board Members: Reneta Barneva, Andrea Frosini, Paulo Miranda, Hugues

Talbot, Nicolas Passat

# 1.3 TC website URL

• Website : <u>https://tc18.org/</u>

The website contains:

- information about incoming events, important deadlines and a Twitter feed
- institutional information about the TC: scope, archives, organization, members,
- statement of ethics and policy on equality, diversity, and inclusion

- various resources for the community, such as educational content, links toward datasets, code, demonstrations, illustrations
- archives about past TC activities (newsletters, reports, main conferences)

The website can be edited by the community through a GitHub project that allows maintaining the website not only by one particular person but also by everyone having a GitHub account. https://github.com/TC-18/tc18.org

• Social media: https://x.com/IAPR\_TC18

#### 1.4 Number of members (people on mailing list)

The number of TC18 members continues progressively to increase 173 (+10 compared to 2022) from more than 24 countries. We plan to make a yearly reminder for TC18 members to invite their new collaborators and students to register.

#### 1.5. Communication means (e.g. newsletters, social media) and frequency

- Mailing list tc18.members@inria.fr : about 35 mail threads during the last 2 years
- Newsletter: at least twice per year in the mailing list and in the IAPR newsletter

#### 1.6. Listing of key event(s) typically organized by the TC

The main conference of the 18th Technical Committee is *Discrete Geometry and Mathematical Morphology* (DGMM) which is a joint event between the Discrete Geometry for Computer Imagery (DGCI) conference, whose first edition was held in 1991 in Strasbourg, and the International Symposium on Mathematical Morphology (ISMM) which started in Barcelona in 1993.

#### 1.7. Equality, Diversity and Inclusion Plans

We added a new page in the website https://tc18.org/soe.html stating that the 18th IAPR Technical Committee on DGMM is committed to adopting and promoting the highest standards of ethical and professional conduct for fair and inclusive research, as described in the IAPR Statement of Ethics and Policy on Equality, Diversity, and Inclusion https://iapr.org/constitution/soe.php. In the future, we plan to encourage organizers of TC18-related events to publicly adopt this SOE, highlight its principles, and commit attendees to abide by them. This could be done with a mandatory check-box in submission and registration forms.

# 2. Activities in the last two years (since ICPR 2022)

# 2.1. Website Updates

The plan of the website is now organized in four main items: institutional information on the TC (scope, organization and members, activity reports), main conferences (detailed information about ongoing and past activities around the main conferences DGMM, DGCI and ISMM), and resources (educational resources, open problems, datasets and code, demonstrations and illustrations).

The content of the website has been updated to reflect the inclusion of the mathematical morphology community and the creation of the joint event DGMM.

Information such as ongoing events, incoming deadlines, member lists, newsletters archives and so on are regularly updated.

Over the last two years, there have been about 50 commits in the GitHub repository hosting the website https://github.com/TC-18/tc18.org/commits/master .

### 2.2. Conferences/Workshops organized

Following the aim of this IAPR-Technical Committee to promote interactions and collaborations between researchers working on Discrete Geometry and Mathematical Morphology, the second edition of the conference on Discrete Geometry and Mathematical Morphology (DGMM) was held in Strasbourg (France) on October 24-27, 2022: <u>https://iapr.org/archives/dgmm2022/</u> and the third edition of DGMM held in Florence (Italy) on April 15-18, 2024.

#### **DGMM 2022**

The second edition of the conference on Discrete Geometry and Mathematical Morphology (DGMM) <u>https://iapr.org/dgmm2022</u>/) was held in Strasbourg (France), October 24-27.

The event was really successful comprising 33 high quality accepted contributions highlighting the current trends and advances in discrete geometry and mathematical morphology, ranging from purely theoretical contributions, algorithmic developments, or novel applications in image processing, computer vision, and pattern recognition.

The best student paper award, sponsored by the IAPR, was won by Josselin Lefèvre et al. for the contribution entitled "Join, Select, and Insert: Efficient Out-of-core Algorithms for Hierarchical Segmentation Trees ". The jury has also awarded a special mention to Jui-Ting Lu for the paper "A new lattice-based plane-probing algorithm".

