Kyle Broder – Curriculum Vitae

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Academic Interests

Complex Geometry, Several Complex Variables, Riemannian Geometry, Algebraic Geometry, Kähler Geometry, Existence of Canonical Metrics, Complex Monge–Ampère equations, Pluripotential theory.

Present Academic Activities

I am currently working on my Ph.D. thesis in the area of Kähler geometry under the supervision of Professor Benjamin Andrews (ANU) and Professor Gang Tian (PKU). I am particularly interested in curvature aspects of complex geometry.

Brief Research Statement

Papers (i) and (ii) address the algebraic structure of the Gromov–Hausdorff limits of collapsed limits of Ricci-flat Kähler metrics. This involves a technical use of the Schwarz lemma in the conical Kähler setting. In paper (iii) I introduce the notions of the Schwarz bisectional curvature: This refines the real bisectional curvature introduced by Yang–Zheng and provides an optimal curvature constraint for the Schwarz lemma in the Hermitian setting. This paper also gives a unified approach to the various forms of the Schwarz lemma. This is expounded upon in paper (iv), which is expository. The refined analysis of the real bisectional curvature carried out in papers (iii) and (iv) is currently being applied to the Quadratic Orthogonal Bisectional Curvature (QOBC). This has led to a number of insightful interpretations of the QOBC which has furnished papers (v)–(vii).

Present collaborations

(i) I am collaborating with Fangyang Zheng on extending the results of paper (iii) to more general connections (beyond the Chern connection).

(ii) I am collaborating with Kai Tang on the problem of characterizing compact Hermitian manifolds with constant Chern holomorphic sectional curvature.

Education

- (2015–2017). B. Sc. Australian National University.
- (2018). B. Sc. (First Class Honours). Australian National University.
- (Since November 2018). Ph.D. Australian National University and Peking University.

Articles and Preprints

(i) Twisted Kähler–Einstein Metrics and Collapsing arXiv:2003.14009 (submitted).

(ii) Second-Order Estimates for collapsed limits of Ricci-flat Kähler metrics, arXiv:2106.13343 (submitted)

(iii) The Schwarz Lemma in Kähler and Non-Kähler Geometry, arXiv:2109.06331 (submitted)

(iv) The Schwarz Lemma: An Odyssey (submitted)

(v) On the non-negativity of the Dirichlet energy of a weighted graph (submitted)

(vi) An eigenvalue characterization of the dual EDM cone (submitted)

(vii) Remarks on the Quadratic Orthogonal Bisectional Curvature (in preparation)

Teaching

I have been a tutor for the following courses:

- (2018 Semester 1, ANU). MATH1013 (Mathematics and Applications 1). Fulfilled the role as a tutor, taking two tutorials per week. Work load of roughly 10 hours per week, with 3 hours of teaching.
- (2018 Semester 2, ANU). MATH1014 (Mathematics and Applications 2). Fulfilled the role as a tutor, taking one tutorial per week. Work load of roughly 7 hours per week, with 2 hours of teaching.
- (2019 Semester 2, USYD). MATH1014 (Introduction to Linear Algebra). Fulfilled the role as a tutor, taking two tutorials per week. Work load of roughly 4 hours per week, with 2 hours of teaching.
- (2020 Semester 1, USYD). MATH1021 (Calculus of one variable). Fulfilled the role as a tutor, taking two tutorials per week. Work load of roughly 8 hours per week, with 2 hours of teaching.
- (2020 Semester 1, USYD). MATH2021 (Vector Calculus and Differential Equations). Fulfilled the role as a tutor, taking two tutorials per week. Work load of roughly 10 hours per week, with 6 hours of teaching.
- (2020 Semester 2, USYD). MATH1023 (Multivariable Calculus and Modelling).
- (2021 Semester 1, USYD). MATH1011 (Applications of Calculus).
- (2021 Semester 1, USYD). MATH1111 (Introduction to Calculus)
- (2021 Semester 1, USYD). MATH2021 (Vector Calculus and Differential Equations)
- (2021 Semester 1, USYD). PHAR1821 (Pharmacy Practice 1)
- (2021 Semester 2, USYD). MATH1023 (Multivariable Calculus and Modelling)

Other Academic Activities

- In semester 2 of 2018 I helped organise a graduate reading group in complex differential geometry at the Australian National University.
- From November of 2018 to January 2019 I helped in the organisation of a graduate reading group in geometric measure theory at the Australian National University.
- Since January 2019 I have been an active participant in Professor Tian's biweekly student seminar.
- Since June of 2019 I have been an active participant in the University of Sydney Geometric Analysis Seminar.
- I have a math YouTube channel (>4K subscribers): `https://www.youtube.com/channel/UCkDicHMdLaJQ3OIly7B6wug`

References

- **Benjamin Andrews**, the Australian National University.

  Em: `Ben.Andrews@anu.edu.au`

- **Gang Tian**, Peking University.

  Em: `gtian@math.pku.edu.cn`

- **Zhou Zhang**, University of Sydney.

  Em: `zhangou@maths.usyd.edu.au`

- **Fangyang Zheng**, Chongqing Normal University

  Em: `20190045@cqnu.edu.cn`