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Born March 2, 1980—Rosario, Argentina
Married, 1 child, Argentinian citizen

Current Activities

Freelance researcher, programmer and consultant in Geometry, Computer Graphics and related areas.

Education and Past Positions

2014–2016 Tenure track professor of Computer Science at the Federal University of Rio de Janeiro (UFRJ), Brazil, since 2014.

2012–2014 Excellence post-doctoral fellow at the National Institute of Pure and Applied Mathematics (IMPA) in Rio de Janeiro, in the Visgraf group headed by Prof. Luiz Velho.

2011–2012 Post-doctoral fellow at the National Kapodistrian University of Athens, Greece, in the Laboratory of Geometric & Algebraic Algorithms headed by Prof. Ioannis Emiris.

2006–2010 *PhD* in Computer Science, Nancy University, France. Thesis: *Non-linear Computational Geometry for Planar Algebraic Curves*, adviced by Sylvain Lazard at INRIA Nancy-Grand Est.

1998–2006 *Computer Science* degree (equivalent to MSc degree), University of Rosario, Argentina.

1993–1997 *High School*, Polytechnic Institute, Rosario, Argentina.

Research Interests

Although I was always eager to explore new areas, my main research topic is *Computational Geometry*. In this field, I am interested in robustness issues in non-linear geometric algorithms, in higher dimensional geometric computing and in the applications of geometric and algebraic algorithms. I am also interested in the robust and efficient implementation of geometric, algebraic and arithmetic algorithms.

In the last years, I biased my research topic to *Computer Graphics*. In this broad field, I am mostly interested in the application of mathematical tools to visualization problems.

In my PhD thesis, I worked in the subfield of non-linear computational geometry. I tackled the problem of computing the topology of plane algebraic curves. Therein, I presented an algorithm that avoids special treatment of degenerate cases, based on algebraic

tools such as Gröbner bases and rational univariate representations. I implemented this algorithm and showed its performance by comparing to similar existing programs. I also presented an output-sensitive complexity analysis of this algorithm. I then discussed the tools that are necessary for the implementation of non-linear geometric algorithms in *CGAL*, the reference library in the computational geometry community. I presented an univariate algebraic kernel for *CGAL*, a set of functions aimed to handle curved objects defined by univariate polynomials. I validated this approach by comparing it to other similar implementations.

After the doctorate, I started working on high-dimensional computational geometry. My project consisted in exploring in detail the behavior of algorithms to deal with higher dimensional objects. The aim was to propose a set of algebraic methods better suited to work in high-dimensions, instead of using generalizations of the algorithms used in small dimensions. Moreover, there are only few efficient implementations of high-dimensional geometric algorithms and another objective of the work was to add such algorithms to the *CGAL* d-dimensional kernel. This is currently being done, and some pieces of code are under review for inclusion on the library.

A related research direction on which I also participated during my first post-doc is the development of an algorithm to compute the Newton polytope of the resultant of a polynomial system. The novelty of this approach is the use of certain liftings that allow us to work on the secondary polytope, and solve the problem combinatorially.

In my second post-doc, at IMPA, I moved a bit from Computational Geometry, approaching the field of Computer Graphics. I worked in the applications of Möbius transformations to panorama visualizers, in order to obtain more realistic views of an image inscribed on a sphere. Currently, I am interested in other applications of Möbius transformations in visualization.

Currently, I am interested in problems from Computational Geometry and Computer Graphics. Namely, in Computational Geometry, I am focusing on the isolation of polynomial roots, what is a central problem in non-linear Computational Geometry, and on the 3-colorability of certain types of graphs. In Computer Graphics, I am focusing the application of complex transformations to image processing problems.

Consulting

During the last years, I had realized that my expertise can greatly help in industrial environments. Freelance consulting offers me a way of acquiring knowledge, thinking about problems in unexplored areas (related or not to my academic research) and applying theoretical concepts to real-life scenarios. Even if I am currently working as a consultant in Geometry, Computer Graphics, 3D modeling and design, I am open to embark on other exciting areas.

Scientific Software

C++ I participated in the development of *HeaDDaCHe*, an implementation of Hashed Dynamic Determinants for use in geometric algorithms, such as Convex Hull and triangulation. This

library consists of efficient implementations of dynamic determinant algorithms and a hash table that stores intermediate results (matrices and determinants) in order to be used in subsequent steps of the geometric algorithm.

C++, GLSL — I also participated on the development of *Panoramic*, a software which uses shaders to visualize panoramic images using different projections. In particular, it permits to use the technique based on Möbius transformations I introduced recently.

