

Sangmin Lim, Ph. D.

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PROFESSIONAL EXPERIENCE

- Assistant Professor, Department of Mechanical Engineering, Republic of Korea Air Force Academy (Current Position)
- Guest Scientist, Max Planck Institute for Intelligent Systems

RESEARCH INTERESTS

- Computational Mechanics, Soft Robotics, Bioinspired Robots, Physics-based Machine Learning, Bacterial Motility

EDUCATION

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| University of California, Los Angeles | Los Angeles, CA |
| • <i>Ph.D. , Mechanical Engineering; GPA: 3.91/4.00</i> | <i>Dec 2019 - June 2023</i> |
| <i>Master of Science, Mechanical Engineering</i> | <i>Aug 2018 - Dec 2019</i> |
| United States Air Force Academy | Colorado Springs, CO |
| • <i>Bachelor of Science, Aeronautical Engineering; GPA: 3.31/4.00</i> | <i>Aug 2012 - May 2016</i> |

RESEARCH EXPERIENCE

- **Ferromagnetic Soft Robot Simulation** in collaboration with Max Plank Institute
Research Assistant (Supervisor : Prof. M. Khalid Jawed) *Jan 2021 - Present*
 - Developed a physics-based simulation for a ferromagnetic soft robot that couples elastic and ferromagnetic material properties using C++. The external magnetic field and magnetization profile are controllable as desired.
- **Machine Learning - Assisted Resistive Force Theory** in collaboration with Charbel Habchi, Ph. D.
Research Assistant (Supervisor: Prof. M. Khalid Jawed) *Oct 2020 - Present*
 - Proposed neural ordinary differential equation method to learn the internal dynamics of high fidelity hydrodynamics model.
 - Developed a fast and accurate hydrodynamics model for rigid helices rotating and translating at low Reynolds numbers using a deep neural network.
- **Bacteria-Inspired Soft Robot**
Research Assistant (Supervisor: Prof. M. Khalid Jawed) *Jul 2019 - Present*
 - Planned an automated desktop experiment to systematically investigate artificial bacterial flagella interaction (bundling, tumbling, unbundling).
 - Investigated existing bacteria-, cilia- robots and mathematical models for the robots. Various scale and actuation methods (magnetic, optical, chemical, and acoustic) were investigated.
 - Designed and tested a centimeter-scale soft robot with two elastic flagella to investigate the propulsive effect of bundling behavior under low Reynolds number flow.
 - Developed and verified a physics-based simulation that couples elasticity, hydrodynamics, and contact for the bacteria-inspired soft robot. Discrete Elastic Rods, Regularized Stokeslet Segment, and penalty-based contact method are integrated.
- **Wind Induced Forces on a Hemispherical Observatory Dome with Open Shutter Doors**
Undergraduate Researcher (Supervisor: Mr. Timothy Siefers) *Sep 2015 - Dec 2016*
 - Induced load coefficients to analyze the mission capability of GEODSS during inclement weather (high wind) by using a 1:35 scale model observatory dome in two configurations, a partially and a fully open configuration in a low-speed wind tunnel.
 - Planned research, calibrated measurement tools (moment balance, pressure transducers), built scaled dome model and conducted data acquisition in a low-speed wind tunnel.
- **Flight Test Technique Lab**
Undergraduate Researcher (Supervisor: Lt Col Joffrion, Lt Col Kyle Kolsti, Lt Col Timothy Jung) *Sep 2015 - Dec 2015*
 - Planned, conducted flight test in T-41D (4 sorties) and T-38 (1 sortie).
 - Obtained and analyzed the flight test data on static/dynamic characteristic of the aircrafts
 - Evaluated the flying qualities of the aircraft based on MIL-HDBK-1797A specification.

