

# CHHOTE LAL SHAH

S/o: Ramanand Shah

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## OBJECTIVE

To work in globally competitive environment on challenging assignments in a highly renowned growth oriented organization using cutting edge technologies where I could constantly learn and successfully deliver solutions to real life problems. This would yield the twin benefits of the job satisfaction and will flourish my professional acumen.

## EDUCATIONAL SUMMARY

Qualifications	Specialization	Board/University	Year of completion	CGPA/%
Postdoctoral Research Associate	Aerospace Engineering	University of Illinois at Urbana Champaign (UIUC) USA	Jan 18, 2024-present	NA
MS + PhD	Aerospace Engineering	Indian Institute of Technology Madras (IITM), Chennai, Tamil Nadu, India	2024	8.96/10
MTech	Mechanical Engineering (Thermal)	JNTU, Kakinada, India	2017	9.5/10 (Gold Medallist)
B.E.	Aeronautical Engineering	Visvesvaraya Technological University (VTU), India	2015	9.39/10
A-Level Science	Mathematics, Physics, Chemistry	University of Cambridge International Examination, UK	2010	80.00%
10 <sup>th</sup>	Mathematics & Science	Nepal Board	2008	82.25%

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## **RESEARCH EXPERTISE**

Immerse Boundary Method, Computational Fluid Dynamics, Flapping Wing Aerodynamics, Fluid-structure Interaction Dynamics, Open Source Solvers - Fluid-structure coupling, Nonlinear Dynamics and Chaos, Time Series Analysis, Experimental Force Measurements, Design and optimization of wings for Flapping Underwater Automated Vehicles and Flapping-wing Micro Air Vehicles (FUAVs and FMAVs), Parallel Computing (using OpenMP, Open MPI, OpenACC for GPU accelerated platform)

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## **RESEARCH EXPERIENCES**

- **Postdoctoral Research Associate** at University of Illinois at Urbana Champaign (**UIUC**) USA  
**Project:** Development of Aeroelastic Lumped Parameter (ALP) Model to predict aerodynamic instabilities in Turbocharger (T/C) for Aviation
  - A lumped parameter model of the T/C system from which approximate geometry, structural, and fluid dynamic conditions of the T/C components, especially the high-pressure turbine (HPT), can be deduced.
  - A physics-based aerodynamic model that is computationally efficient and provides quick estimates of the pressure forces found within the HPT.
  
- Indian Institute of Technology Madras (**IITM**), Chennai, India.  
July, 2017 – Jan, 2024, **PhD Research Scholar**  
**Thesis:** Study of the Dynamical Transitions and Flow-Field Patterns in Chordwise Flexible Flapping Systems
  
- Worked as a Project Assistant in **Computational Mechanics of Advanced Composites Lab (CMAC-Lab)** under the guidance of Dr G Narayana Naik, department of Aerospace Engineering, Indian Institute of Science, Bangalore-12.

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## **RESEARCH FOCUS**

- **Unsteady Aerodynamics and Low Reynolds Number Flows** (flow dynamics behind flapping wings/fins).
- **Fluid-Structure Interactions** (effect of spanwise wing flexibility in bio-inspired propulsions and flow energy harvesting).
- **Biological fluid dynamics** (micro swimmers like flagella, larvae)
- **Nonlinear Dynamics and Transition to Chaos** (unpredictable flow behaviour in flapping flight).
- **Effect of gust in the flight performance of flapping wing Micro Aerial Vehicles.**

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## **TECHNICAL SKILLS**

- Language : C, C++, Matlab, Mathematica, Python
- CFD : OpenFOAM, Salome, ANSYS Mechanical and FLUENT, Solid Edge, CATIA, Abaqus, Solid work
- Parallel Computing : OpenMP, OpenMPI, OpenACC for GPUs, CUDA Programming

## MAIN SUBJECTS STUDIED

Unsteady Aerodynamics of Moving Bodies, Dynamical Systems, Foundation of Computational Fluid Dynamics, Advanced Computational Fluid Dynamics, Advanced Fluid Mechanics, Computational Techniques in Applied Mechanics, Structural Dynamics and Aeroelasticity, Fundamental of Aerodynamics.

