

# Curriculum Vitae of Dr. TUMPACH

- **PERSONAL DETAILS**

Family Name, First Names : TUMPACH, ALICE BARBORA

Civil status: Female, born on September 12, 1976, 3 children, divorced, French.

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Research Institution: [Wolfgang Pauli Institut](#), Oskar-Morgenstern-Platz 1, A-1090 Vienna

URL for web site : <https://geometricgreenlearning.com>

Publicly accessible link to publications: [HAL](#)

- **EDUCATION**

**2022:** Habilitation in Pure Mathematics, University of Lille, France.

Habilitation Thesis: *Some aspects of infinite-dimensional Geometry: Theory and Applications*, Tutor: J.-C. Alvarez-Paiva ([link](#))

**2021–Present:** Master in Visual Computing, Technical University of Vienna, Austria

Successfully completed courses including (but not limited to): *Medical Image Processing, Machine Learning for Visual Computing, Computer Vision, 3D Vision, Stereo Vision, Visual Analysis of Human Motion, Software Engineering and Project Management, Virtual and Augmented Reality, Colors, Image Understanding, Visualization 2, Computer Graphics, Advanced Information Retrieval.*

**2001–2005:** PhD in Pure Mathematics at École Polytechnique, France, 14.03.2006.

PhD Thesis: *Infinite-dim. Kähler and hyperkähler Manifolds*, Advisor: P. Gauduchon ([link](#))

**2000–2001:** French teaching competitive exam called Agrégation.

**1998–2000:** Master in Pure Mathematics (Paris 6 & Paris 7).

**1997–1998:** Bachelor in Mathematics, ÉNS Ulm, Paris.

**1997–1998:** Bachelor in Physics, ÉNS Ulm, Paris.

Bachelor Thesis: *Quantum Computers*, under the supervision of J.-M. Raimond.

- **LANGUAGES:** *French, German, Czech, English.*

- **PROGRAMMING LANGUAGES:** Matlab, Python, OpenGL, HTML

- **POSITIONS**

**2021–2025:** P.I. of the Austrian-Polish FWF-NCN-Project I-5015-N “Banach Poisson-Lie Groups and Integrable systems” in collaboration with T. Goliński from the University of Białystok, Poland.

**2018–present:** Visiting Professor at Wolfgang Pauli Institut, Vienna, Austria.

**2007–present:** Associate Professor in Mathematical Physics, Lille University, France (currently on leave).

**2019–2020:** CNRS grantee (1.5 year), Wolfgang Pauli Institut, Vienna, Austria.

**2014–2015:** CNRS grantee (1 year), Wolfgang Pauli Institut, Vienna, Austria.

**2013:** CNRS grantee (6 month), Dept of Computer Science, Lille, France.

**2012:** Long-term mission (6 month) at Wolfgang Pauli Institut, Vienna, Austria.

**2005–2007:** Post-doctoral position at EPFL, Switzerland.

- **CAREER BREAKS**

**2021:** On leave for Training (10 months), Master in Visual Computing, TU Wien, Austria.

**2020:** Home-schooling for 3 kids during pandemic (single mom)

**2018–2019:** On leave for parental duties from Lille University (12 months), teacher at Lycée Français de Vienne, Austria.

**2015–2016:** On leave for parental duties (12 months)

**2012:** Maternity leave 3rd child.

**2010:** Maternity leave 2d child.

**2008:** Maternity leave 1st child.

- **NET RESEARCH EXPERIENCE**

The length of time that I have actually used in net total for research can be decomposed as follows:

- Time before the completion of doctoral degree: **4 years and 7 months** (Sept. 2001- March 2006)
- Time after the completion of doctoral degree: **10 years and 1 month** = 17 years and 11 months (from March 2006 to February 2024) - 10 months for Training in Visual Computing - 6 months of Pandemia - 12 months as teacher - 12 months for parental leave - 3x18 months for maternity leaves (I am using here the ERC convention, see <https://erc.europa.eu/apply-grant/parental-leave>).

