Curriculum Vitae

Xiaoxiang Chai

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Address: Dept. of Math., POSTECH, 77 Cheongam-Ro, Nam-Gu, Pohang, Gyeongbuk, Korea 37673

Education

2015 - July 2018, PhD in Mathematics, Department of Mathematics

The Chinese University of Hong Kong, HKSAR, China

Advisor: Prof. Martin Man-chun Li; Co-advisor: Prof. Luen-fai Tam

Thesis title: *Some aspects of the minimal surface theory*

2012 - 2015, Master of Science (advisor: Prof. Jiaxin Hu)

Tsinghua University, Beijing, China

Master Thesis title: *First Eigenvalue Problem of Dirichlet forms*

2008 - 2012, Bachelor of Science, Sun Yat-sen University, Guangzhou, China

Employment

Feb 2023 - Now, BK21 Research fellow, POSTECH

Host Prof. Beomjun Choi

Feb 2020 - Feb 2023, Research fellow at Korea Institute for Advanced Study

Host Prof. Inkang Kim

Mar 2019 - Feb 2020, Research fellow at Korea Institute for Advanced Study

Host Prof. Choe Jaigyoung

Research Interests

Minimal surfaces, **curvature flows**, **mathematical relativity and related geometry**; **analysis of partial differential equations**.

References

1. Prof. Jaigyoung Choe (choe@kias.re.kr).

   Professor and President of Korea Institute for Advanced Study, Seoul.

2. Prof. Martin Man-chun Li (martinli@math.cuhk.edu.hk).

   Associate Professor at the Chinese University of Hong Kong, Hong Kong.

3. Prof. Pengzi Miao (pengzim@math.miami.edu).

   Professor at University of Miami, Florida.

Grants

1. Korea NRF, RS-2024-00337418 (PI, 2024-2026)

2. (participant researcher/employee) Korea NRF 2022R1C1C1013511 (PI: Beomjun Choi, 2022 ~ 2027)

3. KIAS Individual Grants MG074401, MG074402 (PI: 2019-2023)

Publications

1. (with *Juncheol Pyo*, *Xueyuan Wan*) Spectral constant rigidity of warped product metrics. J. Lond. Math. Soc. (2) **110** (2024), no.1, Paper No. e12958. arXiv: 2310.13329.

2. Inverse mean curvature flow with a free boundary in hyperbolic space. Calc. Var. Partial Differential Equations, **63**, 109 (2024). arXiv: 2203.08467.

3. (with *Gaoming Wang*) Dihedral rigidity in hyperbolic 3-space. arXiv:2208.03859. (This paper contains a previous result *Mass and polyhedra in asymptotically hyperbolic manifolds* arXiv:2102.10715). Trans. Amer. Math. Soc. **377** (2024), 807-840.

4. A curvature estimate for stable marginally outer trapped hypersurface with a free boundary. Int. Math. Res. Not. IMRN (2024), no. 6, 4624-4655. arXiv: 2205.05890.

5. (with *Xueyuan Wan*) The mass of an asymptotically hyperbolic end and distance estimates. *J. of Math. Phys.* **63** (2022), no. 12, Paper No. 122502. arXiv: 2207.06141.

6. (with *Inkang Kim*) Scalar curvature, mean curvature and harmonic maps to the circle. Annals of Global Analysis and Geometry, **62**, 201–219 (2022). arXiv: 2103.09737.

7. Willmore type inequality using monotonicity formulas. Pacific Journal of Mathematics, **307** (1), 53-62, (2020). arXiv: 1811.05617v2.

8. Evaluation of the mass of an asymptotically hyperbolic manifold. The Journal of Geometric Analysis, **32**, (7), 1-18, (2022). arXiv: 1811.09778.

Submitted Papers and Preprints

1. (with *Martin Man-chun Li*) A mixed boundary value problem for Jang's equation and the existence of free boundary marginally outer trapped surfaces. 2019-2024. Available at https://xxchai.github.io/fb-mots.pdf

2. (with *Xueyuan Wan*) Scalar curvature rigidity of domains in a warped product. arXiv:2407.10212. (This paper contains improvements over results from a previous preprint arXiv:2312.16022 about hyperbolic dihedral rigidity; a Llarull theorem is added)

3. Initial data set rigidity results for polyhedra. (with *Xueyuan Wan*). arXiv:2408.13801 (This paper contains improvements over results from a previous preprint arXiv:2312.16022 about initial data set rigidity)

4. A constrained mean curvature flow on capillary hypersurface supported on totally geodesic plane. (with *Yimin Chen*). arXiv:2405.06934.

5. A tilted spacetime positive mass theorem. arXiv: 2304.05208.

6. (with Gaoming Wang) Scalar curvature comparison of rotationally symmetric sets. arXiv: 2304.13152.

7. (with *Xueyuan Wan*) Band width estimates of CMC initial data sets. arXiv: 2206.02624. (This supersedes previous papers arXiv: 2107.12782, arXiv: 2107.12784)

8. Asymptotically hyperbolic manifold with a horospherical boundary. arXiv: 2102.08889.

9. Minkowski formula of conformal Killing-Yano 2-forms. arXiv: 2101.08966.

10. Positive mass theorem and free boundary minimal surfaces. arXiv: 1811.06254.

11. Two quasi-local masses evaluated on surfaces with boundary. arXiv: 1811.06168.

Invited Talks

1. **26 Nov, 2024**. *Scalar curvature rigidity of domains in a warped product*. MIST 2024 workshop. Chongqing University of Technology, Chongqing.