## ACHIEVEMENTS / PARTICIPATION

- Institute Research Award IITM for best research during PhD
- Gayatri Vidya Parishad College of Engineering (A), Visakhapatnam, India, **Gold Medal-2018** for standing First in order of merit at the MTech (Thermal) in Mechanical Engineering.
- Gayatri Vidya Parishad College of Engineering (A), Visakhapatnam, India, **Outstanding academic performance-2016** for scoring highest CGPA at the MTech in Mechanical Engineering.
- Gayatri Vidya Parishad College of Engineering (A), Visakhapatnam, India, **Outstanding academic performance-2017** for scoring highest CGPA at the MTech in Mechanical Engineering.
- Awarded with full Scholarship to pursue MTech-Mechanical Engineering under **Dr. Homi J.Bhabha Scholarship Scheme 2016-17**.
- Awarded with full scholarship to pursue B.E. (Aeronautical Engineering) under **Nepal Aid Fund Scholarship Scheme 2011-12**.
- Qualified **GATE-2015** with all India rank of **177** in Aerospace Engineering.
- Worked as **TEAM LEADER IN STUDSAT-2** and worked on GPS (Global Positioning System).
- Awarded with “**VEDIC THINKER 2013**” title in 2013 for excellence in “Vedic Thinker Course” among 30 top colleges in Bangalore, India.

## PROJECT ACCOMPLISHED

- **MTech Thesis** : Numerical Study of Nonlinear Fluid Structure Interaction Dynamics of Flapping Aerofoil in an Incompressible Flow.
- **BE Project** : Geometrical Optimization of Turbine Blade for Effective Cooling Using CFD Simulation.
- Completed the mini project entitled **Finite Element Analysis for The Prediction of Laminated Composite Structures** using ANSYS Mechanical APDL in Aerospace Department, IISc, Bangalore during June-August 2014.
- Completed the mini project on **Smoke Flow Visualization** studies on a two-dimensional aerofoil at different angles of incidence at low speeds using low speed wind tunnel and ANSYS CFX during June-August 2013, NMIT, Bangalore.
- Completed the mini project on **Calculation Of Lift and Drag** of a two-dimensional circular cylinder, symmetrical aerofoil & cambered aerofoil using pitot-static probe wake survey low speed wind tunnel and ANSYS CFX during Jan-Feb 2014, NMIT, Bangalore.
- Completed the mini project entitled **Optimization of Combustion Chamber for Different Fuels using Ansys ICEM CFD 14.5**, NMIT, Bangalore.

## JOURNALS

1. **Chhote Lal Shah**, Dipanjan Majumdar, Chandan Bose and Sunetra Sarkar, “Chord-wise flexible foil suppresses jet-switching by reinstating wake periodicity in a flapping foil”, *Journal of Fluid Mechanics*, vol. 946, A12, <https://doi.org/10.1017/jfm.2022.591>

2. Rajanya Chatterjee, **Chhote Lal Shah**, Sayan Gupta and Sunetra Sarkar, “Energy harvesting in a flow-induced vibrating flapper with biomimetic gaits” *International Journal of Mechanical Sciences*, pages 109150, 2024. <https://doi.org/10.1016/j.ijmecsci.2024.109150>
3. **Chhote Lal Shah**, Dipanjan Majumdar, Chandan Bose and Sunetra Sarkar, “Controlling the chaotic wake of a flapping foil by tuning its chordwise flexibility”, (Revision submitted to *Journal of Fluid & Structures*).
4. **Chhote Lal Shah**, Karthick Dhileep, Quixang Huang, Sridhar Ravi and Sunetra Sarkar, “Bioinspired forward and backward swimming gaits resulting from fluid-structure interaction”, (Submitted to *Proceedings of Royal Society A*).
5. **Chhote Lal Shah** and Sunetra Sarkar, “A novel nondimensional parameter to demarcate the boundary between drag-to-thrust producing regime in flexible flapping foil”, (under preparation for *Journal of Fluid Mechanics*).

