

# Daehyun Choi

POSTDOCTORAL RESEARCHER · EXPERIMENTAL FLUID MECHANICS · BIO-INSPIRED PROPULSION · PHYSICAL AI  
School of Chemical & Biomolecular Engineering, Georgia Institute of Technology, Atlanta, GA, USA  
☎ +1 678 788 0049 | ✉ dchoi319@gatech.edu | 🏠 dae416.github.io | 📄 dae416 | 📖 Google Scholar

“Translating biological locomotion into physical intelligence through fluid physics and machine learning”

## Summary

---

Dr. Daehyun Choi is an experimental fluid mechanist and postdoctoral researcher at the Bhamla Lab, School of Chemical & Biomolecular Engineering, Georgia Institute of Technology (advisor: Prof. M. Saad Bhamla). His research bridges **bioinspired propulsion**, **vortex dynamics**, **fluid-structure interaction (FSI)**, and **machine-learning-based flow measurement and optimization**, with the goal of translating biological locomotion strategies into next-generation underwater vehicles, soft robots, and physical AI systems. He combines high-speed laboratory experiments, 3D biological fieldwork, deep-learning flow diagnostics, open-source FSI simulation frameworks, and Bayesian surrogate modeling to uncover the fluid physics underlying extreme animal behaviors.

### HIGHLIGHTS

- **Journals:** *J. Fluid Mech.* (×3), *Phys. Fluids* (Editor’s Pick), *Sci. Rep.*, *J. R. Soc. Interface*, *Integr. Comp. Biol.*, *J. Membr. Sci.*; high-impact papers in preparation/under review targeting *Science*, *Science Robotics*, and *J. Fluid Mech.* (arXiv preprints available).
- **Physical AI & open-source contributions:**
  - **DeepBubbleVelocimetry** [🔗★9] — CNN-based (PWC-Net optical flow) velocity measurement for bubbly two-phase flows; first deep-learning flow-diagnostic tool purpose-built for bubble-laden systems. [paper]
  - **BubMask** — Mask R-CNN adaptation for bubble instance segmentation and detection.
  - **Open-source FSI simulation framework** (OpenFOAM + CalculiX + preCICE): fully reproducible 3D FSI solver for compliant nozzle dynamics; deployed in Singh & **Daehyun Choi** et al., 2026 (arXiv).
  - **Deep-learning Bayesian surrogate model** for soft nozzle thrust optimization (*in preparation, J. Fluid Mech.*).
- **Selected awards & grants** (full list in Awards section):
  - Technical leader, **DARPA Young Faculty Award** (PI: Prof. M. S. Bhamla, **\$500k**), 2024
  - **Sejong International Postdoctoral Fellowship**, NRF Korea (**\$140k**), 2023
- **Experimental:** High-speed imaging, PIV, 3D-PTV, refractive-index matching, stereo-camera reconstruction, dynamometry; biological fieldwork (mudskipper tracking in natural habitats, Borneo).
- **Computational:** CNN / optical flow (PyTorch), Bayesian optimization, surrogate modeling, open-source FSI (OpenFOAM + CalculiX + preCICE), multiphysics simulation (MATLAB, Python).

### RESEARCH INTERESTS

- Bioinspired underwater propulsion: squid-inspired soft nozzles, mudskipper locomotion, water-walking insects
- Vortex dynamics and impulse/thrust enhancement in starting and pulsed jets
- Fluid-structure interaction: flexible/compliant nozzles, elastic wave propagation, Moens-Korteweg scaling
- **Deep learning for experimental fluid mechanics:** optical flow, instance segmentation, pose estimation
- **Bayesian surrogate modeling and data-driven optimization** for propulsion and flow control
- Multiphase flows: liquid atomization, bubbly flows, interfacial and capillary dynamics
- Biomechanics of extreme locomotion (air-water interface, ultra-fast maneuvers)
- Physical AI: bridging biological intelligence, fluid physics, and robotic implementation

