Last updated: November 8, 2026

ABYLAIKHAN MUKHAMEJANOV

abm227@lehigh.edu | Google Scholar | LinkedIn | abylaikhanm.github.io
Department of Mechanical Engineering and Mechanics, Lehigh University, Bethlehem, PA 18015, USA
+1 (484) 353-9865 | abylaikhan.mukhamejanov@gmail.com

RESEARCH INTERESTS

Bio-inspired robotics, experimental fluid dynamics, robotic swimmers, actuator control, feedback control loops

EDUCATION

B.S. in Mechanical Engineering, Lehigh University — 08/2023 – 05/2027 (expected)
P.C. Rossin College of Engineering and Applied Science — *Bethlehem, PA*
GPA: 3.64/4.00

- **Mechanical Engineering Coursework:** Fluid Mechanics, Aerodynamics, Thermodynamics, Heat Transfer, Dynamics, Engineering Vibrations, Finite Element Analysis, Strength of Materials, Advanced Mechanics of Materials, Mechanical Elements, Manufacturing, Materials and Processes, Computer-Aided Design, Mechanical Engineering Laboratory I–III, Capstone Design
- **Mathematics Coursework:** Numerical Methods, Linear Algebra, Complex Variables, Calculus I–III

RESEARCH EXPERIENCE

Undergraduate Researcher, Unsteady Flow Interactions Laboratory — 11/2023 – Present
Lehigh University, Dept. of Mechanical Engineering and Mechanics — *Bethlehem, PA*
Advisor: Keith W. Moored | *Mentor: Ata Tankut Ardic*

Cyber-physical robotic flapper for wave-assisted propulsion

- Designed and built a two-axis (heave and pitch) robotic flapper for a recirculating water channel to study wave-assisted propulsion, in which a hydrofoil under a ship turns wave-driven heaving into forward thrust.
- Developed a cyber-physical controller in MATLAB/Simulink Real-Time that solves a mass–spring–damper model from force/torque and encoder feedback at 4 kHz, so the foil's stiffness, damping, and inertia are set in software.
- Validated the virtual dynamics with free-decay and forced-oscillation tests, with amplitude and phase errors below 5%.
- Modeled 45+ custom parts in SolidWorks with GD&T and DFM/DFA and fabricated them by CNC machining, waterjet cutting, and 3-D printing.
- Traced motion error to drivetrain backlash through tolerance-stack analysis and redesigned the drive with precision shafts and bearings, reducing error 5× and noise by 80%.
- Automated parameter sweeps with unattended data logging and added travel limits and an emergency stop for safe use by other lab members.

Underwater vehicle propelled by passive-pitch flapping foils

- Building an underwater vehicle in which a single motor actively heaves a leading foil that pitches passively on a spring, while two stationary rear foils turn the oscillating flow into forward thrust (the Knoller–Betz effect) and control direction.
- Using cyber-physical springs on the robotic flapper to test pitch stiffnesses in software before selecting the physical springs for the vehicle.

Research Intern, Lauder Laboratory 05/2026 – 08/2026
Harvard University, Dept. of Organismic and Evolutionary Biology *Cambridge, MA*
Advisor: George V. Lauder | Mentor: Yu Pan | Collaborator: Keith W. Moored, Lehigh University

Passive swimming of a fish-like body in a thrust-producing vortex wake

- Ran flow-tank experiments on a passive 3-D-printed fish model tethered behind a pitching hydrofoil to test whether a trailing swimmer can hold position and gain thrust from a leader's wake, as part of an ONR MURI on fish schooling.
- Operated an air-bearing robotic flapper (LabVIEW, PID control, NI DAQ) and completed a 27-condition test matrix over pitching frequency, pitch amplitude, and flow speed, collecting ∼4 TB of high-speed video and PIV data.
- Found that in several conditions the passive body synchronized with the wake and held a stable downstream position with no propulsion of its own.
- Mapped the wake's velocity and vorticity with particle image velocimetry (PIVlab, MATLAB) to link the body's response to the vortex structure.
- Tracked the foil and fish with SLEAP and analyzed their kinematics in MATLAB and R (oscillation frequency, amplitude, phase, and downstream position).

Undergraduate Researcher, Nano | Human Interfaces Presidential Initiative 09/2023 – 05/2024
Lehigh University *Bethlehem, PA*
Supervisor: Joan Stanescu, Visiting Scholar and Lab Manager | Collaborators: John Flory; Xiaoji Xu, Dept. of Chemistry

Augmented-reality visualization of perovskite solar-cell surfaces (Project page, Video)

- Converted atomic force microscopy (AFM) scans of perovskite solar-cell surfaces into 3-D models of the nanoscale topography.
- Built an interactive augmented-reality model in Adobe Aero that lets users walk around and explore the surface in 3-D.

