



**Final Report on IAPR-TC18
(October 2018 - June 2020)**

Bertrand Kerautret (chair) and Michael Wilkinson (co-chair)
with Phuc Ngo (TC18 secretary) and TC18 board

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1 TC Background Information

1.1 TC Aims and Scope

The aim of this IAPR-Technical Committee is to promote interactions and collaborations between researchers working on Discrete Geometry and Mathematical Morphology. Conferences are organised and a TC web page is available to provide these opportunities. The topics are not covered by other IAPR-TCs, but have links with some of them and for the purpose to gather interactions with various application domains. We also draw a particular attention on reproducibility aspect to make easier the diffusion of the results.

1.2 TC Structure and Organization

The structure of the TC is the same as the previous format with the addition of a new secretary for helping to coordinate the inscription and newsletter editions.

Chair: Bertrand Kerautret (LIRIS, Université de Lyon 2, Lyon, France)

Vice Chair: Michael Wilkinson (Bernoulli Institute for Mathematics, Computer Science and Artificial Intelligence University of Groningen, The Netherlands)

Secretary: Phuc Ngo (in charge to new inscriptions, communication help, and updating publication listing)

Board members :

- Arindam Biswas, Indian Institute of Engineering Science & Technology, Shibpur, India
- Andrea Frosini, Dept. Matematica and Informatica "Ulisse Dini", Firenze, Italia
- Georgios K Ouzounis, DigitalGlobe, Inc. Longmont, CO 80503, USA
- Hugues Talbot, Center for Numerical Vision, CentraleSupélec, France

Associated board members with roles in:

- **Reproducible Research:** Miguel Colom, CMLA, ENS Paris Saclay, Paris, France
- **Interface between MM & DG:** Nicolas Passat, Université de Reims Champagne-Ardenne, CReSTIC, France

1.3 TC website URL

The website keeps the same address:

<https://tc18.org>

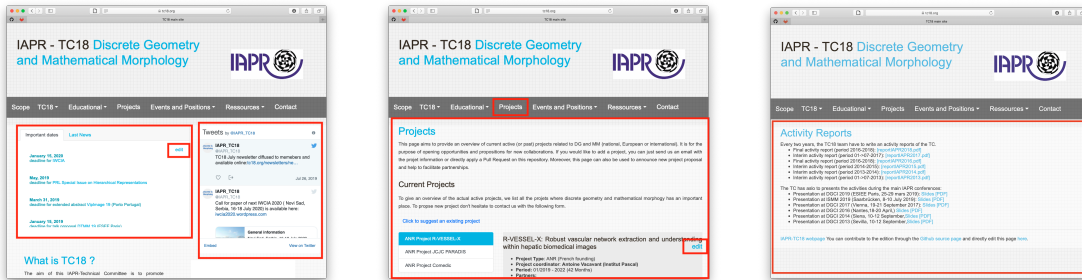
The source page is also available to the community through a *GitHub* project that allows to maintain the website not only by one particular person but also by everyone having an *GitHub* account. It also contains a support team, and such an organisation will make easier the transition and reduce the amount of work to update information with less effort.

<https://github.com/TC-18/tc18.org>

Main activities produced by 5 contributors over time:



SOURCE <https://github.com/TC-18/tc18.org/graphs/contributors?from=2018-01-20&to=2020-12-22&type=c>



(a) <http://tc18.org>

(b) <http://tc18.org/projects.html>

(c) new activity report page
<https://tc18.org/reports.html>

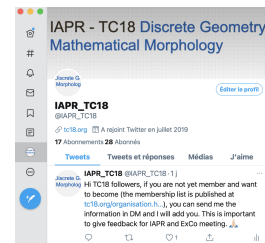
Figure 1: Illustration of the new website components. (a) shows the new twitter feed and important dates panels. (b) highlights the new project page with the links allowing to edit the project content or project proposal. (c) lists the activity report in a new separate page.

1.4 Number of members (people on mailing list)

As awaited, the number of TC18 members continues progressively to increase from the MM integration. At present it has **151 researchers (+18)** compared to end of 2018. This number does not include the new followers of twitter (+28 from its creation since July 2019). This number will probably increase in the future in particular after the main new event of DGMM.

