Brice Loustau

Research Postdoctoral associate – HITS / Heidelberg University

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Research Interests

Teichmüller-Thurston theory, hyperbolic geometry, Riemannian geometry, symplectic geometry of moduli spaces, complex analysis and geometry, minimal surfaces and harmonic maps, geometric analysis, discrete differential geometry, mathematical programming, mathematics visualization, mathematics education.

Academic positions

2020 – present	Postdoctoral Associate at HITS (Heidelberg Institute of Advanced Study) and Heidelberg University, Germany. Research group of Prof. Anna Wienhard.
2018 – 2020	Postdoctoral Associate at TU Darmstadt, Germany.
2015 – 2018	Postdoctoral Associate at Rutgers University - Newark, New Jersey, USA.
2014 – 2015	Visiting Research Associate at IMPA, Rio de Janeiro, Brazil.
2011 – 2014	Postdoctoral Associate at Université Paris-Sud XI Orsay. ERC *HighTeich* program of Prof. François Labourie.

Education

2008 – 2011	Ph.D., Université de Toulouse 3. Mention Très Honorable (highest honors).
	Ph.D. Thesis: The symplectic geometry of the deformation space of complex projective structures on a surface.
	Advisor: Jean-Marc Schlenker.
	Ph.D. Committee: G. Besson (president), S. Kerckhoff (referee), F. Bonahon (referee), J.-M. Schlenker (advisor), C. Lecuire, A. Papadopoulos, S. Tan.
2007 – 2008	Master in Pure Mathematics, Univ. Toulouse 3. Mention Très Bien (highest honors).
2007	Agrégation de Mathématiques. Rank: 28/2801.
2004 – 2006	École Normale Supérieure de Cachan - antenne de Bretagne.
2002 – 2004	Classes Préparatoires, M. Montaigne, Bordeaux (MPSI, MP*).
2002	Baccaulauréat à Option Internationale, série S. Mention Très Bien (highest honors).

Publications and preprints

1. The symplectic geometry of the deformation space of complex projective structures.
Geometry & Topology 19 (2015), no. 3, 1737–1775.
2. Minimal surfaces and symplectic structures of moduli spaces.
Geometriae Dedicata 175 (2015), 309–322.
3. Bi-Lagrangian structures and Teichmüller theory (with A. Sanders).
Submitted. Preprint: arXiv:1708.09145
4. Computing discrete equivariant harmonic maps (with J. Gaster and L. Monsaingeon).
Submitted. Preprint: arXiv:1810.11932
5. Computing harmonic maps between Riemannian manifolds (with J. Gaster and L. Monsaingeon).
Submitted. Preprint: arXiv:1910.08176
6. The sum of Lagrange numbers (with J. Gaster).
Accepted in *Proceedings of the AMS*. Preprint: arXiv:2008.07659
7. Harmonic maps from Kähler manifolds.
Submitted. Preprint. Preprint: arXiv:2010.03545

Works in preparation

8. Hyper-Kähler geometry of minimal hyperbolic germs (with F. Bonsante, A. Sanders, and A. Seppi).
We study the hyper-Kähler geometry of the moduli space of minimal hyperbolic germs, extending the hyper-Kähler metric of Donaldson off almost-Fuchsian space.
9. Complex geometry of the universal moduli space of Higgs bundles (with A. Sanders & N. Tholozan).
We study the complex geometry of the universal moduli space of Higgs bundles over Teichmüller space.
10. Symplectic geometry of Wick rotations (with C. Scarinci).
We study the symplectic properties of Wick rotations between moduli spaces of Einstein 3-manifolds in relation to bi-Lagrangian structures.
11. Discrete Bochner formula on Riemannian manifolds (with J. Gaster and L. Monsaingeon).
We establish a discrete Bochner formula for functions on a discretized Riemannian manifold taking values in a Riemannian manifold.

