

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The TC board has been renewed at the beginning of the term, inactive board members have been replaced by new members.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: Benjamin Perret
- Vice-chair: Sara Brunetti
- Secretary: Phuc Ngo (in charge of new inscriptions, communication help and website update)
- Communications officer: Bertrand Kerautret (social media)
- Reproducible research: Miguel Colom
- 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

| IAPR - TC18 Discrete Geometry and Mathematical Morphology | IAPR | |
|---|---|-----------------|
| Main TC18 • Main conferences • Resources • Contact | | |
| Important dates Last News | Tweets by @IAPR_TC18 | 0 |
| (March 2022) Call for contribution for RRPR workshop at ICPR 2022 (November 2021) Call for contribution for DGMM 2022 (June 2021) Call for contributions for ISPA 2021: Special session "Combinatorial Image Processing and Digital Geometry" (April 2021) Call for participation for DGDVC: Meeting on Tomography and Applications- Discrete Tomography, Neuroscience and Image Reconstruction (January 2021) Call for Papers for DGDVC: Conference on Digital Geometry and Discrete Variational Calculus (November 2020) Call for Papers for ISGV: Symposium on Geometry and Vision in commemoration to Professor Reinhard Klette (October 2020) Call for Papers for DGMM (September 2020) Call for Papers: Special Journal Issue on Combinatorial Optimization in Imaging Sciences | ► IAPR_TC18 Retweeted ■ mpr | |
| 4 | IAPR_TC18 Retweeted | ¥ |
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| What is TC18 ? | | |
| The aim of this IAPR-Technical Committee is to promote interactions and collaboration between researchers working on Discrete Geometry and Mathematical Morphology. | A MA | |

TC website main page

Social media : https://twitter.com/IAPR TC18

1.4 Number of members (people on mailing list)

The number of TC18 members continues progressively to increase 164 (+13 compared to 2020). 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 <u>tc18.members@inria.fr</u> : about 40 mail threads during the last 2 years
- Twitter: about 40 tweets during the last 2 years
- Newsletter: 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. The first edition of DGMM was held in 2021 in Uppsala (Sweden) <u>https://www.dgmm2021.se/</u>

1.7. Equality, Diversity and Inclusion Plans

We added a new page in the website <u>https://tc18.org/soe.html</u> 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 <u>https://iapr.org/constitution/soe.php</u>.

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 2020)

2.1. Website Updates

The plan of the website has been simplified and 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 100 commits in the GitHub repository hosting the website <u>https://github.com/TC-18/tc18.org/commits/master</u>.

2.2. Conferences/Workshops organized

1st DGMM:

The first edition of the new conference on Discrete Geometry and Mathematical Morphology (DGMM) was held from May 24 to 27, 2021 (<u>https://www.dgmm2021.se/</u>). This was the first joint event between the two main conference series of IAPR TC18, the International Conference on Discrete Geometry for Computer Imagery (DGCI) and the International Symposium on Mathematical Morphology (ISMM). The conference was held entirely online, with discussion sessions. All the presentations have been recorded and are available on YouTube <u>https://www.youtube.com/playlist?list=PL61jQAsCUDRLjTQt4KU_YcivUxo1Tysi8</u>.

The event was really successful, comprising 36 high quality 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. A session was dedicated to the memory and work of Reinhard Klette.

The best student paper award, sponsored by the IAPR, was won by Rémi Decelle et al. for the contribution entitled "*Digital Straight Segment Filter for Geometric Description*". The proceedings appeared in Springer's LNCS series (number 12708, DOI: 10.1007/978-3-030-76657-3). A special issue with extended versions of selected outstanding contributions will be published in the *Journal of Mathematical Imaging and Vision*.



Following the success of this first edition, the steering committees of DGCI and ISMM decided to

organize a second edition of the conference. In this context, the TC18 led the constitution of a new steering committee for DGMM with a first selection of members and the organization of the election of the Chair (Yukiko Kenmochi) and Vice-Chair (Michael Wilkinson). The TC Chair is an invited member of the DGMM steering committee and is therefore directly involved in the organization of the conference.