## Education

---

### Seoul National University (SNU)

M.S. & PH.D. IN MECHANICAL ENGINEERING

- Dissertation: “Flow-structure interaction of the starting jet through flexible circular nozzle” [link]
- **Best Thesis Award**, Dept. of Mechanical Engineering, SNU
- Advisor: Prof. Hyungmin Park (Multiphase Flow & Flow Visualization Lab)
- Laboratory leader (2018–2020)
- BK21+ Doctoral Scholarship (\$10k), 2015–2016

Seoul, Republic of Korea

Mar. 2015 – Aug. 2022

- *Cum Laude*
- Presidential Scholarship for undergraduate students (\$30k)
- Head of the Division of Club Association

## Academic Employment

---

### Georgia Institute of Technology

Atlanta, GA, USA

POSTDOCTORAL RESEARCHER

Sep. 2023 – present

- School of Chemical & Biomolecular Engineering
- Advisor: Prof. M. Saad Bhamla (Bhamla Lab)
- Research: bioinspired propulsion (squid, mudskipper), deep-learning flow diagnostics, Bayesian surrogate modeling for soft nozzle optimization, DARPA propulsion project

### Ajou University

Suwon, Republic of Korea

POSTDOCTORAL RESEARCHER

Sep. 2022 – Aug. 2023

- Department of Mechanical Engineering
- Advisor: Prof. Daeshik Kang
- Research: cephalopod-inspired jet-propelled soft underwater vehicle, flow characterization of flexible nozzle systems

## Research Project Experience

---

### Squid-Inspired Nozzles for Enhanced Efficiency and Thrust in Rotary Propulsors

Bhamla Lab, Georgia Tech 

SUPPORTED BY DEFENSE ADVANCED RESEARCH PROJECTS AGENCY (DARPA)

Sep. 2024 – present

- Designed and characterized squid-inspired compliant nozzles for rotary propulsion systems
- Conducted PIV / dynamometry experiments to quantify thrust amplification mechanisms
- Developed deep-learning Bayesian surrogate models for nozzle geometry optimization
- Keywords: bioinspired propulsion, FSI, deep learning, Bayesian optimization, DARPA

### Hydrodynamics of Water-Hopping Mudskipper and Biomimetic Robot Development

Bhamla Lab, Georgia Tech 

SUPPORTED BY NATIONAL RESEARCH FOUNDATION OF KOREA (NRF) – SEJONG INTERNATIONAL POSTDOCTORAL FELLOWSHIP

Sep. 2023 – present

- Investigated interfacial hydrodynamics and 3D kinematics of mudskipper water-hopping locomotion through laboratory experiments and biological fieldwork (Borneo)
- Developed stereo-camera 3D tracking system for non-invasive pose estimation in natural habitats
- Built physical and robotic models to validate discovered locomotion principles
- Keywords: bioinspired robotics, interfacial dynamics, 3D tracking, high-speed imaging

### Development of Cephalopod-Inspired Jet-Propelled Soft Underwater Vehicle

Kang Lab, Ajou University

SUPPORTED BY NATIONAL RESEARCH FOUNDATION OF KOREA (NRF) – DOMESTIC POSTDOCTORAL FELLOWSHIP

Sep. 2022 – Aug. 2023

- Characterized thrust generation and flow dynamics of soft nozzle systems replicating squid funnel mechanics
- Studied elastic energy storage and release mechanisms in compliant nozzle structures
- Keywords: soft robotics, underwater propulsion, fluid-structure interaction

### Physical-Based Model for Film Thickness and Spray Characteristics Depending on Operation Conditions

MFFV Lab, Seoul National University 

SUPPORTED BY DAEWOO SHIPBUILDING &amp; MARINE ENGINEERING (DSME)

Mar. 2021 – Oct. 2022

- Developed experimental and analytical models for spray coating film formation in marine engineering applications
- Performed high-speed flow visualization of atomization and droplet dynamics
- Keywords: liquid atomization, spray coating, multiphase flow, industrial application

