Mattia Serra CV

11 Nov 2026

Web: www.mattiaserra.com

07-2026 - **Associate Professor of Physics, William A. Lee Chancellor's Endowed Jr Faculty Fellow, UCSD**
Research: Nonlinear Dynamics; Biological Physics; Active Matter; Mechanics; Data-Driven Modeling; Control Theory

Education and Previous Positions

09-2020 – 06-2026	Assistant Professor of Physics, **UCSD**
2017 – 2020	Schmidt Science Fellow, **Harvard**; Applied Math., Biophysics. Mentor: Prof. L. Mahadevan
2014 - 2017	Ph.D., **ETH Zürich**; Nonlinear Dynamics. Advisor: Prof. George Haller
2007 - 2012	B.Sc., M.Sc. Control Theory, **Politecnico di Milano**, **110/110 cum laude**, Ranked #1

Selected Awards and Grants

- APS DBIO Early Career Award in Biological Physics — 2027
- William A. Lee Chancellor's Endowed Jr Faculty Fellow, UCSD — 2026
- Alfred P. Sloan Research Fellowship (Physics) — Single PI, $75K — 2026
- IUPAP Interdisciplinary Early Career Science Prize — 2025
- NIH Maximizing Early Stage Investigators' Research Award (MIRA) R35 — Single PI, $1.7M — 2025
- NSF CAREER Award — Single PI, $775K — 2024
- Human Frontier Science Program (HFSP) Early Career Research Award — 3 co-PIs, $400K per PI — 2024
- Hellman Fellow in Physics — 2023
- Schmidt Science Fellow — 2018
- ETH Medal Recipient for an outstanding doctoral thesis — 2017
- NSF PoLS Grant — Single PI, $385K — 2024
- UCMRPI Grant, UC Active Matter Hub — 6 co-PIs, $50K per PI — 2024

Selected Invited Talks and Service

- *Princeton* – Bioengineering — 2026
- *APS DSOFT March Meeting* (AI and soft matter) — 2026
- *Harvard CSMA* (Tutorial Lecturer) – Math. Bio. — 2026
- *Flatiron Institute* – Biophysics — 2025
- *ICTS and NCBS, Bengaluru* – Biophysics — 2025
- *Caltech* – Biophysics — 2025
- *UCSB/KITP* – Physics, Biophysics — 2024-2026
- *Cambridge University* – Biophysics — 2024
- *APS DBIO March Meeting* (Morphogenesis) — 2024
- *University of Oxford* – Mathematical Biology — 2022
- *MIT* – Mathematical Physics — 2020
- *Cornell University* – Mathematics — 2020
- *Courant Institute (NYU)* – Mathematics — 2017, 2026
- *Brown University* – Mathematics — 2017
- *APS DBIO March Meeting* (Morphogenesis) – Session Chair/Organizer — 2025
- *UCSD Biophysics Seminars* - Organizer — 2023-
- Executive Committee Member, NIH T32 Training Program in Quantitative Integrative Biology at UCSD — 2026–

Selected Reviewing Activities and Mentoring

Journals: Science, Nature Physics, PNAS, Science Advances, Science Robotics, Nature Communications, PRX, PRX Life, Journal of Fluid Mechanics, Physical Review Letters, Nonlinear Dynamics, Nonlinearity, Communications on Pure and Applied Mathematics.

Grants/Awards: DOE, NSF, German Research Foundation, UK Research and Innovation (UKRI), Schmidt Science Polymaths, Schmidt Science Fellowship.

Mentoring: Graduate Students: Sreejith Santhosh (2021-), Alex Plum (2022-), Yuyang Lai (2026-). Undergraduate Students: Blase Fencil, Daniel Link, Haruhiko Akimoto (current), Willow Strey (now grad. stud. at OIST), Julian Dukes (Dean's Underg. Excell. Award). Postdoc: Austin Hopkins (September 2025-).

Teaching experience

UCSD: Nonlin. Dyn. and Math. Model. of Complex Systems (grad. course), **prof., developed new class** — 2022-present
UCSD: Advanced Mechanics (upper div. underg. course), **prof.** — 2021-present
UCSD: Stat. & Thermal Phys I (upper div. underg. course), **prof.** — 2023-present
Harvard University: Patterns in Fluids, **co-lecturer, developed new class** — 2019