2. **4 Nov, 2024**. *Scalar curvature rigidity of domains in a warped product*. MIST 2024 workshop. Chinese University of Hong Kong, Hong Kong.

3. **Oct 25, 2024**. *Rigidity of domains in a three dimensional warped product*. KMS fall meeting 2024, special session on Elliptic and Parabolic PDEs and Geometric Analysis. Suwon, Korea.

4. **Oct 17, 2024**. *Scalar curvature rigidity of domains in a warped product*. Peking-Westlake geometric analysis seminar (online).

5. **May 18-20, 2024**. *Three dimensional hyperbolic dihedral rigidity via spinors*. Workshop on Geometry Analysis VI: Korea-Vietnam Joint Research. Pusan National University, Busan.

6. **Apr 5-8, 2024**. *Some scalar curvature rigidity of compact manifolds*. 2024 Frontiers Mathematics Forum. Chongqing University of Technology, Chongqing.

7. **Jan 8-10, 2024**. *Capillary surfaces and spinors in scalar curvature geometry*. Workshop on Geometry Analysis V: Capillary hypersurfaces and beyond. Pusan National University. Busan.

8. **Oct 25, 2023**. *Scalar curvature comparison theorem from Gauss-Bonnet to Gromov*. Differential Geometry Seminar. KAIST. Daejeon.

9. **Apr 27, 2023**. *Scalar curvature rigidity of rotationally symmetric sets.* Special Session of Geometric Analysis. 2023 KMS spring meeting. Daejeon.

10. **Feb 20-23, 2023.** *Inverse mean curvature flow with a free boundary in geodesic balls in hyperbolic space*. The 3rd Conferences on Surfaces, Analysis, and Numerics. Korea University. Seoul.

11. **Jan 8-13, 2023.** *Scalar and mean curvature rigidity of convex rotationally symmetric sets*. Workshop on Geometric Analysis and related topics. High 1 resort, Jeongseon, Korea.

12. **Dec 1-10, 2022.** *Scalar curvature rigidity of polyhedron in hyperbolic 3-space and generalizations.* Pusan National University, Busan.

13. **Nov 11, 2022.** *Band width estimates of CMC initial data sets and applications.* University of Miami.

14. **Aug 22, 2022**. *Gromov dihedral rigidity in hyperbolic 3-space*. Department of mathematics, Peking University, Beijing.

15. **June 10, 2022**. *Free boundary surface in scalar curvature geometry*. Department of Mathematics, Xiamen University, Xiamen.

16. **Apr 14, 2022**. *Inverse mean curvature flow with a free boundary in hyperbolic space*. Pusan National University, Busan.

17. **March 1-3, 2022**. *Mixed boundary value problems in Gromov dihedral rigidity*. Conference of *Geometric analysis on manifolds, fractals and metric spaces*. Yamagata University, Japan.

18. **April 14, 2021**. *Harmonic maps on the cube to the circle and applications to the dihedral rigidity*. Duke University.

19. **Aug 13, 2020**. *Free boundary MOTS: existence theory*. Nankai University, Tianjin.

20. **Sep 23-26, 2019**. *Positive mass theorem and free boundary minimal surfaces*. International Conference on Analysis and PDEs on Manifolds and Fractals. Nankai University, Tianjin.

21. **Jun 3, 2019**. *Constructing a minimal surface in a sphere with an arbitrary metric*. KIAS Three W Seminar.

22. **Feb 21-Mar 1, 2019**. *Willmore inequatilies via monotonicity formulas*. Workshop on Geometric Analysis, Algebraic geometry and Sympletic geometry. The Chinese University of Hong Kong.

23. **Aug 2018**. *Positive mass theorem and free boundary minimal surfaces*. Peking University.

24. **June, 2018**. *Positive mass theorem and free boundary minimal surfaces*. Sun Yat-Sen University (Zhuhai Campus).

Academic Visits

1. Nov 7-Nov 12. University of Miami, Florida. Host: Prof. Pengzi Miao.

2. Nov 5-6, 2022. University of Connecticut, Northeastern Workshop in Geometric Analysis (NEWGA).

3. Oct 27-Nov 4, 2022. Cornell University. Host: Prof. Xin Zhou, Gaoming Wang.

4. Nov 8-11, 2019. *Geometric Analysis Seminar for Young Scholars*. Sun Yat-sen University.

5. Oct 22-24, 2019. Jeonbuk National University, Korea. Host: Prof. Hojoo Lee.

6. Sep 2018, Department of Mathematics, Fudan University. Host Prof. Ling Yang.

7. Sep 2018, Department of Mathematics, Nankai University. Host Prof. Yuhua Sun.

Teaching Assistant Duties

1. 2017 - 2018 Term 2, MATH1010I University Mathematics, CUHK.
2. 2017 - 2018 Term 1, MATH1010 University Mathematics, CUHK.
3. 2016 - 2017 Term 1, MATH1010 University Mathematics, CUHK.
4. 2015 - 2016 Term 1, MATH1510 Calculus for Engineers, CUHK.
5. 2015 - 2016 Term 1, MATH1020 General Mathematics, CUHK.
6. 2014 - 2015 Term 2, Complex function theory (10420252),Tsinghua University.
7. 2014 - 2015 Term 1, Methods of Mathematical Physics (10420262), Tsinghua University.
8. 2013 - 2014 Term 2, Linear Algebra (10421102), Tsinghua University.
9. 2013 - 2014 Term 1, Linear Algebra (10421113), Tsinghua University.
10. 2012 - 2013, Calculus A (10421065), Tsinghua University.

Awards

2014, Awards of Excellence, Department of Mathematics, Tsinghua University.