PUBLICATIONS

1. Alejandra Hernandez Escobar, **Sangmin Lim**, Leixin Ma (2025) Fluid-structure interaction aspects of the shape-morphing structures and robots *Smart Materials and Structures*
2. **Sangmin Lim** (2024) Intelligent materials and structural mechanics for defense application of soft robots *Korean Journal of Military Arts and Science*
3. Suitu Wang, **Sangmin Lim**, Seelay Tasmim, Manivannan Sivaperuman Kalairaj, Laura K Rivera-Tarazona, Mustafa K Abdelrahman, Mahjabeen Javed, Sasha M George, Yoo Jin Lee, M Khalid Jawed, Taylor H Ware (2024) Reconfigurable growth of engineered living materials. *Advanced Materials*
4. **Sangmin Lim**, Achyuta Yadunandan, M. Khalid Jawed (2023): Bacteria-inspired Robotic Propulsion from Bundling of Soft Helical Filaments at Low Reynolds Number. *Soft Matter*
5. **Lim, S.**, Habchi, C., Jawed, M. K. (2023). Machine learning assisted resistive force theory for helical structures at low Reynolds number. *Journal of Fluids and Structures*
6. Zhuonan Hao, **Sangmin Lim**, Jawed, M. K. (2023). Modeling, Characterization, and Control of Bacteria-inspired Bi-flagellated Mechanism with Tumbling. *IROS 2023*
7. **Sangmin Lim**, Yayun Du, Yongkyu Lee, Shivam Kumar Panda, Dezhong Tong, M. Khalid Jawed (2022): Modeling, Control, and Fabrication of Robots Inspired by Flagella and Cilia. *Bioinspiration & Biomimetics*
8. Timothy M. Siefers, Randy J. Frost, **Sangmin Lim**, and Thomas E. McLaughlin (2017): Wind Induced Forces on a Hemispherical Observatory Dome with Open Shutter Doors. *AIAA 2017-1216*

PRESENTATIONS & INVITED TALKS

1. **Sangmin Lim**, Ferromagnetic soft robots and simulations, *Agency for Defense Development, Nov 13, 2024*
2. **Sangmin Lim**, Intelligent materials and novel opportunities in robotics, *GOLE Robotics, Aug 7, 2024*
3. Zhuonan Hao, **Sangmin Lim**, Siddharth Zalavadia, Darren Chin, Sumukh Johri, Vinay Nagappala, Khalid Jawed (2024) Mechanical characterization of bio-inspired flagella interaction *American Physical Society March Meeting*
4. M. Khalid Jawed, **Sangmin Lim**, Zhuonan Hao (2023) Modeling and Characterization of Bi-flagellated Robot with Tumbling *American Physical Society March Meeting*
5. M. Khalid Jawed, **Sangmin Lim**, Zhuonan Hao (2022): Resistive Force Theory vs. Slender Body Theory as Hydrodynamic Models in Simulation of Bacterial Flagella. *American Physical Society March Meeting*
6. M. Khalid Jawed, Zhuonan Hao, **Sangmin Lim** (2022): Bacteria-inspired Bi-flagellated Soft Robot with Bundling and Tumbling Behavior. *American Physical Society March Meeting*
7. **Sangmin Lim**, Achyuta Yadunandan, and M. Khalid Jawed (2020): Bacteria Inspired Multi-Flagella Propelled Soft Robot at Low Reynolds Number *IROS 2020, Robotics-Inspired Biology Workshop* (Poster)

SOFTWARE & PROGRAMMING SKILLS

- **Programming:** C++, Python
- **Software:** Matlab, Mathematica, SolidWorks, Inventor, ABAQUS, ANSYS, OpenSim, ROS, PyTorch, TensorFlow

TEACHING EXPERIENCE

- Republic of Korea Air Force Academy - Thermodynamics
- Republic of Korea Air Force Academy - Automation system research
- Republic of Korea Air Force Academy - MicroUAV design and manufacturing
- Republic of Korea Air Force Academy - Bionics and Biomimetics

MENTORSHIP

- Sumukh Johri, Applied Materials
- Vinay Nagappala, UCLA
- Saptarshi Joshi, UIUC graduate student
- Achyuta Yadunandan, Space X
- Changdae Kim, Texas A&M graduate student

REVIEW SERVICE

- RA-L
- IROS
- Journal of Military Robotics Society (JMRS)
- Journal of Defense Quality Society (JDQS)
- Bioinspiration & Biomimetics