Notes

Available at brice.loustau.eu/research.html#Notes

1. Higgs bundles and Hitchin components.
Notes for the workshop *Higher Teichmüller-Thurston spaces* at Orsay, France, Fall 2012.
2. Minimal surfaces and quasi-Fuchsian structures.
Notes for the NSF workshop *Higgs bundles and harmonic maps* in Asheville, NC, USA, Jan. 2015.
3. Riemann surfaces.
Lecture notes for a Masters course at TU Darmstadt, Winter 2018-2019.
4. Hyperbolic geometry and applications.
Report of the GRG group (HITS). To appear in *HITS Annual Report 2020.*

Book

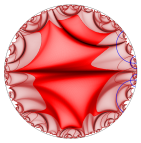
URL: brice.loustau.eu/research.html#Book

Hyperbolic geometry.
Preprint: arXiv:2003.11180 or HAL-02518149.
To be published by *Springer* in Summer 2021.

Mathematical software

More at www.brice.loustau.eu/software.html

Circle Packings
(with B. Beeker)
Computes and shows circle packings and Riemann conformal mappings.



Harmony
(with J. Gaster)
Computes and shows equivariant harmonic maps.

Service

HEGL (Heidelberg Experimental Geometry Lab)

I am a member of the team responsible for the creation of HEGL at Heidelberg University. The goal of HEGL is to promote interaction between theoretical mathematics, experimental mathematics, and computer visualization.

Organization of conferences, seminars, workshops

- Co-organizer of the Seminar *HEGL*, Heidelberg University, Spring 2021.
- Co-organizer of the *HITS Happy Hour*, Heidelberg, February 2021.
- Co-organizer of the *Differential Geometry Seminar*, TU Darmstadt, Spring 2020.
- Organizer of the *Mathematics Colloquium* at Rutgers University - Newark, 2015-2016 and 2017-2018.
- Co-organizer of the NSF GEAR Workshop Analytic Aspects of Higher Teichmüller Theory at Rutgers University - Newark, September 2016. NSF Funding received through GEAR: $25,000.
- Co-organizer of the *Mathematics Colloquium* at Rutgers University - Newark, 2016-2017.
- Co-organizer of the *Teichmüller Theory seminar* at Rutgers University - Newark, 2015–2018.
- Co-organizer of the *Parabolic complex projective structures* workshop at IMPA, Rio de Janeiro, 2014.
- Organizer of the *Geometry and Structures* workshop at Université Paris XI, 2013.
- Co-organizer of the *Higher Teichmüller theory* workshop at Université Paris XI, 2012.

Referee for mathematics journals

- Referee for *American Journal of Mathematics*, 2020.
- Referee for *Differential Geometry and it Applications*, 2019.
- Referee for *Forum Mathematicum*, 2019.
- Referee for *European Mathematical Society Surveys*, 2018.
- Referee for *Annales Scientifiques de l'École Normale Supérieure*, 2018.
- Referee for *Geometriae Dedicata*, 2017.
- Referee for *Inventiones Mathematicae*, 2016.
- Referee for *Geometry & Topology*, 2015.
- Referee for *Journal of Symplectic Geometry*, 2015.
- Referee for *Geometry & Topology*, 2013.

Outreach

- Author of the 2021 HITS Annual Report *Hyperbolic geometry and applications.*
- Interview for the magazine *Science & Vie* (#1 science magazine in France) for the article *On ne saura jamais si nous vivons à l'extérieur ou à l'intérieur de la Terre*, July 2016.
- Creator of the YouTube channel for the Teichmüller Theory Seminar at Rutgers-Newark, 2015–2018.

