# Self-introduction Of Doctoral

Yipeng Zhang
University of Pennsylvania

# Self Introduction

First year of undergraduate at Lille University in the major of mechanical engineering with a gpa of 4.0/4.0.

Main course: mechanical design

Transfer to Sorbonne and obtain bachelor degree in mechanical engineering at Sorbonne University in the major of mechanical engineering with a gpa of 15.8/16 (3.9/4.0)

Erasmus Exchange Program in the last semester of undergraduate at EPFL in the major of mechanical engineering with 4.8/6 (4.0/4.0)

Main course: Flow mechanics, Fortran, Thermodynamics, Finit element analysis

Université de Lille

SORBONNE UNIVERSITÉ

EPFL

# Self Introduction

Currently a second year master at university of pennsylvania in the major of mechanical engineering with the concentration of Robotics. Current gpa 3.9/4.0.

Main Course: Mechatronic Design, Intro to Robo,Machine learning, Machine perception

Research Assistant at Sung Lab at Grasp with Advisor Dr. Sung

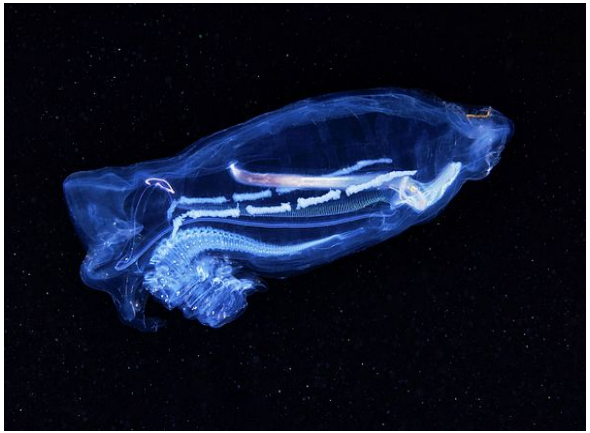
Research Assistant at Kording Lab with Advisor Dr. Kording and Dr. Xiao

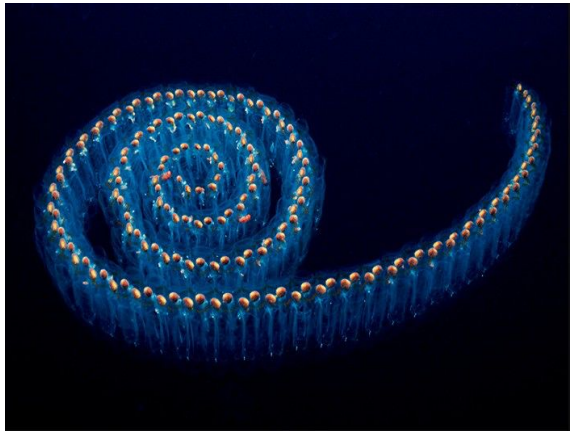

# Current Research : Multi-SALP Robots System

**BackGround:**

According to Professor Kelly's research at the University of Oregon, salps exist in two forms: individual salps and salp chains. However, in natural environments, salps predominantly exist as salp chains. Their research suggests that as more units join, the salp chain becomes faster and more efficient.

Our goal is to use a salp-inspired robot to verify this biological hypothesis.