### Apparatus for Determining Removal of Foley Catheter

MFFV Lab, Seoul National University 

SUPPORTED BY YONSEI SEVERANCE HOSPITAL

Jan. 2020 – Jan. 2022

- Designed flow-sensing apparatus to assess bladder pressure and determine safe catheter removal timing
- Led to multiple Korean and PCT patents (lead inventor)
- Keywords: biomedical device, fluid sensing, pressure measurement


## Measurement of Bubble and Particle in Liquid

MFFV Lab, Seoul National

University 

Jul. 2018 – Apr. 2019

SUPPORTED BY SAMSUNG ELECTRO-MECHANICS

- Developed image-processing and deep-learning-based methods for bubble/particle detection and velocimetry in industrial liquid systems
- Laid groundwork for the DeepBubbleVelocimetry  open-source tool
- Keywords: bubble measurement, CNN, optical flow, two-phase flow

## Analysis of Molten Metal Atomization Using Multi-physics Simulation

MFFV Lab, Seoul National

University 

Feb. 2018 – Sep. 2018

SUPPORTED BY SAMSUNG ELECTRONICS

- Performed multiphysics simulation of molten metal atomization processes
- Keywords: liquid atomization, multiphysics, numerical simulation

## Effects of Superhydrophobic Surface on the Wake of Circular Cylinder

MFFV Lab, Seoul National

University 

Apr. 2016 – Aug. 2016

SUPPORTED BY SAMSUNG ADVANCED INSTITUTE OF TECHNOLOGY (SAIT)

- Investigated drag reduction and wake modification by superhydrophobic coatings on bluff bodies using PIV
- Keywords: superhydrophobicity, wake dynamics, drag reduction, PIV

# Publications

**Bold** denotes the presenting/corresponding author. † denotes equal contribution. \* denotes co-first authorship.

## JOURNAL ARTICLES

1. **Daehyun Choi**, Paras Singh, Halley Wallace, Chandan Bose, & M. Saad Bhamla, “Deep-learning Bayesian surrogate model for thrust enhancement of soft nozzle,” *Phys. Rev. Fluids*. *Under review*.
2. **Daehyun Choi**, Kai Lauren Yung, Halley Wallace, Jacob Harrison, & M. Saad Bhamla, “Interfacial dynamics on the water-hopping behavior of mudskipper,” *In preparation*.
3. **Daehyun Choi\***, Paras Singh, Ian Bergerson, Minho Kim, Jieun Park, Halley J. Wallace, Kenny Zhang, Sandy Y. Hsieh, Aqua T. Asberry, Theodore A. Uyeno, William F. Gilly, Hyungmin Park, Daeshik Kang, Chandan Bose, & M. Saad Bhamla, “Squid-inspired soft superpropulsion,” *arXiv:2605.03239* (2026). *Under review*. [arXiv]
4. Paras Singh, **Daehyun Choi**, M. Saad Bhamla, & Chandan Bose, “Elastic wave propagation governs impulse enhancement in pulsed jets through flexible nozzles,” *arXiv:2605.17319* (2026). *Under review*. [arXiv][Open-source FSI solver: OpenFOAM + CalculiX + preCICE]
5. Pankaj Rohilla, Johnathan Nathaniel O’Neil, Chandan Bose, Victor M. Ortega-Jimenez, **Daehyun Choi**, & M. Saad Bhamla, “Epineuston vortex recapture enhances thrust in tiny water skaters,” *Under review*. [pdf] [bioRxiv]
6. **Daehyun Choi**, Kai Yung, Ian Bergerson, Halley Wallace, Ulmar Grafe, & M. Saad Bhamla, “Three-dimensional tracking method for water-hopping mudskippers in natural habitats,” *Integr. Comp. Biol.*, icaf139 (2025). [pdf] [doi]
7. Pankaj Rohilla\*, **Daehyun Choi\***, Halley Wallace, Kai Lauren Yung, Juhi Deora, Atharva Lele, & M. Saad Bhamla (\*equal contribution), “Mastering the Manu – How humans create large splashes,” *J. R. Soc. Interface*, 15, 2 (2025). [pdf] [doi]
8. **Daehyun Choi** & Hyungmin Park, “Enhanced impulse and entrainments of the pulsed circular jet by flexible nozzle,” *J. Fluid Mech.*, 996, A6 (2024). [pdf] [doi]
9. **Daehyun Choi\***, Hyunseok Kim\*, & Hyungmin Park (\*equal contribution), “Bubble velocimetry using the conventional and CNN-based optical flow algorithms,” *Sci. Rep.*, 12, 11879 (2022). [pdf] [doi] [code]
10. **Daehyun Choi** & Hyungmin Park, “Flow-structure interaction of the starting jet through the flexible circular nozzle,” *J. Fluid Mech.*, 949, A39 (2022). [pdf] [doi]
11. **Daehyun Choi**, Jungwon Byun, & Hyungmin Park, “Analysis of the liquid column atomization by annular dual-nozzle gas jet flow,” *J. Fluid Mech.*, 943, A25 (2022). [pdf] [doi]
12. Dokeun Lee, **Daehyun Choi**, Hyungmin Park, & Sungjae Kim, “Electroconvective circulating flows by asymmetric coulombic force distribution in multiscale porous membrane,” *J. Membr. Sci.*, 636, 119286 (2021). [pdf] [doi]
13. **Daehyun Choi** & Hyungmin Park, “Flow around in-line sphere array at moderate Reynolds number,” *Phys. Fluids (Editor’s Pick)*, 30, 097104 (2018). [pdf] [doi]