Invited talks

Conferences

- *Hyper-Kähler geometry of minimal hyperbolic germs.* Harmonic maps, Higgs bundles, and special surface classes. DMV meeting. Chemnitz, Germany, September 2020.
- *Computing harmonic maps between Riemannian manifolds.* ICERM (Brown University), Geometry Labs United Conference, online conference. July 2020.
- *Computing equivariant harmonic maps.* Higher-Teichmüller theory and geometric structures, scientific meeting. Pavia, Italy, June 2019.
- *Harmonic maps and Kähler geometry.* Harmonic maps and rigidity, *Projet Jeunes Géomètres* workshop. Sisteron, France, April 2019.
- *Computing discrete equivariant harmonic maps.* Geometry and Approximation. AG seminar retreat, Höchst, Germany, February 2019.
- *Bi-Lagrangian structures and Teichmüller theory.* Teichmüller Theory and its Connections to Geometry, Topology and Dynamics. Thematic Program, Fields Institute, University of Toronto, August 2018.
- *Relative character varieties and their symplectic structure.* Parabolic Higgs bundles and relative character varieties, NSF GEAR Workshop. Palm Springs, California, February 2018.
- *Computing discrete equivariant harmonic maps.* Analytic Aspects of Higher Teichmüller Theory, NSF GEAR Workshop. Rutgers University - Newark, September 2016.
- *Harmonic maps.* Workshop on $Sp(4,\mathbb{R})$ Anosov representations, NSF GEAR Network. Granby, Colorado, January 2016.
- *Minimal surfaces in hyperbolic 3-manifolds and deformation spaces.* AMS Sectional Meeting. Rutgers University, New Brunswick, November 2015.
- *Computing equivariant harmonic maps.* Higher Teichmüller theory and Higgs bundles: interactions and new trends. Hengstberger Symposium, European Research Council. University of Heidelberg, November 2015.
- *Minimal surfaces in $\mathbb{H}^3$ and quasi-Fuchsian representations.* Higgs Bundles and Harmonic Maps Workshop, NSF GEAR Network. Asheville, USA, January 2015.
- *Geometric structures and character varieties.* Journées nancéiennes de géométrie. Département de mathématiques de Nancy, Université de Lorraine, January 2013.
- *The hyperkähler geometry of the deformation space of complex projective structures on a surface.* NSF GEAR Retreat. University of Illinois at Urbana-Champaign, USA, August 2012.
- *Minimal surfaces in almost-Fuchsian manifolds and symplectic structures.* Senior seminar, Geometry and analysis of surface group representations. Institut Henri Poincaré, Paris, March 2012.
- *Symplectic geometry of deformation spaces.* Geometry, Topology and Dynamics of Character Varieties. Tokyo Institute of Technology and NSF, National University of Singapore, 18 June- 15 August 2010.

Seminars and Colloquia

- *Discrete Riemannian geometry via the Laplace-Beltrami operator.*
  - Differential Geometry Group Meeting, Heidelberg University, November 2020.
- *The sum of Lagrange numbers.*
  - Geometry seminar, University of Strasbourg, November 2020.
- *Planar graphs, circle packings, and conformal maps.*
  - HITS Lab Meeting, Heidelberg, September 2020.
- *The hyper-Kähler geometry of minimal hyperbolic germs.*
  - Geometry seminar, University of Wisconsin at Milwaukee, November 2020.
  - Geometry seminar, University of Luxembourg, June 2020.
- *GIT quotients and symplectic reduction.* Differential geometry seminar, TU Darmstadt, March 2020.
- *Computing harmonic maps between Riemannian manifolds.*
  - Geometry seminar, National University of Singapore, November 2019.
- *Computing equivariant harmonic maps.*

- Séminaire HORUS, Université de Strasbourg, September 2019.
- Geometry seminar, Stanford University, June 2019.
- Geometry seminar, Heidelberg University, December 2018.

> *Bi-Lagrangian structures and Teichmüller theory.*
- Geometry and discrete groups seminar, IHES (Paris), June 2018.
- Complex analysis and dynamics seminar, CUNY graduate center, May 2018.
- Geometry seminar, McGill University, Canada, April 2018.
- Colloquium, Korea Advanced Institute of Science and Technology, April 2018.
- Colloquium, Minnesota State University at Mankato, March 2018.
- Symplectic geometry seminar, Stony Brook University, February 2018.
- Geometry seminar, University of Texas at Austin, November 2017.
- Geometry seminar, University of Virginia, September 2016.

