

The Computational Geometry Algorithms Library

www.cgal.org

Monique Teillaud

INRIA - Loria (Gamble)

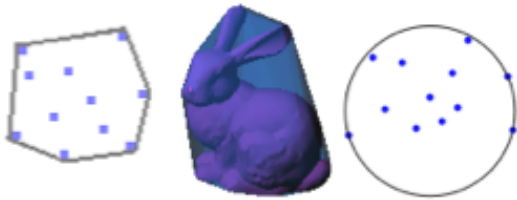


Loria

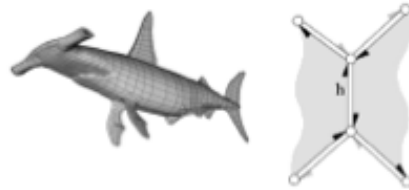
Inria



UNIVERSITÉ
DE LORRAINE



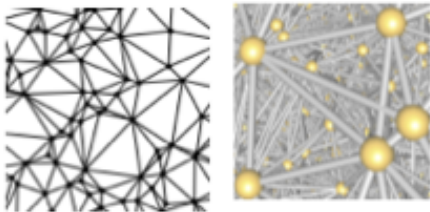
Bounding Volumes



Polyhedral Surface



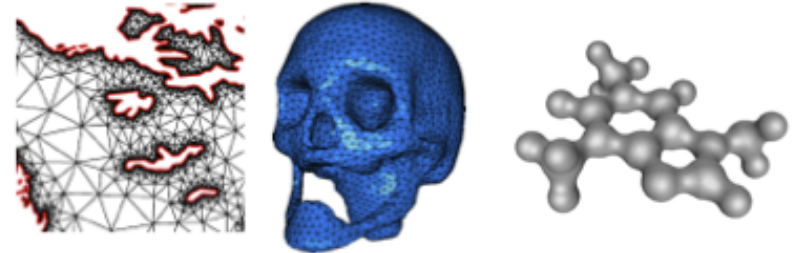
BooleanOperations



Triangulations



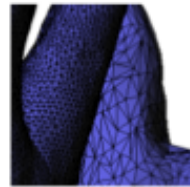
Voronoi Diagrams



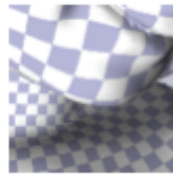
Mesh Generation



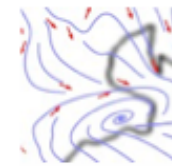
Subdivision



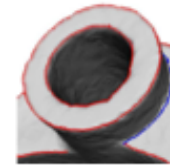
Simplification



Parameterization



Streamlines



Ridge Detection



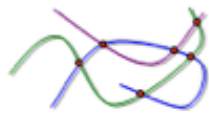
Neighbour Search



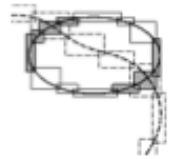
Kinetic Data structures



Lower Envelope



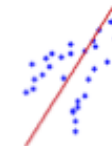
Arrangement



Intersection Detection



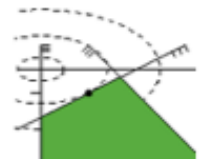
Minkowski Sum



PCA



Polytope distance



QP Solver

CGAL Users



- several thousands of downloads for each release
- included in debian, macports, etc