## CONFERENCES & SEMINARS

1. **Daehyun Choi**, “Geometrical effects of free-end nozzles on wave reflection in self-oscillating flexible nozzles,” *78<sup>th</sup> Annual Meeting of the APS Division of Fluid Dynamics*, Oral presentation. **Houston, USA**, 2025.
2. **Daehyun Choi**, “Bio-inspired flexible nozzle design for enhanced underwater propulsion,” *Fluid and Biodynamics Seminar, Max Planck Institute for Dynamics and Self-Organization*, Oral presentation (Invited). **Göttingen, Germany**, 2025.
3. **Daehyun Choi**, “Squid-inspired nozzles for enhanced thrust in rotary propulsors,” *2025 European Mechanics Society: Bio-inspired Fluid-Structure Interaction (EUROMECH)*, Oral presentation. **Vienna, Austria**, 2025.
4. **Daehyun Choi**, “Squid-inspired nozzles for enhanced thrust in rotary propulsors,” *2025 American Physical Society March Meeting*, Oral presentation. **Anaheim, USA**, 2025.
5. **Daehyun Choi**, “Non-invasive 3D tracking of water-hopping mudskippers in natural habitats,” *2025 Society for Integrative and Comparative Biology (SICB)*, Poster presentation. **Atlanta, USA**, 2025.
6. **Daehyun Choi**, “Physical modelling of water-hopping mudskipper,” *77<sup>th</sup> Annual Meeting of the APS Division of Fluid Dynamics*, Poster presentation. **Salt Lake City, USA**, 2024.

7. **Daehyun Choi**, “Water-hopping behavior of mudskipper,” *2024 IUTAM Symposium on Capillarity and Elastocapillarity in Biology*, Poster presentation. **Seoul, Korea**, 2024.
8. **Daehyun Choi**, “Hydrodynamics of water-hopping mudskipper,” *2024 International Physics of Living Systems Annual Meeting*, Oral presentation. **Trieste, Italy**, 2024.
9. **Daehyun Choi**, “Hydrodynamic study on the water-hopping behavior of mudskipper,” *2024 American Physical Society March Meeting*, Oral presentation. **Minneapolis, USA**, 2024.
10. **Daehyun Choi**, “Vortex mechanism in microvelia-inspired water-walking for thrust optimization using robotic design,” *2024 Society for Integrative and Comparative Biology (SICB)*, Poster presentation. **Seattle, USA**, 2024.
11. **Daehyun Choi**, “Experimental study on the starting jet through the flexible circular nozzle,” *2022 World Congress on Advances in Civil, Environmental and Materials Research (ACEM)*, Oral presentation. **Seoul, Korea**, 2022.
12. **Daehyun Choi**, “On the optimal flexibility condition of an impulsive starting jet nozzle for thrust generation,” *73<sup>rd</sup> Annual Meeting of the APS Division of Fluid Dynamics*, Oral presentation. **Online**, 2020.
13. **Daehyun Choi**, “Experimental study on the effect of nozzle flexibility on the evolution of a starting liquid jet,” *72<sup>nd</sup> Annual Meeting of the APS Division of Fluid Dynamics*, Oral presentation. **Seattle, USA**, 2019.
14. **Daehyun Choi**, “Study on dual-nozzle jet flows for the application of liquid atomization,” *71<sup>st</sup> Annual Meeting of the APS Division of Fluid Dynamics*, Oral presentation. **Atlanta, USA**, 2018.
15. **Daehyun Choi**, “Experimental study on the flow around in-line array of spheres,” *69<sup>th</sup> Annual Meeting of the APS Division of Fluid Dynamics*, Oral presentation. **Portland, USA**, 2016.