Other events:

• **RRPR 2020:** Third Workshop on Reproducible Research in Pattern Recognition. This event was held online on January 11, 2021 as a satellite workshop of ICPR. Following the two previous editions, it continues to cover advances in platforms on reproducibility and new reproducible research results, which were covered by regular or companion short papers.

The growing success of this event is evidenced by the larger number of authors registered for this workshop (60 authors from 10 different countries). The thirteen accepted papers were organized into three main categories. The first contributions focused on reproducible research. The second category of contributions focused on reproducible research results, and the last category included ICPR companion papers describing implementation and details that are an



absolute requirement for reproducibility. In this third edition, we were glad to invite Roberto Di Cosmo to present the *Software Heritage* project, which aims to establish a perpetual universal archive of software source code. A second recent initiative in the Computer Graphics domain was presented by Nicolas Bonneel on *Code Replicability*.

The proceedings are in press in LNCS springer <u>https://link.springer.com/book/10.1007/978-3-030-76423-4</u>. Videos of the pre-recorded presentations remain available on the workshop's website, <u>https://rrpr2020.sciencesconf.org</u>

- **ISGV:** Symposium on Geometry and Vision in commemoration of Professor Reinhard Klette, 28-29 January 2021, Auckland, New Zealand. This symposium included a geometry viewpoint with digital geometry and other application fields, the
- **DGDVC:** Conference on Digital Geometry and Discrete Variational Calculus, 29 Mar-2 Apr 2021 Marseille, France. The international conference on digital geometry and discrete variational calculus DGDVC was originally planned to take place at CIRM, but finally held as a virtual event with the help of CIRM, from March 29th to April 2nd 2021. The aim of the conference is to gather researchers in digital

videos and the proceedings of the event are available online: <u>https://cerv.aut.ac.nz/isgv2021/</u> **DGDVC:** Conference on Digital Geometry and Discrete Variational Calculus, 29 Mar-2 Apr 2021 Marseille, France. The international conference on

ISGV2021



geometry and discrete variational calculus, theoretical mathematical experts from geometric measure theory and variational problems and applications oriented computer scientists from image analysis or geometry processing. During the conference, participants (126 in total) actively experienced a rich program of presentations, punctuated by ample breaks of discussions. The scientific program consisted of 10 keynote lectures and 14 oral presentations. The presentation videos are available at : https://dgdvc.sciencesconf.org/

• TAIR: 15th Meeting on Tomography and Applications of Discrete Tomography,

Neuroscience and Image Reconstruction, organized by Politecnico di Milano in Italy, was held entirely online from 4 to 5 May 2021, The aim of the Meeting is to share interdisciplinary aspects between the experimental research concerning X-ray tomography and the mathematical image reconstruction community. Round table sessions were organized, where moderators involved a few members of their teams to provide an overview, and future perspectives, on general research topics, and later opening the discussion to all' the connected people. Six lecturers, and four different round tables have been supplied, with an audience of forty participants on the average. All the sessions have

been recorded, and are now freely accessible from the meeting webpage <u>https://www.eko.polimi.it/index.php/TAIR/TAIR2021</u>

- ISPA: 12th International Symposium on Image and Signal Processing and Analysis, Special session "Combinatorial Image Processing and Digital Geometry", 13-15 September 2021, Zagreb, Croatia https://www.isispa.org/special-sessions. The talks covered some interesting features of the topics such as coordinate systems for non-traditional grids, efficient implementation scheme for parallel thinning, dual space method for the segmentation of pixels into polynomial curves, and cellular automata for the generation of various binary patterns on the triangular grid. The proceedings are available online https://doi.org/10.1109/ISPA52656.2021
- **ISAIM:** The special session on Combinatorial and Geometric Problems in Imaging Sciences was held at ISAIM (International Symposium on Artificial Intelligence and Mathematics) at Fort Lauderdale, FL. January 3–5, 2022. It received 12 contributions, whose abstract and short papers are available online at https://isaim2022.cs.ou.edu/papers.html.
- **DTMM4MIA:** The special session on Digital Topology and Mathematical Morphology for Medical Image Analysis was held during the CARS (Computer Assisted Radiology and Surgery) conference, 8 June 2022, Tokyo, Japan. The aim of this session is to bring together scientists, engineers and physicians of medical image analysis, digital topology, mathematical morphology, and topological data analysis to present and discuss new advances in these fields. We expect such interactions will