Selected Publications

1. **Serra M.** and Haller G.
Objective Eulerian Coherent Structures
Chaos vol. 26 (2016) pp. 053110 [PDF], Editor's pick
2. **Serra M.**, Sathe P., Rypina I., Kirincich A., Ross S., Lermusiaux P., Allen A., Peacock T., Haller G.
Search and rescue at sea aided by hidden flow structures
Nature Communications, 11, 2525 (2020) [PDF]. MIT News, Scientific American, BBC Science Focus, AMS Societal Impact: The U.S. Coast Guard implements our technique in their Search and Rescue planning at Sea. [1]
3. **Serra M.**, Streichan S., Chuai M., Weijer C.J. and Mahadevan L.
Dynamic morphoskeletons in development
PNAS, vol. 117, n 21 (2020) [PDF], featured on Harvard SEAS News and SIAM News
4. **Serra M.**, Lemma L., Giomi L., Dogic Z. and Mahadevan L.
Defect-mediated dynamics of coherent structures in active nematics
Nature Physics, 1-7 (2023) [PDF]
5. **Serra, M.**, Nájera G.S., Chuai M., Plum A., Santhosh, S., Spadan V., Weijer C.J. and Mahadevan L.
A mechanochemical model recapitulates distinct vertebrate gastrulation modes
Science Advances, 9.49 (2023) [PDF]
6. Sinigaglia C., Braghin F. and **Serra M.**
Optimal Control of Short-Time Attractors in Active Nematics
PRL 132, 218302 (2024) [PDF]
7. Nájera G.S.*, Plum A*, Steventon, B., Weijer C.J. and **Serra M.**
Control of tissue flows and embryo geometry in avian gastrulation
Nature Communications 16, 5174 (2025) [PDF]
8. Plum A. and **Serra M.**
Positional information and information flows in dynamic tissues
(submitted) [PDF]
9. Santhosh S. and **Serra M.**
Achiral Odd Mechanics in Cell Monolayers
(submitted) [PDF]

Full Publication List

PhD Thesis, **Serra M.**
A Geometric Approach to Coherent Structures in Complex Dynamical Systems (2017) [PDF]

1. **Serra M.**, Resta, F. and Ripamonti, F.
Dependent modal space control
Smart Materials and Structures vol. 22 (2013) pp. 105004 [PDF]
2. **Serra M.**, Resta F. and Ripamonti F.
Dependent modal space control: Experimental test rig
J. of Vibration and Control vol. 23 (2015) pp. 2418-2429 [PDF]
3. **Serra M.** and Haller G.
Objective Eulerian Coherent Structures
Chaos vol. 26 (2016) pp. 053110 [PDF], Editor's pick
4. **Serra M.** and Haller G.
Forecasting Long-Lived Lagrangian Vortices from their Objective Eulerian Footprints
J. Fluid Mech., vol. 813 (2017) 436-457 [PDF]
5. **Serra M.** and Haller G.
Efficient Computation of Null-Geodesics with Applications to Coherent Vortex Detection
Proc. Royal Soc. A vol. 473 (2017) pp. 20160807 [PDF] Journal's cover page.
6. **Serra M.**, Sathe P., Beron-Vera F.J. and Haller G.
Uncovering the Edge of the Polar Vortex
J. Atmosph. Sci. vol. 74 (2017) pp. 3871-3885 [PDF], featured on Forbes
7. **Serra M.**, Vétel J. and Haller G.
Exact Theory of Material Spike Formation in Flow Separation
J. Fluid Mech., vol. 845 (2018) pp. 51-92 [PDF]
8. Farazmand M. and **Serra M.**
Variational Lagrangian formulation of the Euler equations for incompressible flow: A simple derivation.
ArXiv 1807.02726 (2018) [PDF]
9. **Serra M.**, Crouzat S., Gaël S., Vétel J. and Haller G.
Material spike formation in highly unsteady separated flows
J. Fluid Mech., vol. 883 A30 (2019) [PDF]

[1] Scientific American covers our work and interviews Lawrence Stone, head developer of the USCG search-and-rescue protocol.

10. Klose B.F., Jacobs G.B. and **Serra M.**
The Kinematics of Lagrangian Flow Separation in External Aerodynamics
AIAA Journal (2020) pp. 1-13 [PDF]

11. Katsanoulis S., Farazmand M., **Serra M.**, Haller G.
Vortex boundaries as barriers to diffusive vorticity transport in two-dimensional flows
Phys. Rev. Fluids vol 5 (2020) pp. 024701 [PDF]

12. **Serra M.**, Sathe P., Rypina I., Kirincich A., Ross S., Lermusiaux P., Allen A., Peacock T., Haller G.
Search and rescue at sea aided by hidden flow structures
Nature Communications, 11, 2525 (2020) [PDF]. MIT News, Scientific American, BBC Science Focus, AMS Societal Impact: The U.S. Coast Guard implements our technique in their Search and Rescue planning at Sea.

13. **Serra M.**, Streichan S., Chuai M., Weijer C.J. and Mahadevan L.
Dynamic morphoskeletons in development
PNAS, vol. 117, n 21 (2020) [PDF], featured on Harvard SEAS News and SIAM News

14. Nolan P., **Serra M.** Ross S.D.
Finite-time Lyapunov exponents in the instantaneous limit and material transport
Nonlinear Dynamics, 1-28, (2020) [PDF]

15. Klose B.F.*, **Serra M.*** and Jacobs G.B.
Objective early identification of kinematic instabilities in shear flows
ArXiv, (2020) [PDF]

16. Duran R., Nordam T., **Serra M.** and Barker C.
Horizontal transport in oil-spill modeling
Elsevier, Marine Hydrocarbon Spill Assessments. 59-96, (2021) [PDF]

17. **Serra M.***, al-Mosleh S.*, Prasath S. Ganga, Raju V., Mantena S., Chandra J., Iams S. and Mahadevan L.
Optimal policies for mitigating pandemic costs, Software available here.
Physical Biology 19.5 (2022) [PDF]

18. Mowlavi, S., **Serra M.**, Maiorino, E and Mahadevan L.
Detecting Lagrangian coherent structures from sparse and noisy trajectory data
J. Fluid Mech., 948, A4 (2022) [PDF], Software available here.