C++ — I collaborated to the development of *respol*, a software to compute a projection of the Newton polytope of the resultant of a polynomial system. Apart of being the implementation of a novel algorithm, this software incorporates improvements in the computation of many sequential determinants, which are crucial to the algorithm, thus considerably speeding-up the computation time.

Maple — In the past, I contributed to the development of *Isotop*, an implementation of the algorithm for the determination of the topology of real plane curves. This software is registered on the French Program Protection Agency.

C++ — The reference software in Computational Geometry is *CGAL*, the Computational Geometry Algorithms Library. Before inclusion in this library, all code goes under a thorough review by experts in the domain chosen by the *CGAL Editorial Board*. In the context of this library, I developed a univariate algebraic kernel based on the *RS* library. This kernel contains functions to deal with univariate polynomials, such as root isolations and comparison of algebraic numbers. It was the first implementation of such a set of functions included in *CGAL*, and is bundled since March 2010 (version 3.6). I also developed interfaces for *CGAL* to the *MPFR* and *MPFI* libraries. These interfaces (known as *number types*) are included in *CGAL* since October 2009 (version 3.5). I am currently the maintainer of the packages I developed.

C — *Libmug* is a small library to compute the greatest common divisor of two univariate polynomials. It uses modular arithmetic, to avoid the coefficient explosion in the Euclidean algorithm. The initial code was first published as part of CGAL's algebraic kernel, but later removed when the kernel was rewritten.

Language Skills

I am able to fluently speak Spanish (my mother tongue), as well as English, French, Italian and Portuguese. I also have basic communication skills in Greek and German.

Certifications

2014 — *Introductory Kanban*. LeanKanban University Certified Training Program.

Internships

2006 — *Arrangements of Algebraic Curves* at INRIA Lorraine, France (6 months).

2004–2005 — *SSA Form in the Testing of Programs with Arrays*, thesis corresponding to the MSc degree level studies (18 months, part-time).

2003 — *Intersection of Quadric Surfaces* at INRIA Lorraine, France (3 months).

2002–2004 *Simulation Methods in Physics* at the university, as part of the Computer Science studies (24 months, part time).

Teaching and Advising

2014–2016 I advised Eric Biagioli on his PhD studies at IMPA, along with Roberto I. Oliveira. We worked on methods for root isolation of univariate polynomials.

2014–2016 Tenure track professor at UFRJ. Courses given include "Computer Graphics", "Integer Numbers and Cryptography", "Computational Geometry" and "Numerical Analysis".

2013 Short course on Line Arrangements in Computational Geometry, in the context of the summer program at IMPA.

2011–1012 Teaching assistant in the postgraduate course "Computational Geometry", in the National Kapodistrian University of Athens, Greece.

2009–2010 At the end of my PhD (2009–2010), I benefited from university funding, which allowed me to do 96 hours of teaching. In this context, I was the head professor of the course "Geometric Foundations of Computer Graphics" in Bachelor degree studies (*License*, in French) at Nancy University; I also conceived the lectures and exams of this course. For the same public, I also gave tutorials on "Geometry and Representation in Space" and I was teaching assistant in "Algorithmic" and "Programming Environment".

2008–2009 During my first three years of PhD (2006–2009), I benefited from an INRIA grant, which avoided me to teach more than 36 hours. I gave introductory courses in Computer Science for non-scientific public at Nancy University (36 hours).

Scientific Publications

The publications listed here are classified by type. Were omitted drafts and reports published later, as well as software manuals. It should be stressed that, in Computational Geometry, authors are usually specified in alphabetical order.

Articles in refereed international journals

[1] V. Fisikopoulos and L. Peñaranda. Faster geometric algorithms via dynamic determinant computation. *Computational Geometry: Theory and Applications*, 54:1–16, Elsevier, Apr. 2016. http://dx.doi.org/10.1016/j.comgeo.2015.12.001.

[2] L. Peñaranda, L. Velho, and L. Sacht. Real-time correction of panoramic images using hyperbolic Möbius transformations. *Journal of Real-Time Image Processing*, Springer, 2015. http://dx.doi.org/10.1007/s11554-015-0502-x.

[3] I. Emiris, V. Fisikopoulos, C. Konaxis, and L. Peñaranda. An oracle-based, output-sensitive algorithm for projections of resultant polytopes. *International Journal of Computational Geometry & Applications (special issue of invited papers from SoCG'12)*, 23(4n5):397–423, World Scientific, 2013. http://dx.doi.org/10.1142/S0218195913600108.

[4] J. Cheng, S. Lazard, L. Peñaranda, M. Pouget, F. Rouillier, and E. Tsigaridas. On the topology of real algebraic plane curves. *Mathematics in Computer Science (special issue on Computational Geometry and Computer Aided Geometric Design)*, 4(1):113–137, Birkhäuser, 2010. http://dx.doi.org/10.1007/s11786-010-0044-3.

