KYLE BRODER – CURRICULUM VITAE

I am interested in leveraging methods from partial differential equations and differential geometry to address fundamental problems in topology, algebraic geometry, and complex analysis. I am particularly interested in using curvature to understand the algebro-geometric properties of Kobayashi hyperbolic manifolds.

Education.

- **The Australian National University and Beijing International Center for Mathematical Research, Doctor of Philosophy (Mathematics).** (2019–2022). Supervised by Professor Benjamin Andrews (The Australian National University) and Professor Gang Tian (Beijing University, Princeton University). Graduated July 13, 2023.
- **The Australian National University, Bachelor of Science (Honours).** (2015–2018). First class honours in mathematics. Supervised by Professor Alexander Isaev (The Australian National University).

Employment.

- **Post-doctoral research fellow, The University of Queensland**. September 2022–June 2024. Supported by the Australian Research Council Discovery Grant held by Artem Pulemotov, Wolfgang Ziller, and Mark Gould.

Fellowships and Grants.

- **Marie Skłodowska-Curie Fellowship.** Curvature aspects of rigidity and flexibility of complex manifolds. Horizon TMA MSCA Postdoctoral Fellowship - European Fellowship, 24 months (155559.36 EUR). Evaluation score: 96.4%. Supervisor: Professor Franc Forstnerič. Scheduled to commence: September 2025.

Published articles.

1. (with J. Stanfield). On the Gauduchon curvature of Hermitian manifolds, *Internat. J. Math.* , **34**, no. 7, paper no. 2350039, 37 pp., (2023). arXiv:2211.05973.
2. The Schwarz Lemma in Kähler and Non-Kähler Geometry, *Asian J. Math*, **27**, no. 1, pp. 121–134, (2023). arXiv:2109.06331.
3. Second-Order Estimates for Collapsed Limits of Ricci-flat Kähler Metrics, *Canad. Math. Bull.* , **66**, no. 3, pp. 912–926, (2023). arXiv:2106.13343.
4. The Schwarz Lemma: An Odyssey, *Rocky Mountain J. Math.*, **52**, no. 4, pp. 1141–1155, (2022). arXiv:2110.04989.

5. (with K. Tang). On the Weighted Orthogonal Ricci Curvature, *J. Geom. Phys.* , **193**, no. 104783, 13 pp., (2023). arXiv:2111.00346.
6. On the Nonnegativity of the Dirichlet Energy of a Weighted Graph, *Bull. Aust. Math. Soc.*, **106**, no. 2, pp. 301–305, (2022).
7. An Eigenvalue Characterization of the Dual EDM Cone, *Bull. Aust. Math. Soc.*, **106**, no. 1, pp. 67–69, (2022).
8. Remarks on the Quadratic Orthogonal Bisectional Curvature, *J. Geom.*, **113**, no. 2, Paper No. 39, 8 pp., (2022). arXiv:2211.05362.

Preprints.

1. (with A. Pulemotov). Hermitian metrics with vanishing second Chern Ricci curvature, arXiv:2309.10295.
2. (with J. Stanfield). A General Schwarz Lemma for Hermitian Manifolds, arXiv:2309.04636.
3. Some Remarks on the Wu–Yau Theorem, arXiv:2306.06509.
4. (with K. Tang). (ε, δ)–Quasi-Negativity and Positivity of the Canonical Bundle, arXiv:2305.01881.
5. (with K. Tang). On the Altered Holomorphic Curvatures of Hermitian Manifolds, arXiv:2201.03666.
6. Twisted Kähler–Einstein Metrics and Collapsing, arXiv:2003.14009.

Lecture notes submitted for publicaton.

1. Lectures on Vector Calculus. Lecture notes written for Applied Mathematics 1 (MATH2305) at The Australian National University, delivered in Semester 1 of 2022.