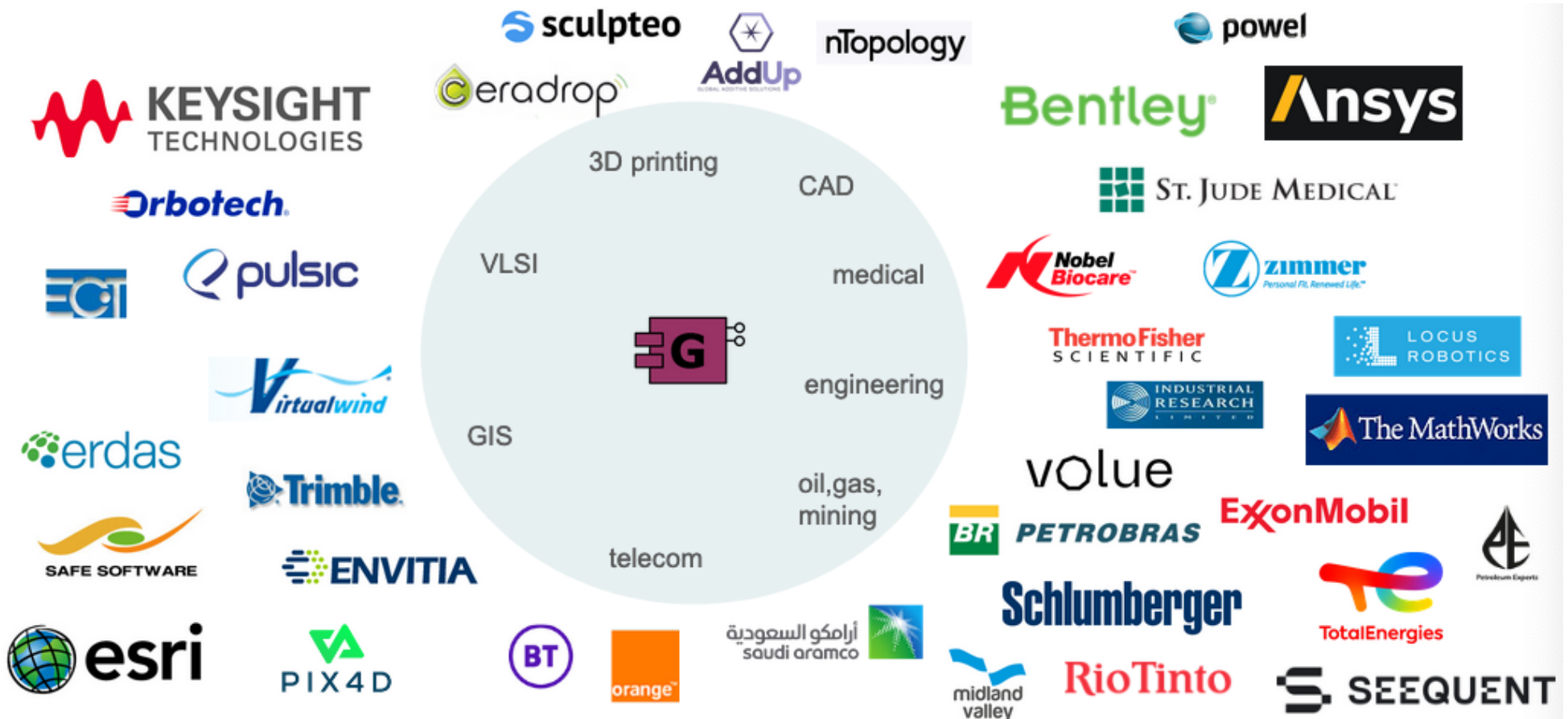
hard to track

academic

- Art
- Architecture, Buildings Modeling, Urban Modeling
- Astronomy
- Computational Geometry and Geometric Computing
- Computer Graphics
- Computational Topology and Shape Matching
- Computer Vision, Image Processing, Photogrammetry
- Games, Virtual Worlds
- Geographic Information Systems
- Geology and Geophysics
- Geometry Processing
- Mathematics
- Medical Modeling and Biophysics
- Mesh Generation and Surface Reconstruction
- 2D and 3D Modelers
- Molecular Modeling
- Motion Planning
- Optimization
- Particle Physics, Materials, Nanostructures, Microstructures, Fluid Dynamics
- Peer-to-Peer Virtual Environment
- Sensor Networks

CGAL Users

commercial



Historical Context

An Assessment (90's)

Computational Geometry: mostly theoretical

Smart algorithms, often hard/impossible to implement

A few pieces of software here and there

Not stable

Code often lost when students leave

Initial Consortium



ETH zürich



max planck institut
informatik



Funding (FP4 ESPRIT Program)

CGAL: Oct **1996** (21 months)

GALIA: Nov 1998 (18 months)

Goals

Promote the research in computational geometry

“make the large body of geometric algorithms developed in the field of CG available for industrial applications”

Mission Statement

CGAL EU Project Proposal, 1996

Create a reward structure for implementations

in academia

High quality

- Robustness
- Tests
- Documentation
- Review
- etc

Organization / Management

large software project

“Learning by walking” ...