1.5 Communication means

The communication was initially composed of two main ways (a first one based on the newsletters, one or two per year depending of the events' calendar; and the second one is a direct diffusion for a more reactivity). In order to get a more dynamic and modern communication, we used a third way of communication with the creation of a new twitter account: @IAPR_TC18 and a call for a "communication board member" was sent in the last July newsletter (available here: <https://tc18.org/newsletters/newsletterJuly2019.html>).



The front page of the main site was also improved with the new twitter feed (see illustration in figure 1 (a)). The page organisation was also adjusted to include the new "project" page, and a new "Report" page was added in order to propose a direct access to all the activity reports written since 2013 (<https://tc18.org/reports.html>).

We maintain the newsletter (bi-annual) and special IAPR newsletters:



TC18 recent activities
(IAPR short news July 2019)



News on new event DGMM
(IAPR short news April 2020)



In Memoriam Reinhard Klette
(IAPR short news April 2020)



News about event update
(IAPR short news July 2020)

1.6 Listing of key events

The two main events of the TC18 are naturally related to the two main domains of Discrete Geometry with **DGCI** and Mathematical Morphology (with **ISMM**). During the period 2018-2020 the following events were organized:

- 21th DGCI: 26-28 March, 2018 - Paris (France) (<https://dgci2019.sciencesconf.org>)
- 14th ISMM: 8-10 July, 2019 - Saarbrücken (Germany) (<http://ismm.uni-saarland.de>)

Other events were also organized on the following topics:

- 19th IWCIA 2018: Workshop on Combinatorial Image Analysis 2018 - Porto (Portugal) (<https://sites.google.com/view/iwcia18>).
- 7th CTIC 2019 : 7th Workshop on Computational Topology in Image Context - Malaga (Spain)
- 13th MTA 2019: Meeting on Tomography and Applications Discrete Tomography, Neuroscience and Image Reconstruction - Milano (Italy)
- 3rd RRPR 2020: Third Workshop on Reproducible Research in Pattern Recognition (ICPR satellite event <https://rrpr2020.sciencesconf.org>)
- 20th IWCIA 2020: Workshop on Combinatorial Image Analysis 2020 - (Serbia) (<https://iwcia2020.wordpress.com>).

2 Activities in the last two years (since ICPR 2018)

Overview of the activities

- **2.1 Reports on main past events**
- **2.2 Other events and special issues**
- **2.3 Tutorial and new code release**
- **2.4 New event gathering GD and MM**

2.1 Reports on main past events

During the period of reference, the two main events of this TC: ISMM and DGCI 2019 that allows us to give the two main short reports of the events.

DGCI 2019 Short Report. The 21th IAPR International Conference on Discrete Geometry for Computer Imagery, DGCI 2019, was held at ESIEE Paris, France, during March 26-28 2019. This conference was organized by Michel Couprie, Jean Cousty, Yukiko Kenmochi and Nabil Mustafa from the ESIEE Paris, Université Paris-Est, France. The DGCI 2019 conference attracted 76 researchers. The scientific program consisted of 3 invited talks, 26 oral and 10 posters presentations during 3 days. This edition attracted 50 submissions by authors from 20 countries: Australia, Austria, Belgium, Brazil, China, France, Hungary, India, Iran, Italy, Japan, The Netherlands, Peru, Poland, Russia, Serbia, Spain, Sweden, UK, and USA.

Three keynote speeches were given:

- Alexandre Xavier Falcaõ, from University of Campinas, Brazil, on “The Role of Optimum Connectivity in Image Segmentation: Can the Algorithm Learn Object Information During the Process?”

- Longin Jan Latecki, from Temple University, USA, on “Computing Maximum Weight Cliques with Local Search on Large Graphs with Application to Common Object Discovery”
- János Pach, from Ecole Polytechnique Fédérale de Lausanne, Switzerland, on “The Blessing of Low Dimensionality”

Loïc Crombez (from Université Clermont Auvergne - LIMOS, France) obtained the best DGCI Student Paper award for his article: “Efficient Algorithms to Test Digital Convexity” (co-authored with Guilherme D. da Fonseca and Yan Gérard).