### **BOOK CHAPTERS/PROCEEDINGS**

1. “Investigating the dynamical behavior of dipteran flight inspired flapping motion using immersed boundary method based FSI solver”, in *Recent Advances in Computational Mechanics and Simulations*, “**Chhote Lal Shah**, Dipanjan Majumdar, and Sunetra Sarkar”, 2021, pp 259-270, Springer Singapore. DOI: [10.1007/978-981-15-8315-5\\_23](https://doi.org/10.1007/978-981-15-8315-5_23).
2. “Delaying the Chaotic Onset in the Flow-field of Flapping Foil with Flexible Aft-tail”, *Proceedings of the AMSE 2020 International Mechanical Engineering Congress and Exposition*. Volume 7A: V07AT027, “**Chhote Lal Shah**, Dipanjan Majumdar, and Sunetra Sarkar”, 2022. DOI: [10.1115/IMECE2020-23868](https://doi.org/10.1115/IMECE2020-23868).
3. “Wake dynamics of a flexible flapping filament at low Reynolds number”, in *Recent Advances in Computational Mechanics and Simulations 2022*, “**Chhote Lal Shah**, Dipanjan Majumdar, Chandan Bose, and Sunetra Sarkar”, 2022, Francis and Taylor Group. DOI: [10.1201/9781003324539-82](https://doi.org/10.1201/9781003324539-82).
4. “Surrogate modeling of unsteady aerodynamic loads acting on a plunging airfoil”, in *ECCOMAS Congress 2020-8<sup>th</sup> European Congress on Computational Methods in Applied Sciences and Engineering*, “Rahul Sundar, Virendra Kumar, Dipanjan Majumdar, **Chhote Lal Shah**, and Sunetra Sarkar”, 2022, SCIPEDIA. DOI: [10.23967/eccomas.2022.263](https://doi.org/10.23967/eccomas.2022.263).
5. “Role of Piezoelectric Coupling Factor on FIV-Based Energy Harvesting of a Piezoelectric Flag”, in *Fluid Mechanics and Fluid Power*, Volume 1. FMFP 2022. *Lecture Notes in Mechanical Engineering*, “Rajanya Chatterjee, **Chhote Lal Shah**, Sayan Gupta, and Sunetra Sarkar”, 2024, Springer, Singapore. DOI: [https://doi.org/10.1007/978-981-99-7827-4\\_59](https://doi.org/10.1007/978-981-99-7827-4_59).

### **CONFERENCES**

1. “Performance Enhancement of an Immersed Boundary Method Based FSI Solver Using OpenMP” in 21<sup>st</sup> Annual CFD Symposium Bangalore, “**Chhote Lal Shah**, Dipanjan Majumdar, and Sunetra Sarkar”, 8-9 August 2019, NAL, Bangalore, India.
2. “Investigating the Dynamical Behavior of Dipteran Flight Inspired Flapping Motion Using Immersed Boundary Method Based FSI Solver”, in 7<sup>th</sup> International Congress on Computational Mechanics and Simulation, “**Chhote Lal Shah**, Dipanjan Majumdar, and Sunetra Sarkar”, 11-13 December 2019, IIT Mandi, India.