Editorial Board

(2001)

Reviews

new package \simeq journal article

Reviews

Quality

“Reward structure for implementations in academia”

= give a value to software packages

Project Rules

- Responsibilities
 - Developer vs. Editor
 - Release / Review managers
- Voting rules
- Contribution process

A profitable investment

prevent the same discussions from going on and on

Limited ego

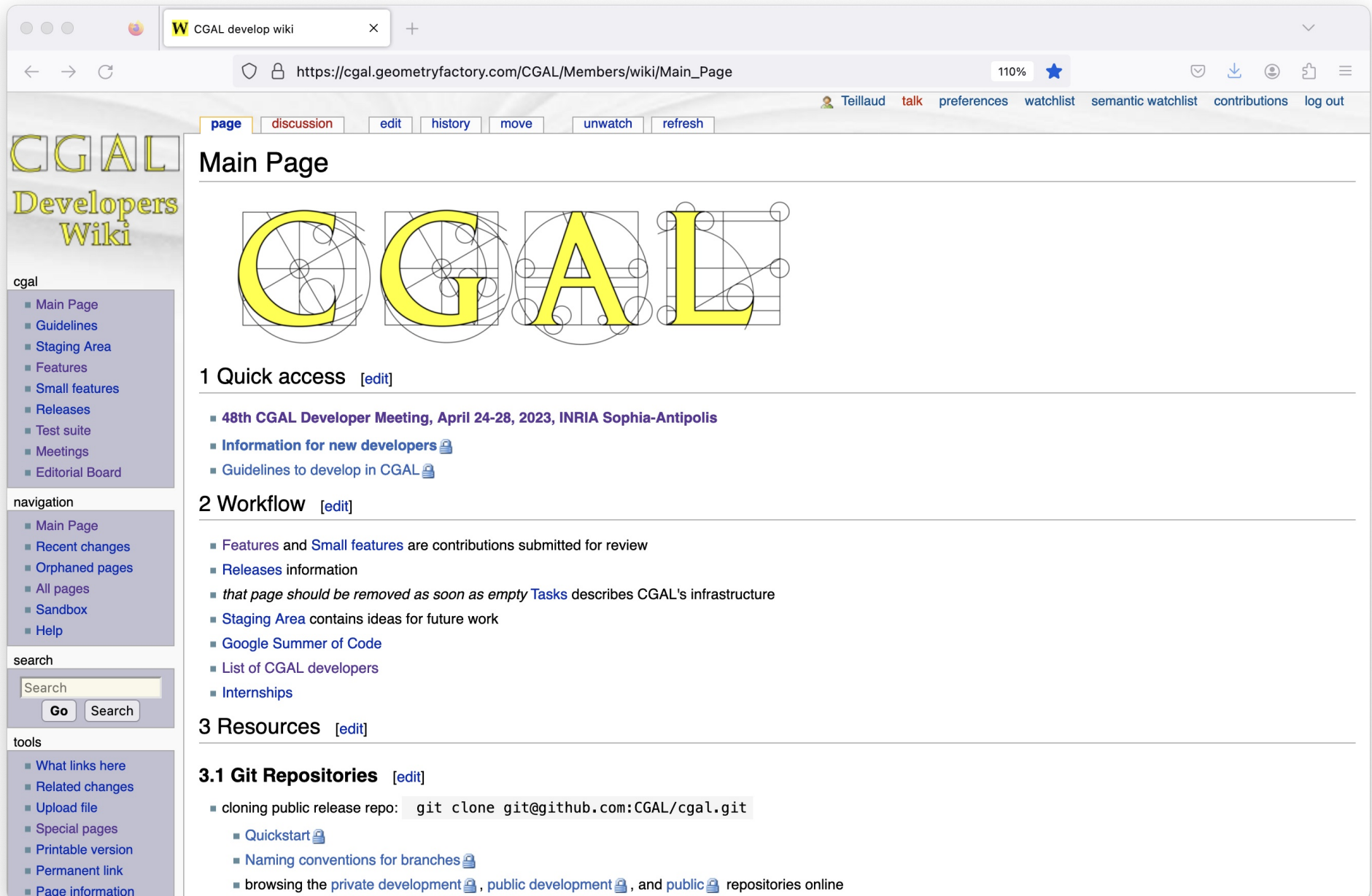
No Chairperson

Board Manager

- period of 6 months
- round-robin process

Infrastructure

Wiki



The screenshot shows a web browser window with the address bar displaying `https://cgal.geometryfactory.com/CGAL/Members/wiki/Main_Page`. The page title is "Main Page". The browser's address bar shows a 110% zoom level and a star icon for bookmarks. The page content includes a navigation menu on the left with sections for "cgal", "navigation", "search", and "tools". The main content area features a large "CGAL" logo with a geometric design, followed by a "1 Quick access" section with links to the 48th CGAL Developer Meeting, information for new developers, and guidelines to develop in CGAL. A "2 Workflow" section lists various development processes and resources. A "3 Resources" section includes a subsection for "3.1 Git Repositories" with a code snippet for cloning the public release repo and links to quickstart, naming conventions, and browsing repositories.

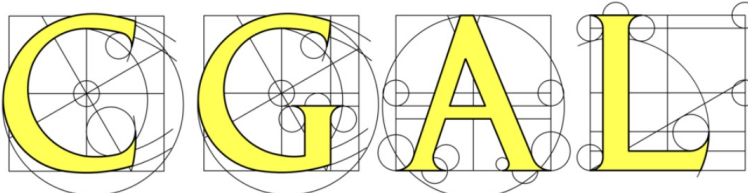
W CGAL develop wiki x +

← → ↻ `https://cgal.geometryfactory.com/CGAL/Members/wiki/Main_Page` 110% ★

Teillaud talk preferences watchlist semantic watchlist contributions log out

page discussion edit history move unwatch refresh

Main Page



1 Quick access [\[edit\]](#)

- 48th CGAL Developer Meeting, April 24-28, 2023, INRIA Sophia-Antipolis
- [Information for new developers](#)
- [Guidelines to develop in CGAL](#)

2 Workflow [\[edit\]](#)