- **RESEARCH INTERESTS**

My first domain of expertise is infinite-dimensional Geometry of manifolds modeled on Banach or Fréchet spaces. I have a PhD from École Polytechnique, France, on Kähler and hyperkähler infinite-dimensional manifolds, and a Habilitation from Lille University, France, with title “Some aspects of infinite-dimensional Geometry: Theory and Applications”. I have published theoretical papers on different aspects of infinite-dimensional Geometry in leading international peer-reviewed Journals including papers in *Journal of Functional Analysis*, *Annales de l’Institut Fourier*, and *Communications in Mathematical Physics*. Remarkably I am the single author of most of these papers proving my independence as a confirmed researcher. I was invited as Keynote speaker in numerous conferences, including GSI2017, XXVIII International Fall Workshop on Geometry and Physics 2019, PADGE 2023. I gave lecture courses notably on Hilbert, Banach and Fréchet manifold at the advanced School on Geometry and Physics, part of the XXXVI Workshop on Geometric methods in Physics, and on Nash-Moser Theorem at [15th International Young Researchers Workshop on Geometry, Mechanics, and Control](#). The videos on my lectures are available online.

My second domain of expertise is Computer Vision. I started working with Computer Scientists in 2013 during a 6-months visit in the Computer Science Department at Lille University enabled by a CNRS grant. I honed my computer vision skills by enrolling in the Master’s program on Visual Computing at Technical University of Vienna, Austria. Successfully completed courses include, but are not limited to, *Medical Image Processing*, *Machine Learning for Visual Computing*, *Computer Vision*, *3D Vision*, *Stereo Vision*, *Visual Analysis of Human Motion*, *Software Engineering and Project Management*, *Virtual and Augmented Reality*, *Colors*, *Image Understanding*, *Visualization 2*, *Computer Graphics*, *Advanced Information Retrieval*.

Moreover, I also have a Bachelor degree in Physics from École Normale Supérieure, Paris, France. My scientific background in physics is a source of inspiration for solving concrete problems in computer vision, notably the Gauge Invariant Framework for Shape Analysis of Surfaces that I introduced in [?] is clearly based on my knowledge of gauge theories. On this topic, I was invited to write a popular paper for the *Notices of American Mathematical Society* about Shape Analysis of curves and surfaces ([link](#)). This invitation was an honor and I did my best to demonstrate my skills in disseminating top-level research to a large audience made of experts and no-experts.

- **MAIN ACHIEVEMENTS**

My main achievements can be divided in two research areas:

1. **Infinite-dimensional Geometry of manifolds modeled on Banach or Fréchet spaces**

- Mostow Decompositions of infinite-dimensional Lie groups and complex homogeneous spaces and induced decompositions of orbits of these groups (selected publication (1))
- Development of the theory of Banach Poisson-Lie groups, link to integrable systems like KdV hierarchy (selected publication (2))
- Pathologies of infinite-dimensional Poisson Geometry (selected publication (3))
- Classification of Hermitian-symmetric affine coadjoint orbits of  $L^*$ -groups using root theory in Hilbert Lie algebras (selected publication (4))
- Construction of explicite hyperkähler metrics on infinite-dimensional Hermitian-symmetric spaces (selected publications (5))
- Hyperkähler structure of the cotangent space of the restricted Grassmannian as hyperkähler quotient (selected publication (6))

2. **Geometric Methods applied in Computer science, in particular in Shape Analysis**

- Introduction of the Gauge Invariant Framework (GIF) for Shape Analysis, allowing the design of green algorithms by bypassing the traditional optimization step on the group of reparameterizations (selected publication (7))
- Application of GIF to non-linear flags consisting of curves on surfaces embedded in  $\mathbb{R}^3$  leading to the best paper award GSI23 (selected publication (8))
- Definition of canonical parameterizations of curves and application in medical image processing (selected publication (9)).
- Transfer of the quotient elastic metric defined on unparameterized plane curves to the manifold of arc-length parameterized curves (selected publication (10)).

• **10 SELECTED PUBLICATIONS:**

In infinite-dimensional Geometry:

- (1) Tumpach, A.B., *Mostow's Decomposition Theorem for  $L^*$ -groups and Applications to affine coadjoint orbits and stable manifolds*, Journal of Geometry and Physics 191 (2023). <https://doi.org/10.1016/j.geomphys.2023.104881>
- (2) Tumpach, A.B., *Banach Poisson–Lie groups and Bruhat–Poisson structure of the restricted Grassmannian*, Communications in Mathematical Physics 373, 795–858 (2020). <https://doi.org/10.1007/s00220-019-03674-3>
- (3) Beltita, D., Golinski, T. and Tumpach, A.B., *Queer Poisson brackets*, Journal of Geometry and Physics 132, (2018), 358–362. <https://doi.org/10.1016/j.geomphys.2018.06.013>
- (4) Tumpach, A.B., *On the classification of infinite-dimensional Hermitian-symmetric affine coadjoint orbits*, Forum Mathematicum 21 :3 (May 2009) 375–393. <https://doi.org/10.1515/FORUM.2009.018>
- (5) Tumpach, A.B., *Infinite-dimensional hyperkähler manifolds associated with Hermitian-symmetric affine coadjoint orbits*, Annales de l'Institut Fourier, Tome 59 (2009) – Fascicule 1, 167–197, <https://doi.org/10.5802/aif.2428>
- (6) Tumpach, A.B., *Hyperkähler structures and infinite-dimensional Grassmannians*, Journal of Functional Analysis, 243 (2007) 158–206. <https://doi.org/10.1016/j.jfa.2006.05.019>

