Cuncheng Zhu

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Fields of Interests

mechanics, discrete differential geometry, active matter, scientific computing

Education

2025 (expected) **PhD in Engineering Science with specialization in Computational Science**
Department of Mechanical and Aerospace Engineering
UNIVERSITY OF CALIFORNIA SAN DIEGO
Advisors: David Saintillan and Albert Chern

2022 **MSc in Engineering Physics**
Department of Mechanical and Aerospace Engineering
UNIVERSITY OF CALIFORNIA SAN DIEGO

2019 **BSc in Mechanical Engineering**
Department of Mechanical and Aerospace Engineering
UNIVERSITY OF CALIFORNIA SAN DIEGO

Honors & Awards

2025 Cover Feature of the Proceedings of the Royal Society A, Volume 481, Issue 2311. url.

2025 Invited Participant, Geometric Mechanics Formulations for Continuum Mechanics. *Banff International Research Station (BIRS).*

2022 Cover Feature of the Biophysical Reports, Volume 2, Issue 3. url.

2022 GEMINI Fellowship Award Honorable Nominee, *Institute of Engineering in Medicine, UCSD.*

2019 California Research Assistant (Cal RA) Fellowship, *Graduate admission, UCSD.*

2019 UCSD SHORE Recipient, *Graduate admission, UCSD.*

2019 UCSD Marshall College Honors Program, *Undergraduate graduation, UCSD.*

2015-2019 Provost Honors (8 quarters), *Undergraduate distinctions, UCSD.*

Publications

Under review

2025 **C. Z.**, Hang Yin, Albert Chern. "Viscous vortex dynamics on surfaces".
2025 Sreejith Santhosh, **C. Z.**, Blase Fencil, Mattia Serra. "Coherent structures in active flows on dynamic surfaces".

Peer-reviewed

2025 **C. Z.**, David Saintillan, Albert Chern. "Active nematic fluids on Riemannian 2-manifolds". *Proceedings of the Royal Society A*, featured as the cover of the April 2025 issue.
2025 **C. Z.**, David Saintillan, Albert Chern. "Stokes flow of an evolving fluid film with arbitrary shape and topology". *Journal of Fluid Mechanics*.
2024 Jacquelin M Griswold, Mayte Bonilla-Quintana, Renee Pepper, Christopher T Lee, Sumana Raychaudhuri, Siyi Ma, Quan Gan, Sarah Syed, **C. Z.**, Miriam Bell, Mitsuo Suga, Yuuki Yamaguchi, Ronan Chereau, Valentin Nagerl, Graham William Knott, Padmini Rangamani, Shigeki Watanabe. "Membrane mechanics dictate axonal morphology and function". *Nature Neuroscience* (2024).
2023 Hideki Nakamura, Elmer Rho, Christopher T Lee, Kie Itoh, Daqi Deng, Satoshi Watanabe, Shiva Razavi, Hideaki T Matsubayashi, **C. Z.**, Eleanor Jung, Padmini Rangamani, Shigeki Watanabe, Takanari Inoue. "ActuAtor, a Listeria-inspired molecular tool for physical manipulation of intracellular organizations through de novo actin polymerization". *Cell Reports* (2023).
2022 **C. Z.**, Christopher T. Lee, Padmini Rangamani. "Mem3DG: modeling membrane mechanochemical dynamics in 3D ssing discrete differential geometry." *Biophysical Reports*, solicited by the editor-in-chief for submission and featured as the cover of the September 14, 2022 issue.

In preparation

C. Z., Albert Chern, David Saintillan. "Defect dynamics on evolving surfaces". *In Preparation*.
Arthur Hernandez, **C. Z.**, Luca Giomi. "Geometry and activity control of defects on metashells". *In Preparation*.

Presentations

Invited Talks

2025 "Active nematic fluid membrane". *UCSB Applied Math/PDE/Data Science Seminar*. Santa Barbara.
2025 "Modeling viscous force on curved surfaces using vorticity-streamfunction formulation".

5-Day Workshop at Banff International Research Station: Geometric Mechanics Formulations for Continuum Mechanics. Banff.

2025 "Viscous flow of evolving film with arbitrary shape and topology". *SIAM Conference on Computational Science and Engineering*. Fort Worth.

2024 "Active nematics on deformable surfaces". *L. Mahadevan research group, Harvard University*. Cambridge.

2024 "Active nematics on deformable surfaces". *Luca Giomi research group, Universiteit Leiden*. Leiden.

2022 "Mem3DG: Modeling Membrane Mechanochemical Dynamics in 3D using Discrete Differential Geometry". *Allen Institute for Cell Science*. Virtual meeting.