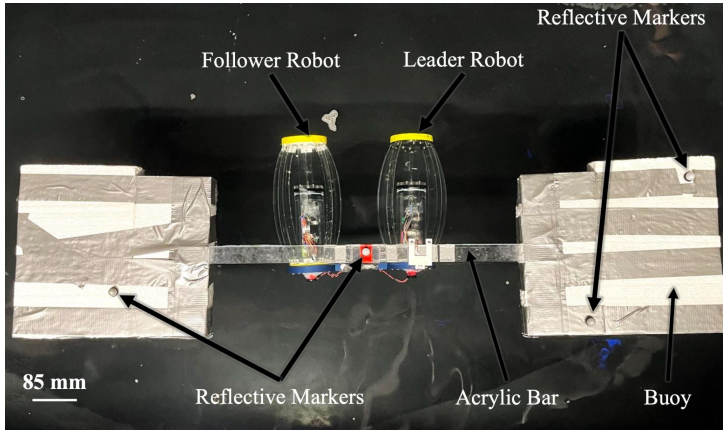




# Current Research : Multi-SALP Robots System

**My Contribution**:

1. Based on the Origami Robot, the improvement of the design of the propulsion system, design of the auxiliary swimming system, design of the rigid connection system.
2. Establishment of the communication system.
3. Computer vision and calibration code of GoPro camera.
4. Code construction of the Motion Capture system.
5. Experiment setting up
6. Data processing and analysis




**MileStone**:
Submitted to RoboSoft 2025 Conference.

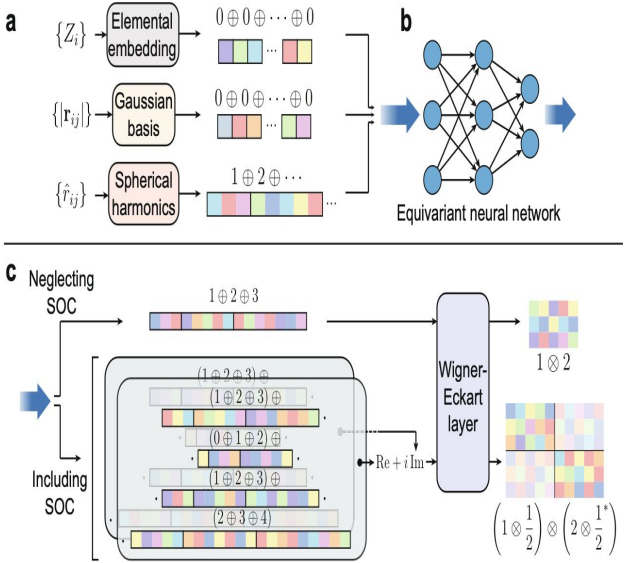
# Current Research : Prediction of the Hamiltonian using equivariant neural networks(ENN)

**BackGround**:

1. The Hamiltonian in density functional theory(DFT) encompasses all electronic structure properties of the material, allowing for various predictions about the material based on the Hamiltonian.
2. Using equivariant neural networks to address design symmetry issues related to the O3 group

**Benefit**:

Geometric symmetry is an inherent property of equivariant neural networks, so we do not need to apply additional processing or constraints (such as data augmentation) on the data within the neural network.



# Current Research : Prediction of the Hamiltonian using equivariant neural networks(ENN)

**Logic**: Mapping geometric graph structures to higher-order vectors.

Here, the geometric graph structure refers to converting information about the crystal cell structure of different materials into input, such as element embedding, angular, and radial features.

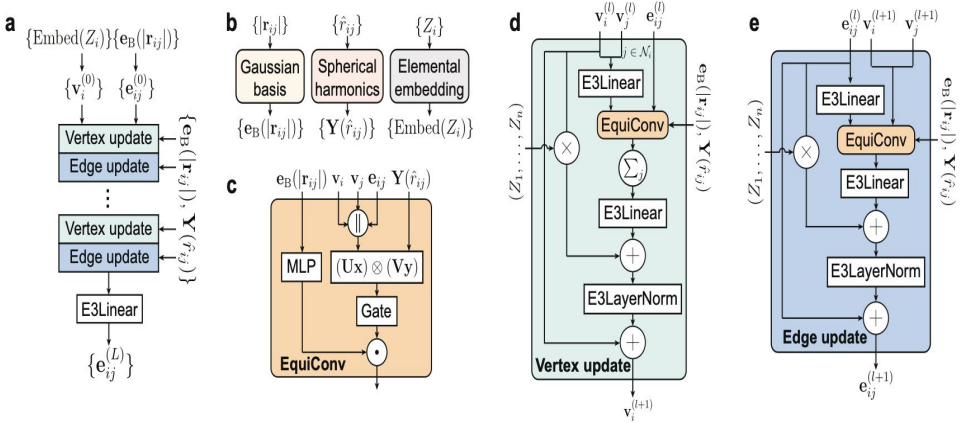
The higher-order vector we seek is the Hamiltonian, which is a second-order tensor.