> *Computing discrete equivariant harmonic maps.*
- Geometry seminar, Korea Advanced Institute of Science and Technology, April 2018.
- Geometry seminar, Minnesota State University at Mankato, March 2018.
- Geometry and dynamics seminar, Université de Paris 7, March 2017.
- Geometry and dynamics seminar, Université de Lille 1, March 2017.
- Topology/Geometry seminar, Rutgers University - New Brunswick, January 2017.
- Analysis seminar, Fordham University, December 2016.

> *Introduction to Teichmüller theory.* Graduate students seminar, Rutgers Universityo, November 2016.

> *Generalized Weil-Petersson metrics on character varieties.* Hyperbolic geometry seminar, City University of New York, November 2016.

> *(Hyper-)Kähler geometry of character varieties.* Geometry seminar, University of Luxembourg, May 2016.

> *Hyperkähler geometry of character varieties.*
- Geometry and Dynamics/ GEAR seminar, University of Illinois at Urbana-Champaign, April 2016.
- Complex Analysis and Geometry seminar, Université de Paris 7, March 2016.
- Geometry and Topology seminar, Université de Grenoble 1, March 2016
- Geometry and Topology seminar, Université de Nice Sophia Antipolis, March 2016
- Complex Analysis and Geometry seminar, Université de Paris 6, March 2016.

> *Complex Bi-Lagrangian structures.*
- Geometry and Topology seminar, University of Maryland, February 2016.
- Geometry and Topology seminar, Boston College, February 2016.
- Mathematics Colloquium, Rutgers University - Newark, December 2015.

> *Computing equivariant harmonic maps.* Teichmüller Theory seminar, Rutgers University - Newark, September 2015.

> *Minimal surfaces and quasi-Fuchsian structures.* Geometry seminar, UFRJ, Rio de Janeiro, June 2015.

> *Bi-Lagrangian and hyperkähler structures.*
- Geometry seminar, University of Luxembourg, December 2014.
- Geometry seminar, Université de Strasbourg, December 2014.
- Geometry seminar, Université de Lorraine, December 2014.
- Geometry seminar, Université de Rennes 1, December 2014.
- Geometry seminar, Université de Bordeaux 1, December 2014.

> *Introduction to Higgs bundles.* Postdoctoral seminar, Université Paris-Sud XI, October 2013.

> *Representations of surface groups and Higgs bundles.* Graduate Students seminar, University of Illinois at Chicago, June 2013.

> *Circle packings and Riemann mappings.* Geometry seminar, Université d'Avignon, May 2013.

> *Complex projective structures and the $SL(2,\mathbf{C})$-character variety.* Topology and Dynamics seminar, Université Paris-Sud XI, December 2012.

> *Higgs bundles and Hitchin components.* Postdoctoral seminar, Université Paris-Sud XI, November 2012.

> *La géométrie symplectique des structures projectives complexes.* Geometry and Spectral Theory seminar, Université de Grenoble 1, June 2011.

> *Complex projective structures.* Thematic Workshop, Université de Toulouse III, October 2010.

> *Géométrie non euclidienne.* Graduate Students seminar, Université de Toulouse III, September 2010.