- Features and Small features are contributions submitted for review
- Releases information
- that page should be removed as soon as empty [Tasks](#) describes CGAL's infrastructure
- Staging Area contains ideas for future work
- Google Summer of Code
- List of CGAL developers
- Internships

3 Resources [\[edit\]](#)

3.1 Git Repositories [\[edit\]](#)

- cloning public release repo: `git clone git@github.com:CGAL/cgal.git`
 - [Quickstart](#)
 - [Naming conventions for branches](#)
 - browsing the [private development](#), [public development](#), and [public](#) repositories online

Submission / Reviews

The screenshot shows a Wiki page for 'Features/Vanilla/1st round'. The page has a navigation bar at the top with links for 'page', 'discussion', 'edit', 'history', 'move', 'watch', and 'refresh'. The user 'Teillaud' is logged in, with links for 'talk', 'preferences', 'watchlist', 'semantic watchlist', 'contributions', and 'log out'. The page content is organized into sections: '1 Submission', '2 Reviews', '3 Discussion', and '4 Conclusion'. A search bar at the bottom shows a search for 'rev' with 1 of 1 match.

CGAL Developers Wiki

cgal

- Main Page
- Guidelines
- Staging Area
- Features
- Small features
- Releases
- Test suite
- Meetings
- Editorial Board

navigation

- Main Page
- Recent changes
- Orphaned pages
- All pages
- Sandbox
- Help

search

Search

tools

- What links here
- Related changes
- Upload file
- Special pages
- Printable version
- Permanent link

Features/Vanilla/1st round

< Features | Vanilla

This subpage should contain more detailed comments by the authors that are specific for this submission, for instance, which pages contain new documentation, where one should read first, etc.

Contents [show]

1 Submission [edit]

Use macro `\cgalModifBegin` and `\cgalModifEnd` to indicate the modifications. When you add a new function, use these macro around its documentation.