19. Santhosh S. and **Serra M.**
Optimal Locomotion for Limbless Crawlers
PRE, 106, 024610 (2022) [PDF]

20. Nájera G.S*., Chuai M*.,**Serra, M.**, Mahadevan L. and Weijer C.J.
Reconstruction of distinct vertebrate gastrulation modes via modulation of key cell behaviours in the chick embryo
Science Advances, 9.1 (2022) [PDF] G. Nájera wins the Beddington Medal.

21. **Serra M.**, Lemma L., Giomi L., Dogic Z. and Mahadevan L.
Defect-mediated dynamics of coherent structures in active nematics
Nature Physics, 1-7 (2023) [PDF]

22. Santhosh, S., Qin, H., Klose, B., Jacobs, G., Vétel, J. and **Serra, M.**
Spike formation theory in 3D flow separation
J. Fluid Mech., 969, A25 (2023) [PDF]

23. **Serra, M.**, Nájera G.S., Chuai M., Plum A., Santhosh, S., Spadan V., Weijer C.J. and Mahadevan L.
A mechanochemical model recapitulates distinct vertebrate gastrulation modes
Science Advances, 9.49 (2023) [PDF] featured on Phys.org

24. Sinigaglia C., Braghin F. and **Serra M.**
Optimal Control of Short-Time Attractors in Active Nematics
PRL 132, 218302 (2024) [PDF]

25. Lange, M., ..., **Serra, M.**, Neff, N., Pisco, A.O., and Royer, L.A.
A multimodal zebrafish developmental atlas reveals the transition dynamics of vertebrate pluripotent axial progenitors
Cell 187, 23, p6742-6759 (2024) [PDF]

26. Michaut A., Mongera A., Gupta, A., **Serra M.**,..., Pourquie O.
Extracellular volume expansion drives vertebrate axis elongation
Current Biology 35, 1-11 (2025) [PDF]

27. Nájera G.S.*, Plum A*, Steventon, B., Weijer C.J. and **Serra M.**
Control of tissue flows and embryo geometry in avian gastrulation
Nature Communications 16, 5174 (2025) [PDF]

28. Plum A and **Serra M.**
Dynamical systems of fate and form in development
Seminars in Cell and Developmental Biology 172, 103620 (2025) [PDF]

29. Plum A, **Serra M.** and Weijer C.J.
Advances in the mechanochemical modeling of vertebrate gastrulation
Biochemical Society Transactions BST20240469 (2025) [PDF]

30. Plum A and **Serra M.**
Morphogen Patterning in Dynamic Tissues
PRX Life, 3(4), 043009 (2025) [PDF]

31. Schwabach S.*, Santhosh S.*, Audrey W., **Serra M.** and Horne-Badovinac S.
Initiation of rotational collective migration in Drosophila through tissue geometry and mechanochemical feedback
PNAS, 123 (34) e2528342123 (2026) [PDF]

32. Santhosh S., Zhu C., Fencil B. and **Serra M.**
Coherent Structures in Active Flows on Dynamic Surfaces
PNAS Nexus, 5(11), 335 (2026) [PDF]

33. Samanta R., Shao Y., **Serra M.** and Stern T.
Extracting Patterns from Develop. Micros. Data: Cell States & Behaviors, Trajectories, Deformations and Networks
Biophysical Journal, (in press, 2026) [PDF]

34. Guillot C.*, Djeffal Y.*, **Serra, M.*** and Pourquié O.
Control of epiblast cell fate by mechanical cues
(submitted) [PDF]

35. Johnson A., Seetharaman S., Yao L., Plum A., **Serra M.**, Heemskerk I., Gardel M.
APLNR regulates directed migration to spatially pattern mesoderm in human gastruloids
(submitted) [PDF]

36. Yu H., Cruz M., Kim Y., Chen K., Liu A., Hopkins A., **Serra M.**, Sunshine M., Signer R.
Proteostasis Remodeling Across Development Defines Fetal, Neonatal, and Adult Hematopoietic Stem Cell States
Developmental Cell, (to appear, 2026)

37. Plum A. and **Serra M.**
Positional information and information flows in dynamic tissues
(submitted) [PDF]

38. Santhosh S. and **Serra M.**
Achiral Odd Mechanics in Cell Monolayers
(submitted) [PDF]

39. Hopkins A. and **Serra M.**
Data-Driven Objective Constitutive Equations of Epithelial Monolayers
(preprint)