[5] S. Lazard, L. Peñaranda, and S. Petitjean. Intersecting quadrics: an efficient and exact implementation. *Computational Geometry: Theory and Applications (special issue of invited papers from SoCG'04)*, 35(1-2):74–99, Elsevier, 2006. http://dx.doi.org/10.1016/j.comgeo.2005.10.004.

[6] L. Gómez, C. Gazza, H. Dacharry, L. Peñaranda, and A. Dobry. Pressure dependence of the melting mechanism at the limit of overheating in Lennard-Jones crystals. *Physical Review B*, 71(13):134106, American Physical Society, Apr. 2005. http://dx.doi.org/10.1103/PhysRevB.71.134106.

Publications in selective international conferences

[7] E. Biagioli, F. Bergero, R. Imbuzeiro Oliveira, and L. Peñaranda. Applying root-finding techniques to extend quantized-state-systems-based solvers. In *XLII Latin American Computing Conference, CLEI 2016*, pages 1–9, Valparaíso, Chile, Oct. 2016. IEEE. http://dx.doi.org/10.1109/CLEI.2016.7833372.

[8] V. Fisikopoulos and L. Peñaranda. Faster geometric algorithms via dynamic determinant computation. In *Proceedings of the 20th European Symposium on Algorithms, ESA 2012*, volume 7501 of *Lecture Notes in Computer Science*, pages 443–454, Ljubljana, Slovenia, Sept. 2012. Springer. http://dx.doi.org/10.1007/978-3-642-33090-2_39.

[9] I. Emiris, V. Fisikopoulos, C. Konaxis, and L. Peñaranda. An output-sensitive algorithm for computing projections of resultant polytopes. In *Proceedings of the 28th Symposium on Computational Geometry*, pages 179–188, Chapel Hill, NC, USA, June 2012. ACM. http://dx.doi.org/10.1145/2261250.2261276.

[10] J. Cheng, S. Lazard, L. Peñaranda, M. Pouget, F. Rouillier, and E. Tsigaridas. On the topology of planar algebraic curves. In *Proceedings of the 25th Symposium on Computational Geometry*, pages 361–370, Aarhus, Denmark, June 2009. ACM. http://dx.doi.org/10.1145/1542362.1542424.

[11] S. Lazard, L. Peñaranda, and E. Tsigaridas. Univariate algebraic kernel and application to arrangements. In *Proceedings of the 8th International Symposium on Experimental Algorithms, SEA 2009*, volume 5526 of *Lecture Notes in Computer Science*, pages 209–220, Dortmund, Germany, June 2009. Springer. http://dx.doi.org/10.1007/978-3-642-02011-7_20.

[12] S. Lazard, L. Peñaranda, and S. Petitjean. Intersecting quadrics: an efficient and exact implementation. In *Proceedings of the 20th Symposium on Computational Geometry*, pages 419–428, Brooklyn, NY, USA, June 2004. ACM. http://dx.doi.org/10.1145/997817.997880.

Publications in other international conferences and workshops

[13] E. Biagioli, L. Peñaranda, and R. Imbuzeiro Oliveira. New method for bounding the roots of a univariate polynomial. In *28th Conference of Patterns, Graphics and Images, Workshop of Works in Progress*, Salvador, Brazil, Aug. 2015.

[14] I. Emiris, V. Fisikopoulos, and L. Peñaranda. Optimizing the computation of sequences of determinantal predicates. In *Proceedings of the 28th European Workshop on Computational Geometry*, pages 109–112, Assisi, Italy, Mar. 2012.

[15] J. Cheng, S. Lazard, L. Peñaranda, M. Pouget, F. Rouillier, and E. Tsigaridas. On the topology of planar algebraic curves. In *Proceedings of the 24th European Workshop on Computational Geometry*, pages 213–216, Nancy, France, Mar. 2008.

[16] S. Lazard, L. Peñaranda, and E. Tsigaridas. A CGAL-based univariate algebraic kernel and application to arrangements. In *Proceedings of the 24th European Workshop on Computational Geometry*, pages 91–94, Nancy, France, Mar. 2008.

Doctoral dissertations

[17] L. Peñaranda. *Non-linear computational geometry for planar algebraic curves*. PhD thesis, Nancy Université, Nancy, France, Dec. 2010.

[18] L. Peñaranda. Testing programs with arrays using the SSA form. Argentinean BsC thesis (equivalent of French MsC thesis), Universidad Nacional de Rosario, Rosario, Argentina, Feb. 2006. In Spanish.