## Awards & Grants

---

### RESEARCH GRANTS

2024	<b>Technical Leader — DARPA Young Faculty Award (\$500k)</b> , Defense Advanced Research Projects Agency (DARPA)	<i>PI: Prof. M. S. Bhamla, Georgia Tech</i>
2023	<b>Sejong International Postdoctoral Fellowship (\$140k)</b> , National Research Foundation of Korea (NRF)	<i>Full funding for overseas postdoctoral research</i>
2022	<b>Domestic Postdoctoral Scholarship (\$50k)</b> , National Research Foundation of Korea (NRF)	<i>Full funding for domestic postdoctoral research</i>
2011–2015	<b>Presidential Scholarship for Undergraduates (\$30k)</b> , Republic of Korea	<i>Seoul National University</i>
2015–2016	<b>BK21+ Doctoral Scholarship (\$10k)</b> , Ministry of Education, Republic of Korea	<i>Seoul National University</i>

### PAPER AWARDS

2025	<b>Emerging Scholar Best Paper Prize (Top 10)</b> , <i>Journal of Fluid Mechanics</i>	<i>Cambridge University Press</i>
2022	<b>Best Thesis Award</b> , Dept. of Mechanical Engineering	<i>Seoul National University</i>

### COMPETITION AWARDS

2024	<b>Robert M. Nerem International Travel Award (\$3k)</b> , Georgia Institute of Technology	<i>Atlanta, USA</i>
2024	<b>Young Researcher Travel Award (\$1k)</b> , IUTAM Symposium on Capillarity and Elastocapillarity in Biology	<i>Seoul, Korea</i>
2014	<b>1<sup>st</sup> Prize — EDISON Challenge (CFD contest, \$1k)</b> , Ministry of Science, ICT and Future Planning, Republic of Korea	<i>“New design research on pantograph panhead having a hole characteristic”</i>

## Teaching & Mentoring

---

### GRADUATE STUDENT MENTORING

#### Ian Bergerson (Ph.D. student, ChBE, Georgia Tech)

##### RESEARCH MENTOR

- Topic: Dynamic stability of interfacial locomotion in water-hopping mudskipper

*Atlanta, USA*

*2025 – present*

#### Gourav Samal (Ph.D. student, ChBE, Georgia Tech)

##### RESEARCH MENTOR

- Topic: 3D PIV-DIC measurement for soft nozzle and turbulent jet characterization

*Atlanta, USA*

*2025 – present*

### UNDERGRADUATE STUDENT MENTORING

### **Joao Pedro Dudziak Fonseca (Aerospace Engineering, Georgia Tech)**

RESEARCH MENTOR

- Topic: Deep-learning tracking of swimming squid depending on funnel morphology

Atlanta, USA

2025 – present

### **Wesley Robert (Aerospace Engineering, Georgia Tech)**

RESEARCH MENTOR

- Topic: Dynamometer development and PIV measurement for underwater propulsion

Atlanta, USA

2025 – present

### **Evin Jerry (Aerospace Engineering, Georgia Tech)**

RESEARCH MENTOR

- Topic: Automated 3D printing using vision sensor and robotic arms

Atlanta, USA

2025 – present

### **Akshayram Sivakumar (Biomedical Engineering, Georgia Tech)**

RESEARCH MENTOR

- Topic: Non-invasive 3D tracking of water-hopping mudskippers

Atlanta, USA

2024

### **Alexander Miramontes (Mechanical Engineering, Georgia Tech)**

RESEARCH MENTOR

- Topic: 3D reconstruction of deformed nozzle using 3D-PTV and refractive-index matching