You can also use a macro like `\tred{modified text}` if your modification concerns only a small part of text.

```
ALIASES += tred{1}="\htmlonly < b > < font color='red' >\endhtmlonly \1 \htmlonly < /font > < /b > \endhtmlonly "
```

THE PAGE MUST CONTAIN THE FOLLOWING LINKS

- [link to pdf file of 1st submission] - 2012-12-21 Monique Teillaud

2 Reviews [edit]

- /Review Andreas Fabri - 2013-01-01

Nobody is allowed to edit the comments of a reviewer. Answers to the review and the subsequent discussion takes place on a separate discussion page.

3 Discussion [edit]

- /Answer to review and discussion -- 2013-01-03 -- Irene

4 Conclusion [edit]

- There is a major unsolved disagreement, see [Section 'major issues' of the discussion](#) -- 2013-01-10 Andreas Fabri
- However, we decided to close the round for now and await the next submission. -- 2013-01-11 Laurent Rineau (primary reviewer)

× ^ v Highlight All Match Case Match Diacritics Whole Words 1 of 1 match

Documentation

Previously:

Home-made LaTeX tools

Nowadays:

Doxygen

+ Home-made scripts

Files

Previously:

`cvs` then `svn` at INRIA

then `git` on the INRIA forge \longrightarrow does not scale

Finally:

`github`

(INRIA `gitlab`
 \longrightarrow too late
 \longrightarrow not open)

HEAVY!

not research work...

no funding for an engineer

Open-Source Project

Licence

November, 2003 (Release 3.0)

Contributions welcome

Dual licence



suits the needs of most academic users

Commercial for companies that sell their software



January, 2003, INRIA startup



sells

commercial licenses

support

Ownership stays to the institutes/universities of authors



Responsible for **long-term maintenance**

C++ / compilers evolutions
portability
etc

Maintenance of **infrastructure**

github
wiki
provider for the website
testsuite
documentation tools

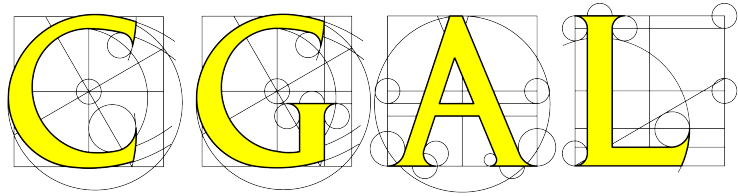
releases



Would the CGAL project have survived without GF...?

Research

Interplay



Result of research

Teams integrate their **favorite** algorithms

Helps researchers (in many fields)

Raises new research questions

New Research Questions

Implementation “ Details ”

*In theory, there is no difference between theory and practice.
In practice, there is.*

Arithmetic Issues

Degenerate cases

User's questions

Evaluation

experimental work in the scope, but papers often rejected

The article is well written. However, it only includes one theoretical result, albeit useful for applications. As a theoretical scientist I cannot accurately assess the importance and impact of the implemented algorithms on the field.

Anonymous SoCG reviewer

Evaluation

experimental work in the scope, but papers often rejected

Confidence: 1. No familiarity (I do not understand the results).