The full report will available online on the TC website: http://tc18.org/dgci/report_dgci2019.pdf

ISMM 2019 Short Report

The 14th International Symposium on Mathematical Morphology (ISMM 2019), was held in Saarbrücken, Germany, during July 8-10, 2019. The event was organized by Bernhard Burgeth, Andreas Kleefeld, Benoît Naegel, Nicolas Passat, and Benjamin Perret. The ISMM 2019 symposium attracted 70 researchers. The scientific program consisted of 3 invited talks, 24 oral and 16 posters presentations during 3 days. This edition attracted 54 submissions by authors from 16 countries: Austria, Brazil, France, Germany, Greece, India, Italy, The Netherlands, Pakistan, Serbia, South Korea, Spain, Sweden, Tunisia, UK, and USA. Three keynote talks were given:

- David Coeurjolly (CNRS, LIRIS, Lyon, France): “Geometry Processing on Voxel Objects”
- Fred A. Hamprecht (IWR, HCI, Heidelberg, Germany): “Watershed and Friends in the Age of Deep Learning”
- Boguslaw Obara (Durham University, Durham, UK): “Combining Mathematical Morphology and the Hilbert Transform for Fully Automatic Nuclei Detection in Fluorescence Microscopy”

RRPR 2018 Short Report

The second edition of the Workshop on Reproducible Research in Pattern Recognition was held in conjunction of ICPR 2018 in Beijing. Compared to the first edition, it followed the same spirit but with a special focus on Digital Geometry and Mathematical Morphology. It was intended as both a short participative course on the RR aspects leading to open discussions with the participants and also on how to actually perform RR. For this second edition, a new call for short paper was proposed to the ICPR authors. The main idea was to give already accepted ICPR authors the possibility to highlight the reproducibility quality of their work with a companion paper including implementation details, source code descriptions, parameter choice etc.

This workshop received a total of 15 papers covering the two main tracks of RR Framework (6 papers) and RR results (3 papers). Six papers were also submitted in the new short paper track. All papers were reviewed by at least 3 reviewers for the main RR result track and the short papers were reviewed by two kinds of review: one for the short paper itself and another coming from the RR label linked to the code repository (when authors apply for the label). A comparable number of participants was present in this workshop with around 20/30 participants and the public was actively participating to the discussions with presenters focusing on RR.

From all these contributions, two invited talks were opening the workshop. The first was related to the evolution and the future of the IPOL journal, including a new structure for machine learning applications. The second invited talk focused on a review of reproducible research platforms with an overview of available, new ways of publications. The three main papers on RR results were oral presentations and 4 short papers were oral fast track presentation. In addition to these new classical presentations, a new type of practical session was proposed by Miguel Colom with an “Hands on IPOL Demonstration System” where users were able to construct their own online demonstration from a simple description file.

The RRPR workshop chairs made the decision to handle the edition of their own post-proceedings (in Springer LNCS) allowing the publication of carefully revised papers and integrating improved content with invited paper contributions. These post-proceedings were published in June. Finally, the “Reproducible Label in Pattern Recognition” defined to highlight the reproducible aspects of the RRPR and ICPR works was once again proposed and will remain active with currently 7 submissions (<https://github.com/RLPR>).

2.2 Other events and Special issues

CTIC 2019

The 7th Workshop on Computational Topology in Image Context CTIC2019 was held in Malaga, Spain on January 24-25, 2019. The CTIC workshops deal with subjects like Topological features and invariants and their computation for digital images Topological algorithms for image processing, image segmentation under topological constraints etc. The event received 21 submissions and 14 were accepted for oral presentation. The proceedings were published in the LNCS Springer proceedings. The invited talks were the following:

- **Herbert Edelsbrunner**: Stochastic Geometry topological and experimental (http://www.ctic2019.uma.es/assets/1^_H-Edelsbrunner.pdf)
- **Carme Torras**: Challenges in Cloth Manipulation by Robots (http://www.ctic2019.uma.es/assets/13^_C-Torras.pdf)