In applications to Computer Vision:

- (7) Tumpach, A.B., Drira, H., Daoudi, M., Srivastava, A., *Gauge Invariant Framework for Shape Analysis of Surfaces*. IEEE Transactions on Pattern Analysis and Machine Intelligence, January 2016, Volume 38, Number 1. <https://doi.org/10.1109/TPAMI.2015.2430319>
- (8) Ciuclea, I., Tumpach, A.B. and Vizman, C., *Shape spaces of nonlinear flags*, Geometric Science of Information, 6th International Conference, GSI 2023, Proceedings, Part I, 41–50, Springer, 2023. **Best Paper Award**. [https://doi.org/10.1007/978-3-031-38271-0\\_5](https://doi.org/10.1007/978-3-031-38271-0_5)
- (9) Tumpach, A.B., *On canonical parameterizations of 2D curves*, Geometric Science of Information, 6th International Conference, GSI 2023, Proceedings, Part I, 31–40, Springer, 2023. [https://doi.org/10.1007/978-3-031-38271-0\\_4](https://doi.org/10.1007/978-3-031-38271-0_4)
- (10) A.B. Tumpach, S. C. Preston, *Quotient Elastic Metrics on the manifold of arc-length parameterized plane curves*, Journal of Geometric Mechanics 9, n°2 (2017), 227–256. <https://doi.org/10.3934/jgm.2017010>

• **ADDITIONAL RESEARCH ACHIEVEMENTS**

1. **Awards:**

- \* Best paper Award at *Geometric Science of Information* conference, 2023.
- \* Awarded a funding of 50.000 euros from Schrödinger Institut, Vienna, Austria, for the organization in 2025 of a Scientific Programme on the topic of my Habilitation Thesis: “Infinite dimensional Geometry: Theory and Applications” ([link](#))

2. **Contribution to conferences:** Organization of “A finite and infinite-dimensional meeting on Lie groupoid, Poisson geometry and integrability”, 2021, Vienna, ([link](#))

3. **Keynote speaker** at 59th Seminar Sophus Lie 2024, PADGE 2023, GSI2017.

4. **Mini-courses** at 15th International Workshop of Young Researchers on Geometry, Mechanics and Control, Utrecht, 2020 ([link](#)) and at advanced School on Geometry and Physics, part of the XXXVI Workshop on Geometric methods in Physics

5. **Significant research projects:** FWF-NCN Grant I-5015-N, 2021–2025, 306.768 €

6. **Peer review activities:**

- \* Referee for *Mathematische Annalen*, *Journal of Differential Geometry*, *Annales de l'Institut Fourier*, *Journal of Geometric Mechanics*, *Journal of Mathematical Physics*, *Journal of Symplectic Geometry*, *Journal of Mathematical Analysis and Applications*, *Advances in Applied Clifford Algebras*, *Journal Royal Society Interface*, *Journal of Mathematical Imaging and Vision*, *Springer Lecture Notes in Computer Science*, *International Journal of Mathematics and Mathematical science...*
- \* Reviewer for international research agencies: *United States-Israel Bilateral Science Foundation (2021)*, *NWO – the Dutch Research Council (2023)*

**7. Promotion of junior researchers:**

\* Member of Hiring Committee for Associate Professors in Mathematics:  
Nice (2023), Lille (2017, 2013), Chambéry (2011)

\* PhD Jury in Computer Science: E. Maignant (2023), E. Pierson (2022)

\* PhD Jury in Mathematics: O.Cosserat(2023), J. Luna(2022), A. Le Brigant(2017)

8. **Science communication:** A.B. Tumpach, *Gauge Invariance of degenerate Riemannian metrics*, Notices of American Mathematical Society, April 2016. ([link](#))

9. **Knowledge transfer:** CIMPA Lecturer, Thiès, Senegal, CIMPA School on *Mathématiques en analyse et traitement du signal, des images et des données* ([link](#)).