The proceedings appeared in Springer's LNCS series (number 13493, DOI: 10.1007/978-3-031-19897-7), and a special issue with extended versions of selected outstanding contributions was



published on the Journal of Mathematical Imaging and Vision.

#### **DGMM 2024**

The third edition of the conference on Discrete Geometry and Mathematical Morphology (DGMM) (<u>https://iapr.org/dgmm2024</u>/) was held in Florence (Italy), April 15-18, 2024.

The event was really successful with submissions from 14 countries (Austria, Brazil, Canada, China, Philippines, France, Germany, Hungary, Italy, Lebanon, Netherlands, Serbia, United Arab Emirates, and USA), The program of DGMM 2024 offered three invited talks, and 34 accepted papers presented into nine oral sessions, one poster session, and three tutorial-lectures and meeting with spin-offs.

The DGMM 2024 accepted papers highlight the current trends and advances in discrete geometry and mathematical morphology, encompassing purely theoretical contributions, algorithmic developments, or novel applications in image processing, computer vision, and pattern recognition.

The proceedings of DGMM 2024 were published by Springer in the Lecture Notes in Computer Science



book series (LNCS, vol 14605)

#### **Other events**

#### **RRPR 2022**

The fourth edition of the Reproducible Research in Pattern Recognition (RRPR) workshop was held in Montreal, Canada on August 21st during ICPR 2022. The event was extended beyond the workshop in two ways:

RRPR continued with a new open poster presentation track at the second edition of the IAPR international conference Discrete Geometry and Mathematical Morphology (DGMM) held two months after RRPR in Strasbourg on 24-27 Oct 2022. Then, two focus groups were formed with the goal of discussing the efforts to integrate reproducible research in international conferences, motivating reproducible research, and measuring the balance between impact versus investment.

Finally, after the post-proceedings process 5 full papers and 4 short companion papers were accepted. <u>Proceedings are now available</u>: Bertrand Kerautret, Miguel Colom, Adrien Krähenbühl, Daniel Lopresti, Pascal Monasse, et al.. Reproducible Research in Pattern Recognition: Fourth International Workshop, RRPR 2022. 14068, Springer International Publishing, 2023, Lecture Notes in Computer



Science, (10.1007/978-3-030-76423-4)

**TAIR 2023:** 17<sup>th</sup>- Meeting on Tomography and Applications Discrete Tomography, Neuroscience and Image Reconstruction - was held in Milan on May 15-17, 2023 (<u>https://www.mate.polimi.it/events/TAIR2023/</u>). Around 40 participants, distributed on the three days, attended the different sections of the meeting. The program consisted of 5 plenary lectures and 8 short talks, touching on different aspects of tomographic reconstruction, as well as on neuroscience topics.

Journes du Group de Travail Geometrie Discrete et Morphologie Mathematique 2023, Caen, France 6-7 July: Journées du Groupe de Travail en Géométrie Discrète et Morphologie Mathématique https://gdmm2023.sciencesconf.org/

**TAIR 2024:** 18<sup>th</sup>- Meeting on Tomography and Applications Discrete Tomography, Neuroscience and Image Reconstruction - was held in Milan on May 6-8, 2023 (<u>https://www.mate.polimi.it/events/TAIR2024/</u>) The three days meeting touched on topics concerning different reconstruction problems, ranging from discrete tomography to neuroscience, and also including combinatorial issues related to Heffter arrays. The meeting was attended by around 40 participants, and consisted of 5 plenary lectures and 10 short talks.

# 2.3. Educational activities (Schools, Tutorials, Short courses, Webinars, Doctoral consortia)

Tutorials on DGtal -Digital Geometry Tools and Algorithms Library- (https://https://dgtal.org/) by David Coeurjolly, and Higra -Hierarchical Graph Analysis- (https://www.sciencedirect.com/science/article/pii/S235271101930247X) by Benjamin Perret, were hosted by DGMM 2022.