Atlanta, USA

2024

### **Halley Wallace (Biomedical Engineering, Georgia Tech)**

RESEARCH MENTOR

- Topic: Development of Manubot and splash high-speed imaging

Atlanta, USA

2024

### **Kai Yung (ChBE, Georgia Tech; currently UC Irvine with NSF GRFP)**

RESEARCH MENTOR

- Topic: Mudskipper locomotion and Manu splash dynamics

Atlanta, USA

2024

### **Jinwon Seo (Mechanical Engineering, Seoul National University)**

UNDERGRADUATE THESIS ADVISOR

- Thesis: “Flow visualization on the gas jet from the bursting bubble on the water surface”

Seoul, Korea

2021

### **Soothan Kim (Mechanical Engineering, Seoul National University)**

UNDERGRADUATE THESIS ADVISOR

- Thesis: “An experimental study on the effects of superhydrophobic surfaces on the flow around a sphere”

Seoul, Korea

2017

### **Taechang Kim (Mechanical Engineering, Seoul National University)**

UNDERGRADUATE THESIS ADVISOR

- Thesis: “Analysis of optimal shape for rowing boat by flow measurement using PIV”

Seoul, Korea

2016

## HIGH SCHOOL MENTORING

### **Kenny Zhang (FSA Program, Georgia Institute of Technology)**

RESEARCH MENTOR

- Topic: Development of mudskipper-inspired robot using half-gear mechanism

Atlanta, USA

2024

## TEACHING ASSISTANTSHIP

### **Mechanical Engineering Laboratory 2: Flow Measurements**

TEACHING ASSISTANT

Seoul National University  
Spring 2017, Fall 2016, Spring 2016

## Patents (Lead Inventor)

---

### **Non-linear instability of a flexible nozzle responding with a steady jet**

US PROVISIONAL PATENT, APPLICATION NO. 63/772,372

Georgia Tech Research Corporation

Mar. 2025

### **System for reducing insertion pressure of the ureteral access sheath for RIRS by artificially inducing hydronephrosis and measuring induced hydronephrosis with flow and hydraulic pressure**

KR PATENT, 10-2021-0149171

Republic of Korea

Nov. 2021

**System for reducing insertion pressure of the ureteral access sheath for RIRS by artificially inducing hydronephrosis and measuring induced hydronephrosis with hydraulic pressure and UASIF**

KR PATENT, 10-2021-0149176

*Republic of Korea*

*Nov. 2021*

**System for reducing insertion pressure of the ureteral access sheath for RIRS by artificially inducing hydronephrosis and measuring induced hydronephrosis with UASIF**

KR PATENT, 10-2021-0149175

*Republic of Korea*

*Nov. 2021*

**Apparatus for determining removal of foley catheter**

PCT PATENT, PCT/KR2020/018848

*International*

*Dec. 2020*

**System for reducing ureteral insertion pressure by artificially triggering hydronephrosis based on measurement of pressure associated with the insertion of the ureteral access sheath for RIRS**

KR GRANTED PATENT, 10-2020-0064729

*Republic of Korea*

*May. 2020*

**System for reducing ureteral entry pressure by generating vibrations in the guide wire for the insertion of the ureteral access sheath for RIRS**

KR GRANTED PATENT, 10-2020-0064731

*Republic of Korea*

*May. 2020*

**Apparatus for determining removal of foley catheter**

KR GRANTED PATENT, 10-2020-0000288

*Republic of Korea*

*Jan. 2020*