Immersive visualization with AR/VR headsets

- Worked with the Apple Vision Pro and other AR/VR headsets to display 3-D scientific data and models.
- Carried out 3-D room scanning to build digital models of lab spaces for use in AR/VR.

INDUSTRY EXPERIENCE

Mechanical Engineering Intern, AeroTargets International LLC 05/2024 – 08/2024
Aerial target drone (UAV) manufacturer *Kingston, PA*

Wind-tunnel test program for a scaled UAV

- Ran a three-phase wind-tunnel program on a scaled military UAV model (preliminary stability, drag with panels off, drag with panels on) to characterize stability and lift-to-drag performance and locate drag sources.
- Designed a SolidWorks fixture that mounts the model on a six-axis force/torque sensor, with a four-bar linkage that changes test angles without re-rigging.
- Acquired and analyzed force and moment data with NI DAQ and MATLAB; found the model stable in pitch and roll but weakly stable in yaw, and recommended fuselage changes that contributed to a 10% drag reduction.

AWARDS & HONORS

- **Best Undergraduate Research Poster Award**, ASME IMECE 2025 2025
  Tied for **1st place** in the ASME Undergraduate Research & Design Expo poster competition for abstract **[A2]**
- **Rossin Research Scholar** ($8,000), P.C. Rossin College of Engineering, Lehigh University 2025
  Year-long funded undergraduate research in the Unsteady Flow Interactions Laboratory
- **STEM-SI Research Fellowship** ($5,500), Lehigh University 2024
  Funded 10-week summer research program
- **Michael Levin '87 Advanced Technology Award**, Baker Institute, Lehigh University 2024
  For the best technology startup (SkillSat) at the Baker Institute's Innovate! Celebrate! venture competition **[P2]**
- **Joan F. and John M. Thalheimer '55 Grand Prize, Finalist**, Baker Institute, Lehigh University 2024
- **Baker Institute Startup Fellowship**, Lehigh University 2023 – 2024
- **EUREKA! Startup Pitch Competition, Winner** ($6,500), Baker Institute, Lehigh University 2023
- **Space Tech Battle, Top-3 Startup** ($5,000), Astana Hub, Almaty, Kazakhstan 2023
  SkillSat named *"most valuable for humanity"* at the Central Eurasian Venture Forum **[P1]**

PUBLICATIONS

In Preparation

I1. **Abylaikhan Mukhamejanov**, Yu Pan, George V. Lauder, Keith W. Moored. "Passive swimming dynamics in a thrust-producing vortex wake." *Bioinspiration & Biomimetics* (manuscript in preparation).

CONFERENCE ABSTRACTS AND TALKS

A5. **Mukhamejanov, A.**, Pan, Y., Lauder, G. V., & Moored, K. W. (2026). Passive swimming dynamics in a thrust-producing vortex wake. *Bulletin of the American Physical Society, 71*, F20.6. (Orlando, FL, Talk) Abstract

A4. **Mukhamejanov, A.**, Ardic, A. T., & Moored, K. W. (2026). Uncovering the fluid–structure interactions of wave-assisted propulsion via cyber-physical fluid dynamics. *Rossin Research Scholars Symposium*, Lehigh University. (Bethlehem, PA, Poster)

A3. **Mukhamejanov, A.**, Ardic, A. T., & Moored, K. W. (2025). Uncovering the fluid–structure interactions of wave-assisted propulsion via cyber-physical fluid dynamics. *Bulletin of the American Physical Society, 70*, S00.12. (Houston, TX, Poster) Abstract, Poster

A2. **Mukhamejanov, A.**, Ardic, A. T., & Moored, K. W. (2025). Design and validation of a cyber-physical fluid dynamics system for bio-inspired propulsion studies. *ASME International Mechanical Engineering Congress and Exposition (IMECE 2025), Undergraduate Research & Design Expo*, IMECE2025-173171. (Memphis, TN, Poster; **Best Undergraduate Research Poster Award**) Abstract, Poster

A1. **Mukhamejanov, A.**, Ardic, A. T., & Moored, K. W. (2024). Dual-axis pitch-and-heave setup for bio-inspired propulsion studies. *Summer Research Expo*, Mountaintop Campus, Lehigh University. (Bethlehem, PA, Poster)

ENGINEERING PROJECTS & LEADERSHIP

Design and Manufacturing Engineer, Lehigh Racing (Formula SAE) 12/2025 – Present
Lehigh University *Bethlehem, PA*

Carbon-fiber and aluminum hybrid suspension control arms

- Redesign the car's steel suspension control arms as carbon-fiber tubes bonded into CNC-machined 7075-T6 aluminum joints, designed in SolidWorks with controlled bond-gap tolerances, to reduce unsprung mass.
- Sized the joints with ANSYS FEA against the team's 2.0 factor-of-safety target and developed the team FMEA for the new design.
- Machined and anodized prototype joints in-house and developed a bond-test procedure comparing bonding methods, rod lengths, and surface treatments; measured load response matched FEA with no joint separation.