Contributed Talks

2024 "Viscous flow of evolving film with arbitrary shape and topology". *APS Division of Fluid Dynamics 77th Annual Meeting*. Salt Lake City.

2024 "Viscous flow of evolving film with arbitrary shape and topology". *The 16th World Congress on Computational Mechanics (WCCM)/ 4th Pan American Congress on Computational Mechanics (PANACM)*. Vancouver.

2024 "Active nematic fluids on Riemannian 2-manifolds". *SOCAMS (Southern California Applied Mathematics Symposium) 2024*. San Diego.

2024 "Viscous flow of evolving film with arbitrary shape and topology". *SoCal Fluids (Southern California Flow Physics Symposium) XVII 2024*. Irvine.

2023 "Dynamics of active nematic fluids on arbitrary manifolds: exploring the role of geometry and topology". *APS Division of Fluid Dynamics 76th Annual Meeting*. Washington DC.

2023 "Hydrodynamics of active nematics on curved and deformable surface". *SoCal Fluids (Southern California Flow Physics Symposium) XVI 2023*. San Diego.

Posters

2023 "Dynamics of active nematic fluids on arbitrary manifolds: exploring the role of geometry and topology". *Mechanics of Life workshop at the Center for Computational Biology, Flatiron Institute*. New York.

2022 "Mem3DG: Modeling Membrane Mechanochemical Dynamics in 3D using Discrete Differential Geometry". *Research Expo 2022, Jacobs School of Engineering, UCSD*. San Diego.

2022 "Mem3DG: modeling membrane mechanochemical dynamics in 3D using discrete differential geometry". *Biophysical Society 2022*. San Francisco.

2021 "Modeling Membrane Dynamics in 3D using Discrete Differential Geometry". *Biophysical Society 2021*. Virtual meeting.

Visiting positions

2024 **Visiting Scholar**
Luca Giomi research group
UNIVERSITEIT LEIDEN
Collaborate with Arthur Hernandez and Luca Giomi, providing numerical support for a research project.

Press coverage

2022 "From the animation industry to membrane biophysics". *Biophysical Society*. url.

Service

2023 Session chair, Biofluids: Collective Behavior and Active Matter V. *APS Division of Fluid Dynamics 76th Annual Meeting*. Washington DC.
2024 Co-Reviewer, *Proceedings of the Royal Society A*.

Memberships

American Physical Society (APS) Society for Industrial and Applied Mathematics (SIAM)
Association for Computing Machinery (ACM SIGGRAPH) Biophysical Society (BPS)

Mentoring & Teaching

Mentoring

2024-present Leo Serbinov (undergraduate), On computational techniques and theoretical foundations of active nematics on curved surfaces.
2022 Nandana Madhukara, Eleanor Jung (high school students), On biophysical applications using Mem3DG.
2019-2020 A group of undergraduate students, On coursework management and graduate school applications. *UCSD JSOE IDEA JUMP program*.

Teaching Assistant

FA2024 CSE 270 - discrete differential geometry. *UCSD*. (50 students)
SP2024 MAE 101B - fluid mechanics II. *UCSD*. (100 students)
FA2023 MAE 210A - fluid mechanics I. *UCSD*. (50 students)

SP2023 MAE 101B - fluid mechanics II. *UCSD*. (50 students)

Reader

MAE 8 (WI2023, *UCSD*), MAE 209 (WI2022, *UCSD*), MAE 11 (WI2021, *UCSD*).

Tutor

2018-2019 *UCSD MAE Math Open House*. Coordinated bi-weekly walk-in sessions in which over 20 undergraduate students in the MAE department got help on mathematics or related coursework.

Software

2022-2024 *Evolving Stokes Flow*. An implementation of evolving Stokes flow simulation in MATLAB.

2022-2024 *Riemannian Active Nematics*. An implementation of active nematics simulation in Houdini.

2020-2022 *Mem3DG: Modeling Membrane Mechanochemical Dynamics in 3D using Discrete Differential Geometry*. A flexible software package to model biological membrane and its dynamics using unstructured meshes.

2020 *Geometry Central Utilities for Eigen Interoperability*. The utility functions that map a homogenous POD type to `Eigen::Matrix`.

2019 *MuroDrone Localization using Virtual Reality Set*. An Arduino implementation for a custom circuit board that detects infrared signals to output localization coordinates for a drone.

Skills

Languages: English, Mandarin, Hakka
Programming Languages: MATLAB, Python, C++
Software: Houdini FX, COMSOL, FEniCS, Adobe Illustrator
Tools: Git, LaTeX, CMake, Bash