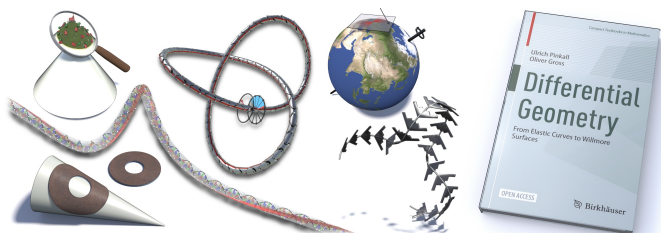


OLIVER GROSS | TEACHING STATEMENT

Students should leave my classroom able not only to reproduce definitions and proofs, but also to recognize which ideas organize a problem, move between geometric intuition and formal argument, and use mathematics to answer questions of their own. To do so, they must learn to **identify mathematical structure and make it usable**. My teaching is grounded in three principles:

- A | I use **research- and application-based teaching** to make the value of mathematical ideas concrete and motivate students to engage with them. Audio compression, navigation, CAD, and CGI depend on ideas from analysis, graph theory, and geometry, and advances in these fields continue to expand what these technologies can do.
- B | I teach students to turn theory into simple computational prototypes and use **computation as a testing ground**. These prototypes become tools for independent exploration: varying parameters builds intuition, while failures of convergence and experiments beyond a theorem's hypotheses reveal what the theory actually guarantees.
- C | I use **examples and visualization as tools for reasoning**. I begin with concrete systems, such as soap films or universal joints, and build toward abstraction. Carefully designed illustrations connect new ideas to students' existing intuition, expose details that abstraction can hide, and prepare them for formal argument.

Over multiple years of experience across *Europe* and the *United States* (*TU Berlin*, *Caltech*, *EPFL*, and *UC San Diego*), I have developed course materials, supervised theses and projects, and coauthored a textbook, strengthening my ability to **communicate mathematical ideas effectively to diverse audiences**. My interdisciplinary research allows me to adapt to students' individual backgrounds, informing how I communicate through tools such as clear visualizations, selective historical context, and well-chosen examples that build intuition. For example, students enjoy the illustration of the concepts of *framed curves* through airplane analogies, *parallel transport* and *holonomy* for space curves using universal joints, or *isometries* through fitting of leather patches (see inset). Bridging theory and practice in ways that resonate with each audience creates a classroom in which **a proof, a physical mechanism, and a numerical experiment all count as progress on the same question**.



The same principles guide *Differential Geometry: From Elastic Curves to Willmore Surfaces*, the textbook I coauthored with Ulrich Pinkall [P5], which has quickly reached a wide readership¹. Designed for a semester-long introductory course on the differential geometry of curves and surfaces, the book uses carefully constructed figures to build intuition for geometric and topological ideas. Rather than introducing classical theory through local coordinates, it adopts the **modern language of contemporary research**, easing students' transition to Riemannian and broader differential geometry. The calculus of variations connects this theory to physics, computer graphics, and fabrication, while the self-contained presentation reaches advanced topics such as Willmore surfaces, central to membrane modeling and the resolution of the Willmore conjecture [1]. The result is a course that unites mathematical foundations, computation, and applications.

1 | TEACHING EXPERIENCE

I have taught and mentored students from **mathematics**, **computer science**, and **engineering**. I served as a **teaching assistant** in TU Berlin's Department of Mathematics (2017–2019) and completed its **"TU Tutor Plus" teaching certificate**. For *Calculus I and Linear Algebra for Engineering Sciences*, I taught up to three weekly ninety-minute tutorials of approximately 25 students each, held office hours, and graded homework. Across three semesters, 23 of 24 evaluation respondents would recommend my tutorials, and 18 awarded them the top overall grade. As a **teaching assistant** for *Differential Geometry of Curves and Surfaces* (Spring 2020; approximately 30 students) and *Differential Geometry II: Analysis and Geometry on Manifolds* (Winter 2020/21; approximately 25 students), I designed exercise sheets and tutorials, taught two weekly ninety-minute sessions, held office hours, and graded assignments. I typically structured exercise sheets around a concrete calculation, a familiar construction applied to a new object, and an unfamiliar problem requiring students to combine known ideas. This progression develops fluency with definitions, understanding through transfer, and independent mathematical reasoning. The first course became the basis of our textbook [P5].

¹As of September 2026, the book had more than 26,000 downloads, over five times the roughly 5,000 of the next-ranked title, placing it 1st of 58 titles in its series by downloads and 7th among more than 7,500 Springer mathematics graduate textbooks.

In 2025, I volunteered as a **project mentor** for MIT's *Summer Geometry Initiative*, which gives students from underrepresented groups access to geometry processing and research mentors. I co-advised five international students through a week-long research project, combining short lectures, coding assignments, and several daily discussions to help them formulate and pursue concrete research goals.