Lead Structures Engineer, OSPREY CubeSat 09/2023 – 09/2025
Lehigh University *Bethlehem, PA*

OSPREY: Ocean Satellite for Plastic Research and Environmental Yield (Overview, NASA CSLI Proposal)

- Led a 10-member structures team for Lehigh's first nanosatellite, a 3U CubeSat with a VS/SWIR camera payload to detect plastic on the ocean surface.
- Redesigned 70% of the structural assembly, reducing mass by 23% and volume by 33%; ran FEA for natural frequencies, launch loads, and thermal stresses.
- Prepared ASME Y14.5 GD&T drawings for the team's proposal to the NASA CubeSat Launch Initiative; the team raised $200,000 for satellite design and launch.

Founder & CEO, SkillSat (educational robotics startup) 01/2020 – 2024
Resident startup of Astana Hub technology park *Astana, Kazakhstan*

STEM kits for building and launching student satellites

- Built kits that let school students assemble small satellites and launch them to near space (40+ km) on stratospheric balloons; prototyped 25+ designs and cut production cost by 44%.
- Raised $15,000 and delivered 80+ kits to 240+ students across 25+ schools.

TEACHING EXPERIENCE

Head Teaching Assistant, Applied Engineering Computer Methods (ENGR 010) 12/2023 – Present
P.C. Rossin College of Engineering and Applied Science, Lehigh University *Bethlehem, PA*

- Lead a 30-student section in weekly Python and robotics labs; authored 8 hands-on robotics lab modules.
- Coordinate a team of 3–4 TAs for the section and mentor 1–2 new TAs each semester.

Makerspace Coordinator, Design Labs, Wilbur Powerhouse Makerspace 08/2024 – 01/2025
Lehigh University *Bethlehem, PA*

- Supported fabrication of 30+ projects using 3-D printers, CNC routers, waterjet cutters, and laser cutters.

PROFESSIONAL SOCIETIES

- American Society of Mechanical Engineers (ASME)
- American Physical Society (APS), Division of Fluid Dynamics

PRESS & MEDIA

P2. *Innovate! Celebrate! event shows interconnectedness of Lehigh entrepreneurial, international programs* 04/29/2024
Lehigh University Office of International Affairs
Coverage of SkillSat and the Michael Levin '87 Advanced Technology Award at Innovate! Celebrate!

P1. *The strongest startups of 2023: advice and insight from the winners* 12/15/2023
Forbes Kazakhstan (article in Kazakh)
Profile of SkillSat after its recognition at the Space Tech Battle

TECHNICAL SKILLS

- **Experimental Methods:** Particle image velocimetry (PIVlab), high-speed imaging, water-channel and flow-tank testing, wind-tunnel testing, six-axis force/torque measurement, free-decay system identification
- **Programming & Data Analysis:** MATLAB, Python, R, C/C++; SLEAP tracking
- **Controls & Data Acquisition:** Simulink Real-Time, LabVIEW, NI DAQ, PID control, Arduino, Raspberry Pi, STM32
- **Design & Simulation:** SolidWorks, Fusion 360, ANSYS FEA, Mastercam, Moldflow, GD&T, DFM/DFA, FMEA
- **Manufacturing:** CNC milling, waterjet and laser cutting, 3-D printing, injection molding, composite bonding
- **Languages:** English, Russian, Kazakh

REFERENCES

Keith W. Moored
Professor of Mechanical Engineering and Mechanics
Lehigh University, Bethlehem, PA 18015, USA
Email: kmoored@lehigh.edu
Phone: +1 610-758-4105

George V. Lauder
Professor of Organismic and Evolutionary Biology
Harvard University, Cambridge, MA 02138, USA
Email: glauder@oeb.harvard.edu
Phone: +1 617-496-7199

George Witmer
Professor of Practice, Computer Science and Engineering
Lehigh University, Bethlehem, PA 18015, USA
Email: gsw2@lehigh.edu
Phone: +1 484-437-3338

Joan Stanescu
Visiting Scholar and Lab Manager, Nano | Human Interfaces Presidential Initiative
Lehigh University, Bethlehem, PA 18015, USA
Email: jdsj@lehigh.edu
Phone: +1 610-653-1178