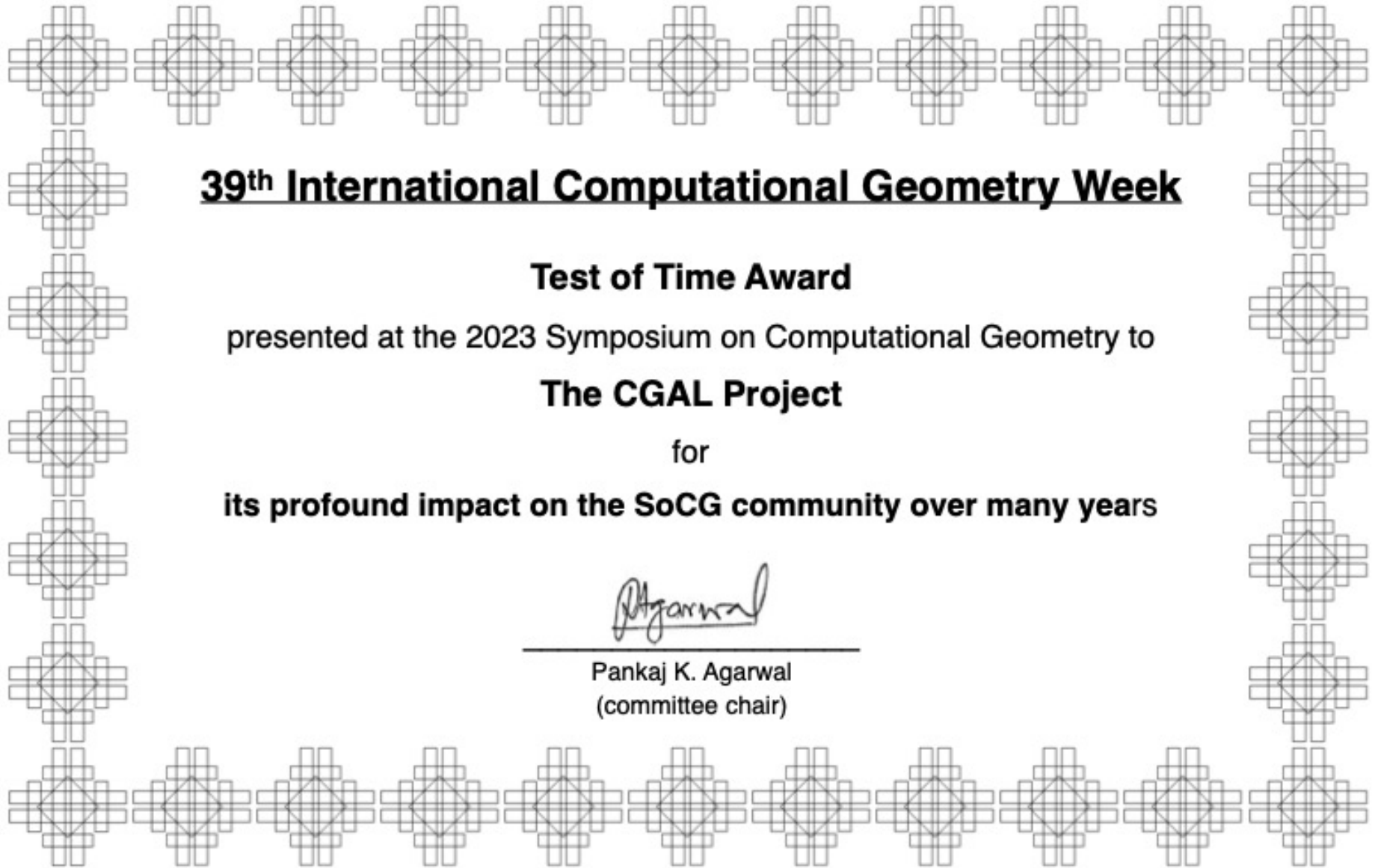
Paper summary and comments for authors

“This reviewer did not understand the actual result. The paper studies flips of triangulations of surfaces. [...]

It is unclear [...] why it should be interesting to a general algorithms audience.

I think it’s a clear rejection.”

Anonymous SODA reviewer



39th International Computational Geometry Week

Test of Time Award

presented at the 2023 Symposium on Computational Geometry to

The CGAL Project

for

its profound impact on the SoCG community over many years

A handwritten signature in black ink, which appears to read "P. Agarwal".

Pankaj K. Agarwal
(committee chair)

People

Diversity

gather **many** skills:

mathematics

algorithms

C++

development tools

organization / project management

contacts with application fields

etc

Contributors

Past and Current

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Ken Arroyo Ohori
Dror Atariah
Alon Baram
Matthias Bäsken
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Yin Xu
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Mariette Yvinec (former editor)
Lingjie Zhu
Afra Zomorodian
Guy Zucker
Baruch Zukerman
Tali Zvi

+ Editorial Board

Contributors

“Reward structure for implementations in academia” ?

CGAL developers leave



companies (Google, Intel, Apple, ...)

positions in universities

CGAL developers in academia

mostly in research institutes

(INRIA, CNRS, ETHZ, ...?)

Ingredients - Summary

Will + Goals

Technical choices

Project Management / Organization / Rules

Infrastructure

GeometryFactory

Research

People

Will + Goals

Technical choices

Project Management / Organization / Rules

Infrastructure

Geometry Factory

Research

People

THANK YOU