## LIST OF PUBLICATIONS OF ALICE BARBORA TUMPACH

### In Peer-reviewed Journals in Pure Mathematics

In the following papers, the convention is alphabetic order of the authors, unless the contribution of one author is significantly more than the others, marked with a \*.

- A.B. Tumpach, *Mostow's Decomposition Theorem for  $L^*$ -groups and Applications to affine coadjoint orbits and stable manifolds*, Journal of Geometry and Physics 191 (2023).  
<https://doi.org/10.1016/j.geomphys.2023.104881>  
<http://fr.arxiv.org/pdf/math-ph/0605039>
- A.B. Tumpach, *Banach Poisson–Lie groups and Bruhat–Poisson structure of the restricted Grassmannian*, Communications in Mathematical Physics 373, 795–858 (2020).  
<https://doi.org/10.1007/s00220-019-03674-3>  
[http://math.univ-lille1.fr/~tumpach/Site/research\\_files/Bruhat\\_Poisson.pdf](http://math.univ-lille1.fr/~tumpach/Site/research_files/Bruhat_Poisson.pdf)
- D. Beltita, T. Golinski, A.B. Tumpach, *Queer Poisson brackets*, Journal of Geometry and Physics 132, (2018), 358–362.  
<https://doi.org/10.1016/j.geomphys.2018.06.013>
- \*• A.B. Tumpach, S. C. Preston, *Quotient Elastic Metrics on the manifold of arc-length parameterized plane curves*, Journal of Geometric Mechanics 9, n°2 (2017), 227–256.  
<https://doi.org/10.3934/jgm.2017010>
- A. B. Tumpach, *On the classification of infinite-dimensional Hermitian-symmetric affine coadjoint orbits*, Forum Mathematicum 21 :3 (May 2009) 375–393.  
[http://math.univ-lille1.fr/~tumpach/Site/research\\_files/classification.pdf](http://math.univ-lille1.fr/~tumpach/Site/research_files/classification.pdf)  
<https://doi.org/10.1515/FORUM.2009.018>
- A. B. Tumpach, *Infinite-dimensional hyperkähler manifolds associated with Hermitian-symmetric affine coadjoint orbits*, Annales de l'Institut Fourier, Tome 59 (2009) – Fascicule 1, 167–197, DOI: 10.5802/aif.2428.  
[http://math.univ-lille1.fr/~tumpach/Site/research\\_files/paper3.pdf](http://math.univ-lille1.fr/~tumpach/Site/research_files/paper3.pdf)  
[http://aif.cedram.org/item?id=AIF\\_2009\\_59\\_1\\_167\\_0](http://aif.cedram.org/item?id=AIF_2009_59_1_167_0)
- D. Beltita, T. Ratiu, A. B. Tumpach, *The restricted Grassmannian, Banach Lie-Poisson spaces and coadjoint orbits*, Journal of Functional Analysis, 247 (2007) 138–168.  
[http://math.univ-lille1.fr/~tumpach/Site/research\\_files/grassm\\_final.pdf](http://math.univ-lille1.fr/~tumpach/Site/research_files/grassm_final.pdf)  
<https://doi.org/10.1016/j.jfa.2007.03.001>
- A. B. Tumpach, *Hyperkähler structures and infinite-dimensional Grassmannians*, Journal of Functional Analysis, 243 (2007) 158–206.  
<https://doi.org/10.1016/j.jfa.2006.05.019>

### In Peer-reviewed Journals in Computer Science

In the following, the convention is that the first author has the main contribution.

- A.B. Tumpach, H. Drira, M. Daoudi, A. Srivastava, *Gauge Invariant Framework for Shape Analysis of Surfaces*. IEEE Transactions on Pattern Analysis and Machine Intelligence, January 2016, Volume 38, Number 1.  
<https://doi.org/10.1109/TPAMI.2015.2430319>

### In Proceedings of International Mathematical Conferences

In the following papers, the convention is alphabetic order of the authors, unless the contribution of one author is significantly more than the others, marked with a \*.

