

Songrui LI
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RESEARCH INTERESTS

My research focuses on computational fluid dynamics, optimization, and nonlinear dynamical systems, with particular emphasis on sensitivity analysis and adjoint methods for chaotic flows. My broader interests include reduced-order modeling and scientific machine learning for developing efficient and physically consistent models of complex engineering systems.

EDUCATION

School of Mechanical Engineering, National Technical University of Athens Athens, Greece
MSCA Doctoral Candidate, Parallel CFD & Optimization Unit 09/2026 – Present

- **Fellowship:** Marie Skłodowska-Curie Actions (MSCA) Doctoral Network Fellow within the FairCFD project
- **Doctoral Project:** DC8: Adjoint-based Optimisation for Flows exhibiting Chaotic Dynamics
Supervisor: Prof. Kyriakos Giannakoglou; Industrial Partner: Toyota Gazoo Racing
- **Research:** Developing shadowing-based and adjoint sensitivity methods for chaotic CFD problems, with applications to aerodynamic shape optimization in automotive flows

Department of Aeronautics, Imperial College London London, United Kingdom
MSc in Advanced Computational Methods for Aeronautics, Flow Management, and Fluid-Structure Interaction; Graduated with Merit 09/2019 – 11/2020

- **Thesis:** Bifurcation and Oscillation Effects of Gyrotactic Swimming Microorganism Suspension
Supervisor: Prof. Yongyun Hwang
- **Selected Coursework:** CFD, HPC, Hydrodynamic Stability, and Flow Control

ETSIAE, Universidad Politécnica de Madrid Madrid, Spain
International Exchange Student; Grade: 9.0/10.0 02/2019 – 07/2019

- **Scholarship:** Awarded Erasmus+ International Credit Mobility Scholarship (KA107), including European Commission travel support
- **Thesis:** Flow Field Analysis Based on RANS Solver and BiGlobal Stability Theory
Supervisors: Prof. Eusebio Valero Sanchez (UPM) & Prof. Yaguo Lyu (NPU)

School of Power and Energy, Northwestern Polytechnical University Xi'an, China
BEng in Flight Vehicle Propulsion Engineering; Grade: 86.5/100, Ranked 11th of 269 09/2015 – 07/2019

- **International Summer School:** Awarded a fully funded scholarship to attend the University of Southern Denmark Summer School in Experimental Fluid Mechanics; conducted a group project on airfoil optimization for LM Wind Power turbine blades (08/2018)
- **National Competition:** Led research on “Bionic Anti-drag Propeller” in the China College Students’ “Internet+” Innovation Competition; awarded Second Prize (04/2017 – 04/2018)
- **Awards:** Distinguished Student Scholarship, awarded in two consecutive academic years (2015–2016 and 2016–2017)

EXPERIENCE

Department of Mechanical Engineering, Vanderbilt University Nashville, United States
Research Assistant (Volunteer) 08/2024 – 01/2026

- **FSI Solver Development:** Coupled the finite-element structural solver (FEBio) with an in-house immersed boundary solver for large-deformation FSI simulations in biomedical applications
- **Patient-Specific Modeling:** Performed CT-based geometry reconstruction and FEM simulations to analyze upper airway responses to Ansa Cervicalis Stimulation in Obstructive Sleep Apnea
- **Biomedical Simulation:** Collaborated with *California Medical Innovations Institute* and *Prima Medical Technologies GmbH (Germany)* on prosthetic aortic valve design and simulation-based performance evaluation

Pre-R&D group, SAIC Volkswagen Automotive Co., Ltd.

Shanghai, China

CFD Methodology Engineer

05/2021 – 08/2024

- **Solver Development:** Extended SPH solver DualSPHysics (C++/CUDA) by introducing surface tension and aerodynamic drag effects, enabling one-way air-water coupling for GPU-accelerated rain simulations
- **CFD Methodology:** Developed and calibrated automated OpenFOAM-based simulation workflows for external and underhood vehicle aerodynamics, including mesh sensitivity, convergence, and numerical robustness studies on complex automotive geometries
- **Active Learning:** Developed an active-learning GNN-CFD framework for aerodynamic performance prediction, triggering high-fidelity simulations for low-confidence predictions, and incorporating the resulting data into iterative model retraining.
- **Scientific Machine Learning:** Developed a physics-informed neural network with customized loss functions for predicting gap-induced automotive aeroacoustic noise from experimental data
- **Computer Vision:** Developed an image-segmentation tool to quantify automotive soiling test data
- **Mentorship:** Mentored three graduate engineers in MPI/CUDA parallel computing, OpenFOAM, and Machine learning

Data Science Engineer (Rotational), Data & Connectivity Group

06/2023 – 01/2024

- **Predictive Modeling:** Developed data-driven predictive maintenance frameworks by integrating cross-functional datasets, improving vehicle diagnostic reliability

PUBLICATIONS&PRESENTATIONS

Gupta, M., **Li, S.***, Luo, H., Kent, D. T., & Li, Y. (2026). Finite Element Analysis of Upper Airway in Ansa Cervicalis Stimulation for Obstructive Sleep Apnea. *The Laryngoscope*, 136(10), 4575–4584. doi:10.1002/lary.70603

Sarkar, N., **Li, S.**, & Luo, H. (2025). A coupled FEBio-immersed boundary framework for fluid-structure interaction in biological applications. *78th Annual Meeting of the APS Division of Fluid Dynamics*, Houston, TX.

* Co-first author

SKILLS

Programming & HPC: C++, Python, MATLAB, CUDA, Fortran, MPI

Numerical Methods: CFD, FSI, Finite Volume Methods, Immersed Boundary Methods, SPH, numerical optimization

Data-Driven Methods: POD, DMD, GNNs, scientific machine learning

Solvers/Frameworks: OpenFOAM, DualSPHysics, FEBio, COMSOL Multiphysics

Pre/Post-Processing: Gmsh, ANSA, ParaView