Teaching

URL: brice.loustau.eu/teaching.html

2020 – 2021	Teaching at Heidelberg University: Undergraduate and Graduate level. Supervising of student research projects for the *Heidelberg Experimental Geometry Lab*. Co-organizer of the student seminar *Experimental Geometry and Mathematics Visualization: Graphs on hyperbolic spaces*.
2018 – 2020	Teaching at TU Darmstadt, Undergraduate and Graduate level. Service: ~100 hours/year. Courses taught: *Riemann Surfaces*, *General Relativity*, *Hyperbolic geometry*, *Differential Manifolds*. Series of video lectures: brice.loustau.eu/teaching/TUDarmstadt/Manifolds2020. Supervising of student's Master thesis.
2015 – 2018	Teaching at Rutgers University, Undergraduate and Graduate level. Service: ~160 hours/year. Courses taught: *Abstract Algebra*, *Calculus III* (x3), *Complex Analysis*, *Discrete Structures* (x2), *Elementary Differential Equations*(x2), *Foundations of Modern Mathematics*, *Hyperbolic geometry*. Supervising of undergraduate research project.
2011 – 2014	Teaching at Université Paris-Sud, Undergraduate level. Service: ~80 hours/year. Courses taught: *Calculus II*, *Complex Analysis* (x3), *Linear Algebra*, *Mathematics for Engineers*, *Plane Geometry* (x2), Supervising of undergraduate computer project.
2008 – 2011	Teaching at Université de Toulouse 3, Undergraduate level. Service: ~80 hours/year. Courses taught: *Calculus II*, *Calculus III*, *Differential Geometry*, *Elementary Differential Equations*, *Linear Algebra*, *Mathematics for Biology*, *Mathematics for Engineering*.
2006 – 2011	Oral examinations in *classes préparatoires*. Lycée Basch, Rennes (service: ~50 hours/year) and Lycée Fermat, Toulouse (service: ~150 hours/year).
2006	Teaching Mathematics in lycée Chateaubriand (high school), Rennes. 2nde and TeS. Service: ~80 hours.

Student research

Spring 2021	Supervision of several research projets at the Heidelberg Experimental Geometry Lab: > Computing harmonic maps > Graph embeddings in the hyperbolic plane > Limit sets in spheres > Julia sets and Kleinian groups > Can you hear the shape of a drum?
Summer 2019	Darja Zierau: Master thesis at TU Darmstadt, Germany. *Thesis title: Cross-ratios of torsion points on elliptic curves.*

Skills

Languages	French (native speaker), English (bilingual), Spanish (conversational), Portuguese (conversational), German (conversational).
Computer science	Development in C++/Qt, Web development (HTML, CSS, PHP, Javascript), Programming in C, Python, Matlab, Julia, Pascal, Maple, Mathematica, Octave, etc. 3D printing and new technologies. LaTeX, GNU/Linux, desktop tools.
Music	I am a proficient piano player and love classical and jazz music. My husband Benjamin Velez is a musical theater (Broadway) composer.
Sports	Hiking, running, cycling.
Hobbies	Reading, chess, cooking.

References

Note: My references have all written letters of recommendation for me; feel free to reach out directly to them.

References for research

- Ara Basmajian, Professor, CUNY Graduate Center. ABasmajian@gc.cuny.edu
- Francis Bonahon, Professor, University of Southern California. fbonahon@math.usc.edu
- David Dumas, Professor, University of Illinois at Chicago. david@dumas.io
- William Goldman, Professor, University of Maryland. wmg@math.umd.edu
- Steven Kerckhoff, Professor, Stanford University. spk@math.stanford.edu
- Jean-Marc Schlenker, Professeur, Université de Luxembourg. jean-marc.schlenker@uni.lu
- Anna Wienhard, Professor, Heidelberg University. wienhard@mathi.uni-heidelberg.de

References for teaching and academic service

- Jane Gilman, Professor, Rutgers University. gilman@rutgers.edu
- Karsten Grosse-Brauckmann, Professor, TU Darmstadt. kgb@mathematik.tu-darmstadt.de
- Dominique Hulin, Maître de conférences, Université Paris-Sud XI. dominique.hulin@math.u-psud.fr
- John Loftin, Professor, Rutgers University. loftin@newark.rutgers.edu

Details & Contact

Civil status

Date of birth:	5 December 1984
Citizenship:	French
Marital status:	Married to US citizen (Benjamin Velez)
Resident status in the US:	Permanent Resident

Contact

Address (USA):	41 E Sunrise Ave Newark - NJ 07105, USA	Address (France):	53 allée du Rouquet 33610 Cestas, FRANCE
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