Three tutorial lectures: "Connected Morphology: Theory and Practical Applications in Astronomy" by Michael H.F. Wilkinson; "Digital Geometry" by David Coeurjolly and Jacques-Olivier Lachaud "CAT and DT Image Reconstruction Problem" by Paolo Dulio, were hosted by DGMM 2024.

### 2.4. Promotion of research, publicity and dissemination activities

In order to promote the work of young researchers, in the context of the main conference DGMM an award for the best student paper has been established:

- during DGMM 2022, the award was won by Josselin Lefèvre et al. for the contribution entitled "Join, Select, and Insert: Efficient Out-of-core Algorithms for Hierarchical Segmentation Trees". The jury has also awarded a special mention to Jui-Ting Lu for the paper "A new lattice-based plane-probing algorithm";
- during DGMM 2024, the award was won by Bastien Laboureix for his work entitled "Recognition of arithmetic line segments and hyperplanes using the Stern-Brocot tree".

#### ${\bf 2.5. \ Collaborations \ with \ otherorganizations \ and \ TCs}$

No formal activity recorded but informal collaborations exist with:

- TC 15: Graph-based Representations in Pattern Recognition
- TC 19: Computer Vision for Cultural Heritage Applications

#### 2.6. Other (Dataset Curation, etc.)

#### **Code release:**

**DGtal:** DGTal is a collaborative project, with 26 developers contributing, and it aims at developing generic, efficient and reliable digital geometry data structures, algorithms and tools. It takes the form of an open-source C++ library DGtal and a set of tools and binaries DGtalTools. The 1.2 release offered quite a long requested feature: (partial) python binding. This release also includes many new features on the Geometry package, including plane probing based normal vector estimators, and the Quickhull algorithm in arbitrary dimensional lattice space, used to speed-up the new convexity package that was introduced in the release 1.1. <u>https://dgtal.org/</u>

The last DGtal 1.3 was released on November 25, 2022: https://dgtal.org/2022-11-25-dgtal-release1.3/

**Higra**: Higra is a new C++/Python library for efficient sparse graph analysis with a special focus on hierarchical methods https://github.com/higra/Higra . Some main features are:

- efficient methods and data structures to handle the dual representations of hierarchical clustering: trees (dendrograms) and saliency maps (ultrametric distances);
- hierarchical clusterings: quasi-flat zone hierarchy, hierarchical watersheds, agglomerative clustering (single-linkage, average-linkage, complete-linkage, exponential-linkage, Ward, or user provided linkage rule), constrained connectivity hierarchy;
- component trees: min and max trees;
- manipulate and explore hierarchies: simplification, accumulators, cluster extraction, various attributes (size, volume, dynamics, perimeter, compactness, moments, etc.), horizontal and non-horizontal cuts, hierarchies alignment;
- optimization on hierarchies: optimal cuts, energy hierarchies;

- algorithms on graphs: accumulators, vertices and clusters dissimilarities, region adjacency graphs, minimum spanning trees and forests, watershed cuts;
- assessment: supervised assessment of graph clusterings and hierarchical clusterings;
- image toolbox: special methods for grid graphs, tree of shapes, hierarchical clustering methods dedicated to image analysis, optimization of Mumford-Shah energy.

# **3. Future plans (timeline until ICPR 2026 and beyond): 3.1. Planned activities**

Beyond the recurrent institutional activities (website updates, newsletters, IAPR reports...), the TC is involved in several ongoing and planned activities:

- **DGMM 2025:** This event will be host by Groeninger (Netherlands) in November, 2025 The TC is involved in the follow-up team of the steering committee, which closely monitors the preparation of the conference with the organizing committee.
- **RRPR 2024:** The TC is the main organizer (Bertrand Kerautret) of the fifth workshop on Reproducible Research in Pattern Recognition (RRPR) that will be held in Kolkata as a satellite event of ICPR <u>https://rrpr2024.sciencesconf.org</u>
- **JMIV:** A special issue on Discrete Geometry and Mathematical Morphology has planned in the Journal of Mathematical Imaging and Vision: selected papers from DGMM 2024 have been invited to submit.