<http://www.ctic2019.uma.es>

IWCIA 2018 & IWCIA 2020

The 19th Workshop on Combinatorial Image Analysis IWCIA 2018 was held in Porto, Portugal on November 22-24, 2018. The presented papers (18) were grouped into two main parts: a first group contains nine papers dealing with theoretical foundations of combinatorial image (like digital geometry, topology...) and the second was including nine papers oriented from the application context (like tomography, segmentation, medical imaging). The invited talks were the following:

- **José M. Bioucas-Dias**, Universidade de Lisboa, Portugal: “*Patch-based Inverse Problems in Interferometric Phase Imaging*”
- **Jan Kratochvil**, Charles University, Czech Republic: “*Geometric Representations of Graphs*”
- **Nicolai Petkov**, University of Groningen, The Netherlands: “*Representation learning with trainable COSFIRE filters*”

<https://sites.google.com/view/iwcia18/>

The 20 th workshop was held in Novi Sad, Serbia on July 16–18, 2020. 20 papers were presented following the same axis. The keynote presentation was done by Prof. Gyula O. H. Katona who spoke about the classification of random pictures in cryptology.

MTA 2019: 13th Edition on Meeting on Tomography and Applications Discrete Tomography, Neuroscience and Image Reconstruction. The aim of this Meeting is to share interdisciplinary aspects between the experimental research concerning X-ray tomography and the mathematical image reconstruction community. Annually a special issue of MTA is organized on the journal *Fundamenta Informaticae*. For this edition several members of TC18 were invited to present recent works:

- **Yan Gerard**, Université d’Auvergne: “*Polynomial Time Reconstruction of Regular Convex Lattice Sets from their Horizontal and Vertical X-Rays*”
- **Jacques-Olivier Lachaud**, Université de Savoie, LAMA: “*Digital convexity and digital planarity, global and local perspectives*”

- **Bertrand Kerautret**, Université Lumière Lyon 2, LIRIS: “*Overview of Recent Advances on Knot Segmentation in Tomographic Wood Images and Applications with Future Projects*”
- **Lama Tarsissi**, Université Paris Est Marne La Vallée: “*Inflation of digitally convex polyominoes*”

<https://www.eko.polimi.it/index.php/TAIR/TAIR2019>

All the proceedings of the presented events (except the MTA meeting) were published in LNCS series:



Workshop ipaMAC. Also organized in conjunction with ACPR2019, a new workshop was co-organized by Yukiko Kenmochi including discrete geometry in its topics: Image and Pattern Analysis for Multidisciplinary Computational Anatomy

<http://www.media.imit.chiba-u.jp/ipaMAC2019/>

Fives papers were presented as oral presentation and published in the common workshop proceedings.

Third Edition of RRPR Workshop 2020. Following the second successful edition of the IAPR RRPR workshop, we organizes the third edition of this workshop always in association to ICPR in order to promote Reproducible Research in Pattern Recognition. The workshop received a total of 18 submissions and 12 were selected for publication. From these papers, three were focused on Reproducible Research (RR) framework, four papers were on the topic of RR results and five were short extended ICPR papers. Thanks to this latter tyoe, the ICPR authors had the opportunity to publish content with a focus on the reproduction results.

Special Issues in different journals

Several special issues were proposed in conjunction to the previous main events and also from new initiatives of TC members.

- **Pattern Recognition Letters:** Special issue on: Hierarchical Representations: New Results and Challenges for Image Analysis Edited by Nicolas Passat, Camille Kurtz, Antoine Vacavant. <https://www.sciencedirect.com/journal/pattern-recognition-letters/special-issue/10ZCM30BRNN>
- **Journal of Mathematical Imaging and Vision:** Special issue on DGCI 2019. The special issue contains selected 8 extended papers. Editors: Michel Couprie, Jean Cousty, Yukiko Kenmochi, David Coeurjolly. <https://link.springer.com/journal/10851/volumes-and-issues/62-5>
- **Mathematical Morphology - Theory and Applications:** ISMM 2019 Special issue. https://www.degruyter.com/view/journals/mathm/mathm-overview.xml?tab_body=latestIssueToc-79128



2.3 Tutorial and New Code Release

Tutorial in Digital Geometry during ACPR 2019

A new tutorial on Digital Geometry has been presented during the international event of ACPR 2019. It took place on the first day of the conference: “Digital Geometry in Pattern Recognition: Extracting Geometric Features with DGtal and Applications”. It was presented by Bertrand Kerautret (Université de Lyon 2, France) and Jacques-Olivier Lachaud (Université Savoie Mont-Blanc, France).