The mapping process is done by the model: DeepHe3.

**My current work**: Reproduce DeepHe3 on the SACADA dataset.

**Future Work**: Verify the potential of equivariant neural networks in robotic optimization problems.

**Milestone**: Plan to submit Nature Machine Intelligence

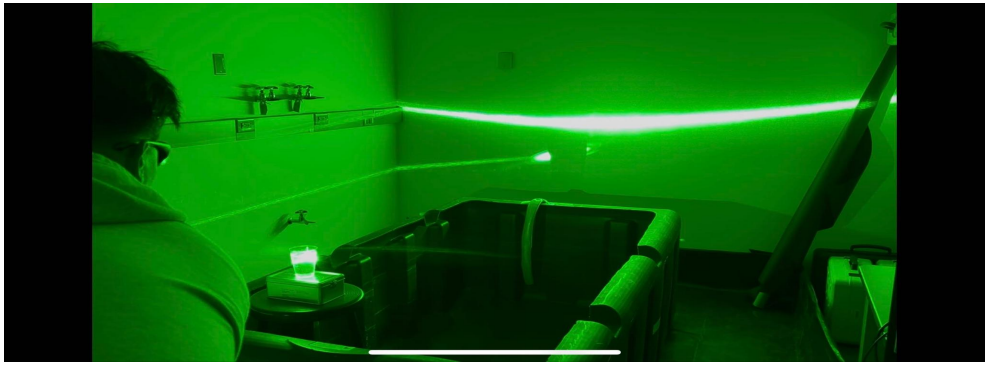


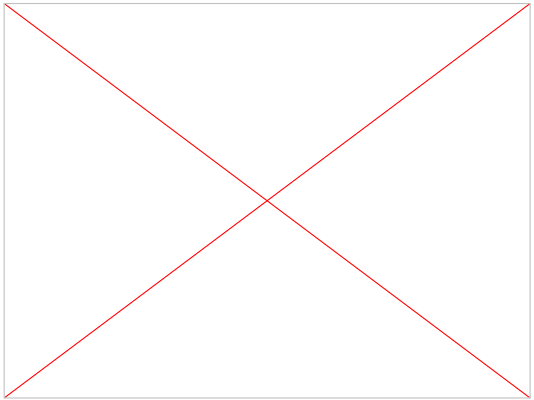
# Current Research: My Master Thesis

**Goal**：Exploring the influence of geometric shapes on the flow field

**BackGround**: When working on the salp robot, we encountered an issue with the second robot shell: due to laser cutting inaccuracies, the bending rate of the second robot was lower than that of the first, resulting in a significantly lower speed. Considering that the current robot shape has not been optimized, I want to optimize the current robot shape to its best possible configuration before proceeding with further functional design, laying a solid foundation for subsequent experiments.

**Method**: Set up a PIV system and fix robots of different shapes in the water. Then, use the PIV system to observe jet propulsion and determine the optimal shape by comparing differences in the velocity fields.





# Current Research: My Master Thesis

**Current Progress**:

1. Experiment environment setting up

2. PIV system setting up from zero

3. Flow velocity field calculation

**Future Work**:

1. Trying to contribute the model of the robot based on ENN. for the data processing, I prefer use machine learning.

2. Trying to extend my master's thesis to a paper as the first author.

# Research Interest

Soft Robotics

Fluid Dynamic

Artificial Intelligence

Mechanical Design

Exploring the unknown aera

Thank You

Merci