3. “Identifying the Route to Chaos for a Dipteran Flight System”, in 6<sup>th</sup> International Conference on Complex Dynamical Systems and Applications, “**Chhote Lal Shah**, Dipanjan Majumdar, and Sunetra Sarkar”, 21-23 Feb 2020, Central University of Rajasthan, India.
4. “Delaying the Chaotic Onset in the Flow-field of Flapping Foil with Flexible aft Tail”, Proceedings of the ASME IMECE 2020, “**Chhote Lal Shah**, Dipanjan Majumdar, and Sunetra Sarkar”, 16-19 November 2020, Portland, USA (Virtual).
5. “Bifurcations and Chaos in the Fluid-Structure Interaction Dynamics of a Dipteran Flight Motor”, in 73<sup>rd</sup> Annual Meeting of the APS Division of Fluid Dynamics, “**Chhote Lal Shah**, Dipanjan Majumdar, and Sunetra Sarkar”, 22-24 November 2020, CT (Chicago, USA) (Virtual).
6. “Massive Parallelisation and Performance Enhancement of an Immersed Boundary Method based Unsteady Flow Solver”, in NSM Workshop on High Performance Computing in Computational Fluid Dynamics, “Rahul Sundar, Dipanjan Majumdar, **Chhote Lal Shah**, Isaac George, Amber Shah, and Sunetra Sarkar”, 01-03 December 2020, IIT Madras, Chennai, India (Virtual).
7. “Stabilising the Flow-field of a Heaving Foil using a Flexible Aft Tail Attached at the Trailing Edge”, in 25<sup>th</sup> International Congress of Theoretical and Applied Mechanics (ICTAM), “**Chhote Lal Shah**, Dipanjan Majumdar, and Sunetra Sarkar”, 22-27 August 2021, Milano, Italy (Virtual).
8. “Intermittency in Flow-field of Plunging Teardrop Foil”, in 25<sup>th</sup> International Congress of Theoretical and Applied Mechanics (ICTAM), “**Chhote Lal Shah**, Dipanjan Majumdar, and Sunetra Sarkar”, 22-27 August 2021, Milano, Italy (Virtual).
9. “Recurrent Neural Network based Surrogate Modelling of Unsteady Forces Acting on Plunging Airfoil”, UK Fluid Conference, “Rahul Sundar, Dipanjan Majumdar, **Chhote Lal Shah**, and Sunetra Sarkar”, 8-10 September 2021, UK (Virtual).
10. “Energy Harvesting Potential of an Unimorph Flexible Beam in Uniform Flow”, UK Fluid Conference, “Rajanya Chatterjee, **Chhote Lal Shah**, Sunetra Sarkar, and Sayan Gupta”, 8-10 September 2021, UK (Virtual).
11. “Inertial Effect on the Flow-induced Vibration for Energy Harvesting from a Piezoelectric Beam”, Symposium on Aeroelasticity, Fluid-structure Interaction and Vibrations, “Rajanya Chatterjee, **Chhote Lal Shah**, Sayan Gupta, and Sunetra Sarkar”, 14-15 October 2021 (Virtual).
12. “Investigating the Effect of Chord-wise Flexibility to Control Aperiodicity in the Flow-field around a Flapping Foil”, in 74<sup>th</sup> Annual Meeting of the APS Divisions of Fluid Dynamics, “**Chhote Lal Shah**, and Sunetra Sarkar”, 21-23 November 2021, Phoenix, Arizona, USA.
13. “Wake Dynamics of a Flexible Filament at a Low Reynolds Number”, in International Conference on Theoretical Applied Computational and Experimental Mechanics (ICTACEM), “**Chhote Lal Shah**, Dipanjan Majumdar, Chandan Bose, and Sunetra Sarkar”, 20-22 December 2021, IIT Kharagpur, India.
14. “Flow-field transition in the wake of a flexible foil at low Reynolds number”, in 8<sup>th</sup> European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS), “**Chhote Lal Shah**, Dipanjan Majumdar, Chandan Bose, and Sunetra Sarkar”, 5-9 June 2022, Oslo, Norway.