<https://kerautret.github.io/ACPR19-DGPRTutorial>

New Code Release

After about 10 years of developments, the Dgtal Team was very proud to announce the DGtal 1.0 release. 26 developers have contributed to DGtal and its tools (see <https://dgtal.org>). Link to this new major version:

- DGtal 1.0: <https://github.com/DGtal-team/DGtal/releases/tag/1.0>
- DGtalTools 1.0: <https://github.com/DGtal-team/DGtalTools/releases/tag/1.0>



2.4 New event gathering Discrete Geometry and Mathematical Morphology

In order to facilitate / increase scientific interactions between researchers working in DG and MM, it was decided to initiate a new common event that will be organized for the first time in 2020. A call for proposals was released, and the steering committee has announced that Uppsala (Sweden) was selected to organize the first edition of this event in Fall 2020 (December 10-13, to be confirmed). The event will be chaired by Filip Malmberg (main chair), Nataša Sladoje (program chair) and Joakim Lindblad (Organization Chair). The organisation team is completed by advisors (Robin Strand, Ingela Nyström), honorary chair (Gunilla Borgefors, Christer Kiselman) and assistant (Johan Öfverstedt).

From this new event, we could also expect to increase the quality of scientific interactions. Depending of the its success, the future and frequency of the next editions of the event will be decided with the support of the TC18 which plays an important role for the interface between the two steering committees of DGCI and ISMM.

2.5 Other Usual Activities

As usual the activities of the TC18 were presented during the main TC18 conferences:

- During DGCI 19 (ESIEE, Paris, France): 27 March 2019, before the poster session. It was presented by Bertrand Kerautret and the support is from the TC18 website:

<https://tc18.org/files/reportDGCI2019.pdf>

- During ISMM 19 (Saarland University, Saarbrücken, Germany): presented on 9 July 2019 before the poster session. It was presented by Michael Wilkinson and the support is available from the TC18 website:

<https://tc18.org/files/reportISMM2019.pdf>

3 Future plans (timeline until ICPR 2022 and beyond)

3.1 Planned Activities

The planned activities follow the ones of the previous period, in particular the main event that already begin with the DGMM event (actually in the review phase). The RRPR workshop will be edited in a separated post-proceedings in order to give more time to authors to improve their paper after the event. New editions of special issues with JMIV already got approval of editor in chief and a new IPOL special issue on TC18 is also planned. A new edition of MTA is also planned if the covid situation allow it.

From the previous event of ICWIA 2020 this special issue is in progress:

Journal of Combinatorial Optimization: IWCIA 2020 Special issue. Guest editors: Reneta Barneva and Tibor Lukić. <https://www.springer.com/journal/10878/updates/17535916>



3.2 Recommendation to ExCo for TC leadership team for 2021-2022

For the next term, and following the IAPR rules, the TC18 chair has to change since Bertrand Kerautret already served two terms. Michael Wilkinson who is co-chair, unfortunately did not manifest the wish to take over. To alternate DG and MM, we had to look for new people coming from the MM and active in this field. Finally, we recommend the following TC18 leadership team for the 2020-2022 term:

- Benjamin Perret, Chair: since his PhD in 2011, Benjamin has been assistant professor in ESIEE (Paris, France). He is the authors of 13 articles in international journals and 22 conference papers (including 10 in ISMM). He co-organized the ISMM conference in Saarbrücken, Germany. He is also interested in Reproducibility and developed several online demonstrations of his research results.
- Sara Brunetti, Vice-Chair: she obtained her PhD in 2001. She is assistant professor in University of Siena (Italy), she authored 29 papers in international journals (including various high quality journals: TCS, JMIV, DAM) and 15 international workshops or conferences. She well know the different DGCI editions with contributions on discrete tomography to 10 different events since the 9th edition of DGCI in 2000.

Such a recommendation alternate the domains axis between Mathematical Morphology with Benjamin Perret and Discrete Geometry with Sara Brunetti.