Nimesh Chahare, PhD

Postdoctoral Research Scientist,
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EDUCATION

PhD	Applied Mathematics, Universitat Politècnica de Catalunya, Barcelona, Spain	Jun. 2023
ME	Mechanical Engineering, Indian Institute of Science, Bengaluru, India	Sept. 2016
BTech	Mechanical Engineering, National Institute of Technology, Nagpur, India	Sept. 2014

RESEARCH AREAS

Epithelial Mechanics Neurodevelopmental Biology Mechanobiology Biophysics

RESEARCH EXPERIENCE

Postdoctoral Reseach Scientist, at Columbia University

Adviser: **Prof. Nandan Nerurkar** May 2024–Present

Project: **Mechanics of morphogenesis of embryonic brain development**

Characterized chick embryonic brain morphology through various developmental stages using confocal imaging, while also developing computational tools to analyze geometric changes.

Investigating the relationship between molecular signaling and physical forces, such as pressure and tension, by developing techniques to control lumen pressure and alter morphogen patterning.

Doctoral Researcher and Postdoctoral Researcher, at Institute for Bioengineering of Catalonia

Adviser: **Prof. Xavier Trepat** and **Prof. Marino Arroyo** Aug. 2017–Apr. 2024

Thesis: **Mechanics of epithelial layers subjected to controlled pressure**, Grade: *cum laude*

Developed a microfluidic chip to control epithelial tissue shapes and lumen pressure. Implemented an innovative approach to pattern epithelial folds through controlled buckling.

Acquired expertise in cell culture, protein micropatterning, microfluidic device design and fabrication, advanced microscopy, along with proficiency in image processing and cell segmentation.

Collaboration: **Modeling nuclear to cytoplasmic transport of proteins**

Developed a computational tool to track protein diffusion and import/export rates across nuclear membrane using photobleaching techniques (FRAP and FLIP). *Published in Nat. Cell Biol. 2022*

Collaboration: **Analyzing force loading rates associated with cell mechanosensing**

Analyzed rate-dependent mechanosensitivity of cells using large datasets from Atomic Force Microscopy and Optical Tweezers experiments. *Published in Nat. Commun. 2021*

Graduate Researcher, at Indian Institute of Science

Adviser: **Prof. Namrata Gundiah** Aug. 2014–Jun. 2017

Master's thesis: **Design and fabrication of miniature shear device for cell mechanics**

Developed a bioreactor with a cone plate rheometer-like design to apply uniform shear stress on cells, while gaining expertise in computer-aided design, 3D printing, and assembling/programming electrical components. *Patented in India*

Side project: **Finite element analysis of coffee white stem borer (CWSB) mandible**

Discovered mechanical advantages of mandible for wood cutting through 3D tomography, CAD modeling, and finite element analysis. *Published in JMBBM 2020*

Side project: **Developing constitutive model of Fiber Reinforced Elastomers (FRE)**

Performed uniaxial/biaxial stretching of fiber-reinforced elastomer and modeled the data using a hyperelastic constitutive equation. *Published in Soft Robotics 2020*

PUBLICATIONS

Patents

Pullarkat, P., Vishwakarma, R., Gundiah, N., and Chahare, N. R. (2018) A microscope mountable fluid shear device. Indian patent, IN201641029893A.

Chahare, N. R., Le Roux, A., Roca-Cusachs, P., and Trepat, X. A novel microfluidic chip for stretching adherent cells and tissues. (*Patent application process initiated 2024*)

Journal Articles

Chahare, N., Imamura, C., & Nerurkar, N.L. Lumen pressure regulates cellular proliferation patterns during chick early embryonic brain development. (*in preparation*)

Chahare, N., Ouzeri, A., Golde, T., Wilson, T., Roca-Cusachs, P., Trepat, X., & Arroyo, M. Wrinkling and folding dynamics of epithelial shells at multiple scales. bioRxiv, 2025-06. (*in review*)

Golde, T., Pensalfini, M., Chahare, N., Roca-Cusachs, P., ..., Arroyo, M., & Trepat, X. A keratin bundling transition uncages the nucleus in stretched epithelia. bioRxiv, 2025-08. (*in review*)

Ouzeri, A., Kale, S., Chahare, N., ..., Trepat, X., & Arroyo, M. Theory of multiscale epithelial mechanics under stretch: from active gels to vertex models. bioRxiv, 2025-03. (*in review*)

Andreu, I.*, Granero-Moya, I.*, Chahare, N., ... & Roca-Cusachs, P. (2022). Mechanical force application to the nucleus regulates nucleocytoplasmic transport. **Nature Cell Biology**, 24(6), 896.

Andreu, I.*, Falcones, B.*, Hurst, S., Chahare, N., ... & Roca-Cusachs, P. (2021). The force loading rate drives cell mechanosensing through both reinforcement and cytoskeletal softening. **Nature Communications**, 12(1), 4229.

Chatterjee, A., Chahare, N., ... & Gundiah, N. (2021). Role of fiber orientations in the mechanics of bioinspired fiber-reinforced elastomers. **Soft Robotics**, 8(6), 640-650.