   In conjunction with colleagues and former lecturers, I developed the course for MATH2305, following the removal of the honours stream (MATH2405). The approach in the notes is computational and presents a unified perspective on the subject using differential forms. The student evaluations for the course were very positive.

Invited talks.

- April 2024 – *Invariant Metrics in Complex Analysis and a Conjecture of Kobayashi and Lang*. The University of Melbourne.
- March 27, 2024 – *Invariant Metrics in Complex Analysis and a Conjecture of Kobayashi and Lang*, Geometry with Symmetries Seminar.
- February 20, 2024 – *A General Schwarz Lemma for Hermitian Manifolds with Applications to a Conjecture of Kobayashi and Lang*, Generalized Ricci flow seminar.
- December 8, 2023 – *A Locality Theorem for Einstein metrics on compact complex manifolds*; The 67th annual meeting of the Australian Mathematical Society (Topology).
- December 5, 2023 – *A Locality Theorem for Einstein metrics on compact complex manifolds*; The 67th annual meeting of the Australian Mathematical Society (Geometric Analysis).
- October 16, 2023 – $\mathcal{C}^2$ *and* $\mathcal{C}^3$*–estimates in Kähler geometry*; The University of Queensland.
- June 5, 2023 – *Curvature Aspects of Hyperbolicity in Complex Geometry*; Complex Analysis, Geometry, and Dynamics; Portorož 2023.

- June 3, 2023 – *Recent Developmenst on the Schwarz Lemma*; The University of Rome "Tor Vergatta".
- May 18, 2023 – *Curvature Aspects of Hyperbolicity in Complex Geometry*; The University of Adelaide.
- May 17, 2023 – *Complex Manifolds of Hyperbolic and Non-Hyperbolic-Type*; The University of Adelaide.
- March 3, 2023 – *Curvature Aspects of Hyperbolicity in Complex geometry*; Differential Geometry Days at UQ; The University of Queensland.
- November 25, 2022 – *Curvature and Moduli – Some Intimations and Propaganda*; The Australian Geometric PDE Seminar.
- November 1, 2022 – *Curvature and Moduli – Some Intimations and Propaganda*; The University of Queensland.
- June 8, 2022 – *Recent developments concerning the Bochner technique in the Hermitian category*; Monash University.
- June 1, 2022 – *Recent developments concerning the Bochner technique in the Hermitian category*; Beijing International Center for Mathematical Research.
- April 1, 2022 – *A Kähler–Ricci flow proof of the Wu–Yau Theorem (part 2)*; The Australian Geometric PDE Seminar.
- March 25, 2022 – *A Kähler–Ricci flow proof of the Wu–Yau Theorem (part 1)*; The Australian Geometric PDE Seminar.
- December 7, 2021 – *Recent developments on the curvature of Hermitian manifold*; The 63rd Annual Meeting of the Australian Mathematical Society (Geometry with Symmetries).
- September 16, 2021 – *The Schwarz Lemma: An Odyssey*; The Australian National University.
- April 15, 2020 – *Collapsed limits of Ricci-flat Kähler metrics*; Beijing International Center for Mathematical Research.
- December 10, 2019 – *Twisted Kähler–Einstein metrics and Collapsing*; Beijing International Center for Mathematical Research.
- November 12, 2019 – *Canonical metrics in Kähler geometry*; The Australian National University.
- October 29, 2019 – *Canonical metrics in Kähler geometry*; The University of Sydney.
- April 23, 2018 – *Analytic functions of several complex variables*; The Australian National University.

Visiting Research Positions.

- The University of Melbourne, visiting Diarmuid Crowley, April 2024.
- Tsinghua University, visiting Xiaokui Yang, March 2024.
- Beijing University, visiting Gang Tian, March 2024.
- The Australian National University, visiting Benjamin Andrews, July 2023.