Beyond semester-long courses, I have given **invited workshops and short courses** at TU Berlin, the Technical University of Denmark, and the University of Oxford. At TU Berlin, I led two *Scientific Visualization with Houdini* workshops, each comprising two five-hour sessions, in which approximately twenty participants created figures and animations for their own theses and presentations. Following participant requests for a continuation, TU Berlin's Mentoring Office reinvited me. At an interdisciplinary summer school at the Technical University of Denmark, I taught two three-hour classes for approximately twenty participants, combining an introduction to differential geometry and elastic curves with hands-on coding exercises. At the University of Oxford, I delivered two invited two-hour expert lectures on conformal geometry in plasma physics and magnetic relaxation to approximately twenty participants, both in person and online.

2 | THESIS/PROJECT SUPERVISION & MENTORING

As a student, I volunteered in a mentoring program for first-semester mathematics students at TU Berlin in 2017 and 2018. Now, I supervise undergraduate and master's theses and research projects in differential geometry and physical simulation, meeting students anywhere from several times a week to monthly, depending on their needs. In these meetings we review progress, plan next steps, and close gaps in theoretical prerequisites.

My goal as a mentor is to prepare students to conduct research independently by giving them increasing responsibility for the direction of their projects. I have **supervised or co-supervised twelve theses and research projects across five institutions**, including ten at the undergraduate and master's level, four of which have produced publications or preprints with student coauthors. Several of these projects have also developed into lasting mentor-mentee relationships. At TU Berlin, I co-supervised Moritz Wahl's undergraduate thesis on elastic curves with variable bending stiffness. We continued meeting weekly after his graduation, and the work culminated in a **joint article in *Studies in Applied Mathematics*** [P3].

At Caltech in 2023, I supervised Patrick Martinez's undergraduate project applying my work on geometric locomotion [P4] to robotics. The project continued beyond its planned semester-long scope and developed into a collaboration with a robotics group at the University of Notre Dame, resulting in a **joint preprint** [P1]. At UC San Diego, I mentored Ritoban Roy-Chowdhury on vakonomic fluid simulation, resulting in a **joint preprint** [P6] **under review at the *Journal of Nonlinear Science***, and co-supervised Rohit Jammula's master's thesis on isoperimetric approaches to elastic curves [P2], resulting in a **joint-first-authored preprint under review at *ACM Transactions on Graphics***.

As a first-generation college graduate, I understand the difficulties of gaining a foothold in academia, and I am aware of the challenges, prejudices, and structural barriers that students from all underrepresented groups often face. I explain unfamiliar academic conventions, make space for questions, and adapt guidance to students' preparation and circumstances so that they can participate confidently and develop intellectual ownership. **For five years, I have mentored one student through several stages of her academic career.** When severe exam anxiety threatened her progress, I supported her through individual training sessions, and I now serve as her external graduate-school mentor as she pursues her PhD.

3 | POTENTIAL COURSES

My research in computation, geometry, and mathematical physics prepares me to teach undergraduate and graduate mathematics, from core courses such as *Calculus*, *Linear Algebra*, and *Complex Analysis* to a coherent sequence in computational mathematics. My work in *Structure-Preserving Discretization* would bring current research into *Numerical Analysis*, *Numerical PDEs*, and *Numerical Optimization*. I would also be well prepared to teach *Discrete Differential Geometry*, showing how smooth geometry can be reformulated in a finite, computable language that preserves its essential structure and illuminates classical theory. I can also teach *Differential Geometry of Curves and Surfaces*, drawing on my textbook [P5], followed by *Riemannian Geometry* and advanced topics in *Vector Bundles* and *Exterior Calculus*. My experience creating textbook illustrations, research visualizations, and Houdini workshops would inform courses in *Mathematical Visualization* or *Computer Graphics for Mathematicians*. Across these courses, students would learn to identify essential structure, move between continuous and discrete models, test theory computationally, and use visualization as a form of reasoning.

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- [P2] O. Gross, R. Jammula, and A. Chern, “Elastic Curves via Geometric Mechanics,” 2026, arXiv: 2607.29654.
- [P3] O. Gross, U. Pinkall, and M. Wahl, “Elastic Curves with Variable Bending Stiffness,” *Stud. Appl. Math.*, vol. 155, no. 2, p. e70097, 2025.
- [P4] O. Gross, Y. Soliman, M. Padilla, F. Knöppel, U. Pinkall, and P. Schröder, “Motion from Shape Change,” *ACM Trans. Graph.*, vol. 42, no. 4, pp. 107:1–107:11, 2023.
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- [P6] R. Roy-Chowdhury, M. S. Nabizadeh, O. Gross, A. Gruber, and A. Chern, “Vakonomic Fluids,” 2026, arXiv: 2607.18312.

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- [1] F. C. Marques and A. Neves, “Min-max theory and the Willmore conjecture,” *Ann. of Math.*, pp. 683–782, 2014.