- F. Gay-Balmaz, T.S. Ratiu, A.B. Tumpach, *The restricted Siegel Disc as coadjoint orbit*, Geometric Methods in Physics XXXX, Workshop, Białowieża, Poland, Springer, 2023.
- \*• T. Goliński and A.B. Tumpach, *Integrable system on partial isometries: a finite dimensional picture*, Geometric Methods in Physics XXXX, Workshop, Białowieża, Poland, Springer, 2023.  
<https://arxiv.org/pdf/2311.07412.pdf>

- \*• A.B. Tumpach and T. Goliński, *The Banach Poisson–Lie group structure of  $U(H)$* , Geometric Methods in Physics XXXIX, Workshop, Białystok, Poland, Springer, 2022.  
<https://arxiv.org/abs/2303.11795>  
[https://doi.org/10.1007/978-3-031-30284-8\\_22](https://doi.org/10.1007/978-3-031-30284-8_22)
- A.B. Tumpach, *An Example of Banach and Hilbert manifold : the Universal Teichmüller space*. Geometric Methods in Physics XXXVI, Workshop, Białowieża, Poland, Springer, 2017.  
[https://link.springer.com/chapter/10.1007/978-3-030-01156-7\\_42](https://link.springer.com/chapter/10.1007/978-3-030-01156-7_42)  
<https://arxiv.org/abs/2303.15165>

## In Proceedings of International Conferences in Computer Science

In the following, the convention is that the first author has the main contribution.

- A.B. Tumpach and S.C. Preston, *Three methods to put a Riemannian metric on Shape Space*, Geometric Science of Information, 6th International Conference, GSI 2023, Proceedings, Part I, 3–11, Springer, 2023.  
<https://arxiv.org/abs/2303.11682>,  
[https://doi.org/10.1007/978-3-031-38271-0\\_1](https://doi.org/10.1007/978-3-031-38271-0_1)
- A.B. Tumpach, *On canonical parameterizations of 2D-curves*, Geometric Science of Information, 6th International Conference, GSI 2023, Proceedings, Part I, 31–40, Springer, 2023.  
<https://arxiv.org/abs/2303.15205>  
[https://doi.org/10.1007/978-3-031-38271-0\\_4](https://doi.org/10.1007/978-3-031-38271-0_4)
- I. Ciuclea, A.B. Tumpach and C. Vizman, *Shape spaces of nonlinear flags*, Geometric Science of Information, 6th International Conference, GSI 2023, Proceedings, Part I, 41–50, Springer, 2023. **Best Paper Award 2023**.  
<https://arxiv.org/abs/2303.15184>  
[https://doi.org/10.1007/978-3-031-38271-0\\_5](https://doi.org/10.1007/978-3-031-38271-0_5)
- A.B. Tumpach and P. Kán, *Temporal Alignment of Human Motion Data: A Geometric Point of View*, Geometric Science of Information, 6th International Conference, GSI 2023, Proceedings, Part II, 541–550, Springer, 2023.  
<https://arxiv.org/abs/2303.15259>,  
[https://doi.org/10.1007/978-3-031-38299-4\\_56](https://doi.org/10.1007/978-3-031-38299-4_56)
- E. Pierson, M. Daoudi, A.B. Tumpach, *A Riemannian Framework for Analysis of Human Body Surface*, Conference: Winter Conference on Applications of Computer Vision (WACV 2022), DOI: 10.1109/WACV51458.2022.00282  
<https://www.researchgate.net/publication/355545398>  
<https://hal.science/hal-03389592>
- H. Drira, A.B. Tumpach, M. Daoudi, *Gauge Invariant Framework for Trajectories Analysis*, Conference paper in 1st International Workshop on DIFFerential Geometry in Computer Vision for Analysis of Shapes, Images and Trajectories (DIFF-CV), (2015).  
<https://hal.science/hal-01534886>

## Science Communication

- A.B. Tumpach, *Gauge Invariance of degenerate Riemannian metrics*, Notices of American Mathematical Society, April 2016.  
[http://math.univ-lille1.fr/~tumpach/Site/research\\_files/Notices\\_full.pdf](http://math.univ-lille1.fr/~tumpach/Site/research_files/Notices_full.pdf)  
<https://www.ams.org/journals/notices/201604/rnoti-p342.pdf>

## Habilitation Thesis

- A.B. Tumpach, *Some aspects of infinite-dimensional Geometry: Theory and Applications*, 212 pages, Habilitation Thesis, Lille University, 9.12.2022.  
<http://tel.archives-ouvertes.fr/tel-00012012>

## PhD Thesis

- A.B. Tumpach, *Variétés kählériennes et hyperkähleriennes de dimension infinie*, 202 pages, Thèse de doctorat, École polytechnique, 14.03.2006  
<http://tel.archives-ouvertes.fr/tel-00012012>