15. "Surrogate modeling of unsteady aerodynamic loads acting on a plunging airfoil", in 8<sup>th</sup> European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS), "Rahul Sundar, Virendra Kumar, Dipanjan Majumdar, **Chhote Lal Shah**, and Sunetra Sarkar", 5-9 June 2022, Oslo, Norway.
16. "Effect of piezoelectric coupling on dynamical transitions of a flexible beam in viscous flow", in 10<sup>th</sup> European Nonlinear Dynamics Conference (ENOC), "Rajanya Chatterjee, **Chhote Lal Shah**, Sayan Gupta, and Sunetra Sarkar", 17-22 July 2022, Lyon, France.
17. "Comparative study of the wake dynamics of rigid and flexible flapping foils", in 14<sup>th</sup> European Fluid Mechanics Conference (EFMC-14), "**Chhote Lal Shah**, Dipanjan Majumdar, Chandan Bose, and Sunetra Sarkar", 13-16 September 2022, Athens, Greece.
18. "Numerical investigation of wake dynamics of mosquito larva-like swimmers", in 75<sup>th</sup> Annual Meeting of the APS Division of Fluid Dynamics (APS-DFD), "**Chhote Lal Shah**, Karthick Dhileep, Sridhar Ravi, and Sunetra Sarkar", 20-23 November 2022, Indianapolis, Indiana, USA.
19. "Role of piezoelectric coupling factor on FIV-based energy harvesting of a piezoelectric flag", in Fluid Mechanics and Fluid Power (FMFP), "Rajanya Chatterjee, **Chhote Lal Shah**, Sayan Gupta, and Sunetra Sarkar", 14-16 December 2022, IIT Roorkee, India.
20. "Massive parallelization and performance enhancement of an immersed boundary method based unsteady flow solver", in Fluid Mechanics and Fluid Power (FMFP), "Rahul Sundar, Dipanjan Majumdar, **Chhote Lal Shah**, and Sunetra Sarkar", 14-16 December 2022, IIT Roorkee, India.
21. "Dynamical transitions in flexible piezoelectric flapper in the wake of a bluff body", in 3<sup>rd</sup> International Nonlinear Dynamics Conference (NODYCON), "Rajanya Chatterjee, **Chhote Lal Shah**, Sayan Gupta, and Sunetra Sarkar", 1-4 August 2023, IIT Madras, India.
22. "Exploring forward and backward swimming dynamics in bioinspired undulatory swimmers", in 76<sup>th</sup> Annual Meeting of the APS Division of Fluid Dynamics (APS-DFD), "**Chhote Lal Shah**, Karthick Dhileep, Quixang Huang, Sridhar Ravi, and Sunetra Sarkar", 19-21 November 2023, Washington, DC, USA.

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## **WORKSHOPS**

1. "Fluid Dynamic Simulations using OpenFOAM", 24-25 February 2018, Organized by Research Affairs Council (RAC), IIT Madras.
2. "ACM Winter School 2019 on High-Performance Computing (HPC)", 5-11 December 2019, Organized by ACM India, C-DAC and IIT Kanpur, IIT Kanpur India.
3. "Design, Simulation and Development of Unmanned Aerial Vehicles (Drones) and Applications in Various Engineering Sectors (Webinar)", 30 April-4 May 2020, organized by NAFEMS in association with Rajarambapu Institute of Technology, Islampur, Maharastra and Ramchandra College of Engineering, Eluru, AP, India.
4. "GPU Hackathon", 31 August 2020 to 09 September 2020, Organized by Edvancer Eduventures (Virtual).
5. "HPC Shiksha: Basics of Hight Performance Computing", November 2020 to February 2021, Organized by C-DAC and the NSM Nodal Centers for Training in HPC and AI at IITs Goa, Kharagpur, Madras and Palakkad (Virtual).

6. "Certified Machine Learning and AI Course", 21 September 2020 to 03 October 2020, Organized by Edvancer Eduventures and IIT Madras (Virtual).
7. International Workshop: Networks and Dynamical Systems, 2021 organized by the Complex Systems and Dynamics group, Indian Institute of Technology Madras, and which was held in an online mode from August 25-28, 2021.
8. "3 day Workshop on Basics of CFD and OpenFOAM", 11-13 January 2023, Organized by the FOSSEE (Free Open Source Software for Education) and the Spoken Tutorial Projects, MoE, Government of India at IIT Bombay.

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**PERSONAL INFORMATION**

Fathers' Name : Ramanand Shah

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Languages known : English, Nepali, Hindi

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**REFERENCES**

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(Chhote Lal Shah)