help identify new research opportunities. The session was composed of three regular talks and two invited speakers: Chao Chen from Stony Brook University who talked about "Topology-Driven Learning for Biomedical Imaging Informatics" and Atsushi Imiya from Chiba University who presented his work on "Cardiac Motion Analysis using Transport Distance". https://dtmm4mia2022.sciencesconf.org/

• **TAIR:** 16th Meeting on Tomography and Applications Discrete Tomography, Neuroscience and Image Reconstruction, was held from 2 to 4 May 2022, at Politecnico di Milano, Italy. The 16th edition of the meeting was dedicated to Carla Peri (1957-2022), member of the organizing and scientific committee since the first edition in 2007, and also a very active researcher in discrete tomography. The three sessions of the meeting were composed of invited talks and regular talks proposed by young researchers, whose participation have always been encouraged. A few special contributions coming from researches in neuroscientific imaging have been also included since the edition in 2017, later expanded, and now integral part of the event. <u>TAIR2022</u>



edings of the 12th International Symposis Image and Signal

Processing and Analysis





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

Lecture on the library DGtal at the Graduate School of the Symposium on Geometry processing 2021 by David Coeurjolly and Jacques-Olivier Lachaud. The lecture notes, code and slides are available online https://dgtal.org/2021-07-12-dgtal-sgp/.

2.4. Promotion of research, publicity and dissemination activities

The best student paper award at DGMM 2021, sponsored by the IAPR, was won by Rémi Decelle et al. for the contribution entitled "Digital Straight Segment Filter for Geometric Description"

2.5. Collaborations with other organizations 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:** release 1.2 (June 2021). The collaborative project DGtal 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 new 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>

- **Higra**: Higra is a new C++/Python library for efficient sparse graph analysis with a special focus on hierarchical methods <u>https://github.com/higra/Higra</u>. 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 2022 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 2022:** This event will take place in Strasbourg, France in October 2022. 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.
- **DGMM 2024:** The call for organization for the next DGMM has been sent on the TC mailing list. The TC Chair will be involved in the selection process of the candidates and in the follow-up of the organization.
- **RRPR 2022:** The TC is the main organizer (Bertrand Kerautret) of the workshop on Reproducible Research in Pattern Recognition that will be held during ICPR 2022.
- **JMIV:** A special issue on Discrete Geometry and Mathematical Morphology is planned in the Journal of Mathematical Imaging and Vision: selected papers from DGMM 2022 will be invited to submit.
- **Tutorial on DGtal and Higra:** DGMM 2022 will host two tutorial sessions on DGtal, library on Discrete Geometry, done by David Coeurjolly, and Higra, library on Mathematical Morphology, done by Benjamin Perret.

3.2. Recommendation to ExCo for TC leadership team for 2022-2024 term

At first, we plan to continue with the same team, except that we swap the roles of the Chair and the Vice Chair. At term, we would like to involve more people in the organizing team of the TC with well-defined roles as suggested by the IAPR.

- 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)
- Other officers (optional)
- Dataset curator: (optional)
- Advisory Board Members: Reneta Barneva, Andrea Frosini, Paulo Miranda,

Hugues Talbot, Nicolas Passat

3.3. Other Comments (please suggest members of TC for leadership roles such as standing committee memberships, if possible)

We currently have no candidates to suggest for leadership roles. A call has been sent on the TC mailing list and the idea will be discussed during the TC presentation at the next DGMM 2022.