- The University of Roma “Tor Vergatta", visiting Filippo Bracci, June 2023.
- The University of Adelaide, visiting Finnur Lárusson, May 2023.
- Monash University, visiting Julie Clutterbuck and Wenhui Shi, May 2022.
- The University of Sydney, visiting Zhou Zhang, October 2019.
- The University of Sydney, visiting Zhou Zhang, June–September 2018.

Student supervision.

- Xavier Sauvage (UQ). Undergraduate Thesis. Co-supervised with Artem Pulemotov.
- Stepan Hudecek (UQ). PhD Thesis. Supervisory Panel.
- Adam Thompson (UQ). Masters Thesis. Supervisory Panel.
- Patrick Donovan (UQ). Undergraduate Thesis. Expert assessor.
- Benjamin Kruger (UQ). Undergraduate Thesis. Expert assessor.
- Calder Barksdale (UQ). Undergraduate Thesis. Expert assessor.

Lecturing.

(1) *Applied Mathematics 1 (MATH2305).* Lecturing (204 students). ANU. Semester 1, 2022.
In conjunction with colleagues to improve outcomes in vector calculus and provide a more appropriate course for the mix of students from pure and applied mathematics-focused degrees, I developed the course and wrote the lecture notes. These are still the lecture notes for this course and are available on my website.
(2) *Differential Geometry (MATH3405).* Lecturing (47 students). UQ. Semester 2, 2023.
(3) *Advanced Ordinary and Partial Differential Equations (MATH4407).* Lecturing (18 students). UQ. Semester 2, 2023.

Other teaching.

(1) *Mathematics and Applications 1 (MATH1013).* TA. ANU. Semester 1, 2018.
(2) *Mathematics and Applications 2 (MATH1014).* TA. ANU. Semester 2, 2018.
(3) *Introduction to Linear Algebra (MATH1014).* TA. USYD. Semester 2, 2019.
(4) *Calculus of One Variable (MATH1021).* TA. USYD. Semester 1, 2020.
(5) *Vector Calculus and Differential Equations (MATH2021).* TA. USYD. Semester 1, 2020.
(6) *Multivariable Calculus and Modelling (MATH1023).* TA. USYD. Semester 2, 2020.
(7) *Applications of Calculus (MATH1011).* TA. USYD. Semester 1, 2021.
(8) *Introduction to Calculus (MATH1111).* TA. USYD. Semester 1, 2021.
(9) *Vector Calculus and Differential Equations (MATH2021).* TA. USYD. Semester 1, 2021.
(10) *Pharmacy Practice 1 (PHAR1821).* TA. USYD. Semester 1, 2021.
(11) *Multivariable Calculus and Modelling (MATH1023).* TA. USYD. Semester 2, 2021.
(12) *Multivariable Calculus and Modelling (MATH1023).* TA. USYD. Semester 2, 2022.
(13) *Invariant Metrics in Complex Analysis.* Reading Course. UQ. Summer 2023.
(14) *Complex Differential Geometry.* Reading course. UQ. Semester 2, 2023.

Referee work. I have refereed articles for publications in The Journal of Differential Geometry, Advances in Mathematics, The Journal of Geometry and Physics, The Proceedings of the Edinburgh Mathematical Society, The Journal of Mathematical Sciences, and The American Mathematics Monthly.

Service.

- In Semester 2 of 2018, I organized a graduate reading group in complex geometry at The Australian National University.
- From November 2018 to January 2019, I organized a graduate reading group in geometric measure theory at The Australian National University.
- While at The University of Sydney, I was assigned by Jonathan Spreer to guide and instruct teaching assistants and lecturers on the use of the *Ed forum*—a digital platform employed by The University of Sydney to foster communication among students, tutors, and lecturers.

Outreach. To help promote mathematics and mathematical research to the general public, I manage a mathematically focused YouTube channel. The YouTube channel has received non-trivial attention, with the subscriber count currently at 11,500. The top-performing video – *Have all math problems been solved? What is mathematical research?* – has a view count exceeding 108,000 views.