Kundanati, L., Chahare, N., ... & Gundiah, N. (2020). Cutting mechanics of wood by beetle larval mandibles. **Journal of the Mechanical Behavior of Biomedical Materials**, 112, 104027.

Conference Presentations

"Harnessing active viscoelasticity for synthetic epithelial morphogenesis." XIX Jornada de biologia molecular (Catalan Society for Biology), September 14, 2023

"Harnessing active viscoelasticity for synthetic epithelial morphogenesis." Deutsche Physikalische Gesellschaft (German Physics Society), Dresden, Germany. March 26-31, 2023

"Shaping epithelia through buckling in pressure-controlled tissue." World congress of biomechanics, Taipei, Taiwan. July 10-14, 2022

"Synthetic epithelial morphogenesis through controlled stretching and buckling." EMBL-IBEC Conference, Engineering multicellular systems, Barcelona, Spain. June 08-10, 2022

"Synthetic epithelial morphogenesis through controlled stretching and buckling." EMBO-EMBL Symposium, Mechanobiology in development and disease, Heidelberg, Germany. May 15–18, 2022

Invited Talks and Presentations

"What is epithelial mechanics? " Pint of Science talk, New York, USA, May, 2025

"Multiscale dynamics of epithelial shells." Gulmohar: Indian Society of Developmental Biologists' postdoc talk series, November 2024 (online)

"Mechanics of epithelial shells." International Developmental Mechanics Zoom Seminar Series, November 2024 (online)

"Multiscale buckling of epithelial shells." Indian Institute of Science, Bengaluru, India, March 2024

KEY PROFICIENCIES

Biology

Chick embryology, cryosectioning, mammalian cell culture, immunofluorescence stainings, protein micropatterning (microcontact printing and photopatterning), hydrogel preparation, 3DISCO clearing Handling epithelial cell lines in the context of in vitro 2D/3D experiments.

Microscopy

Advanced microscopy techniques, including light/fluorescence microscopy and 2 photon, spinning disk/laser scanning confocal microscopy, and SPIM lightsheet microscopy.
Utilized photobleaching techniques (FRAP, FLIP), along with local photoactivation for optogenetics.

Microfluidics

Experienced in working within microfabrication facilities, involving designing photomasks, photolithography, plasma bonding, 3D printing with a DLP projector, elastomer (PDMS) preparation, and fabrication of frugal microfluidic devices using a desktop cutting machine.

Design and Analysis

Programming: Python, MATLAB, R, FIJI macro, Markdown, LaTeX. Image Processing: Automated segmentation, Napari, Vedo, and 3D analysis pipeline development for large datasets.
3D modeling: FreeCAD, SolidWorks, Inkscape, Blender, and Keyshot.

Soft skills

Strong collaboration and teamwork abilities, confident in public speaking, self-motivated quick learner, adept at trouble-shooting, and adaptable to dynamic challenges.

LEADERSHIP EXPERIENCE

Elected as **Co-Vice President** at Columbia University Postdoctoral Society (CUPS). 2025–Present

Elected as **Steward** at Columbia Postdoctoral Workers, UAW Local 4100. 2024–Present

Founder and convenor of the International Epithelial Mechanics Fan Club. 2023–Present

ENGAGEMENTS AND SERVICE ACTIVITIES

Mentoring undergraduate student at Columbia University. 2024–Present

Managed data servers (synology and magnetic tape drive system) at Prof. Trepat's lab. 2018–2024

Invited to be a panelist in a discussion on the topic of 'Why Scientists Should Care About Art?' organized by the Barcelona City Government. 2023

Active participation in organizing March for Science events in Barcelona. 2018, 2023

Mentored two high school students, an undergraduate, and a master's student for summer projects on separate occasions at IBEC. 2018, 2021

Member of PhD committee at IBEC. 2017–2019

ART EXHIBITIONS

"A=A, B=B", Antoni Tàpies Foundation Museum, Barcelona, Spain. Dec. 2023–Mar. 2024

"Organic Origami" artwork as part of City and Science Biennial 2023, Centre de Cultura Contemporània de Barcelona, Barcelona, Spain. Feb. 2023

ACADEMIC ACHIEVEMENTS

Won the travel grant for attending EMBO Practical Course: Computational modelling of multicellular systems - EMBL Barcelona 2025

Won the best poster prize at 15th IBEC symposium on Bioengineering for Active Ageing. 2022

International travel grant for attending winter school on Quantitative Systems Biology at International Centre for Theoretical Sciences (ICTS), Bengaluru, India. 2019

Awarded scholarship by Indian Ministry of Human Resource and Development for attending Indian Institute of Science, Bengaluru, India. 2014

Ranked in the top 0.2% (362nd out of 185,578 candidates) in national level entrance examination, Graduate Aptitude Test in Engineering (GATE) for Mechanical Engineering. 2014

LANGUAGES

Fluent: English, Marathi, Hindi

Conversational: Catalan, Spanish

REFERENCES

Available on request

Updated April 2026