

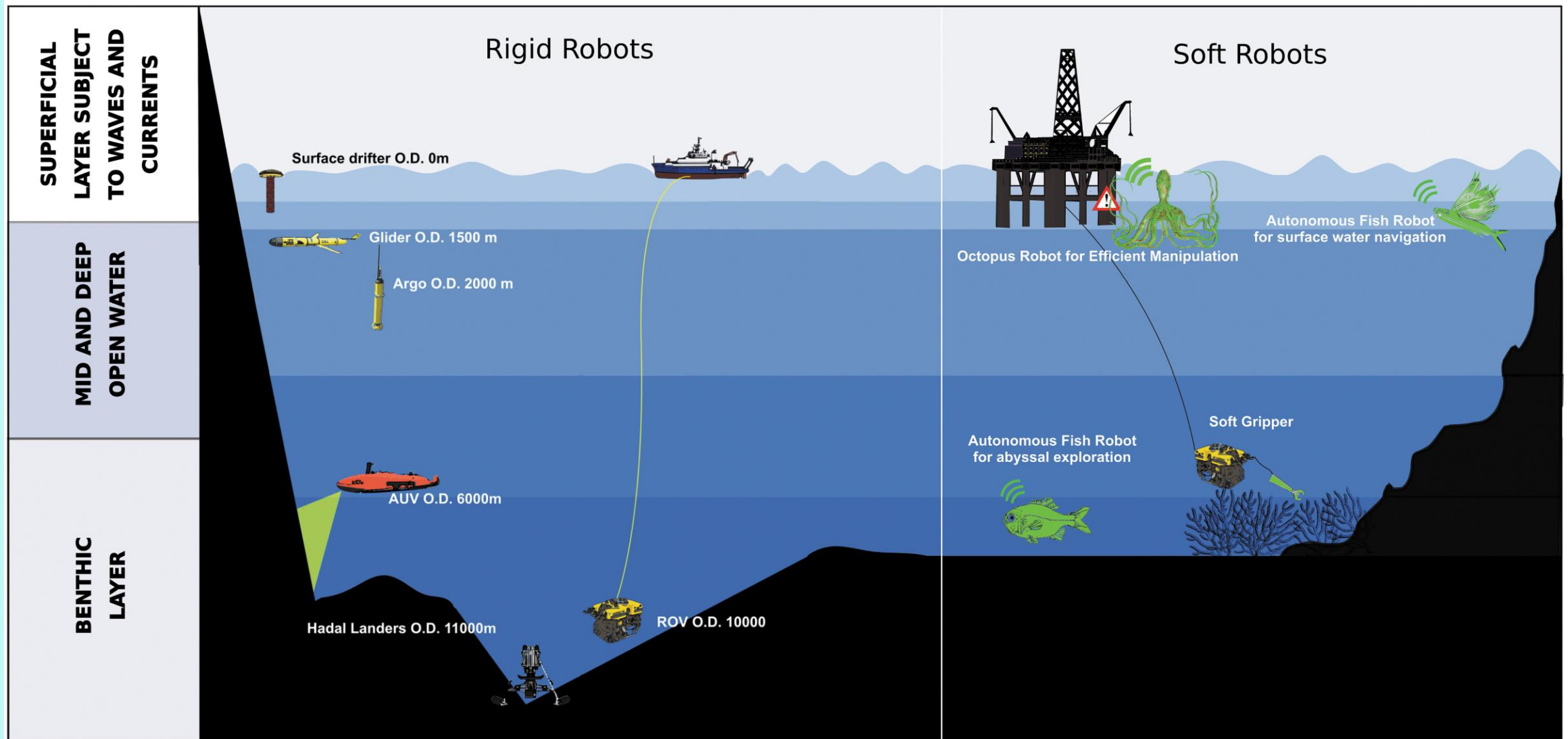


Underwater Soft Robotics

Pranav Jain

Soft Robotics (RBE 530)

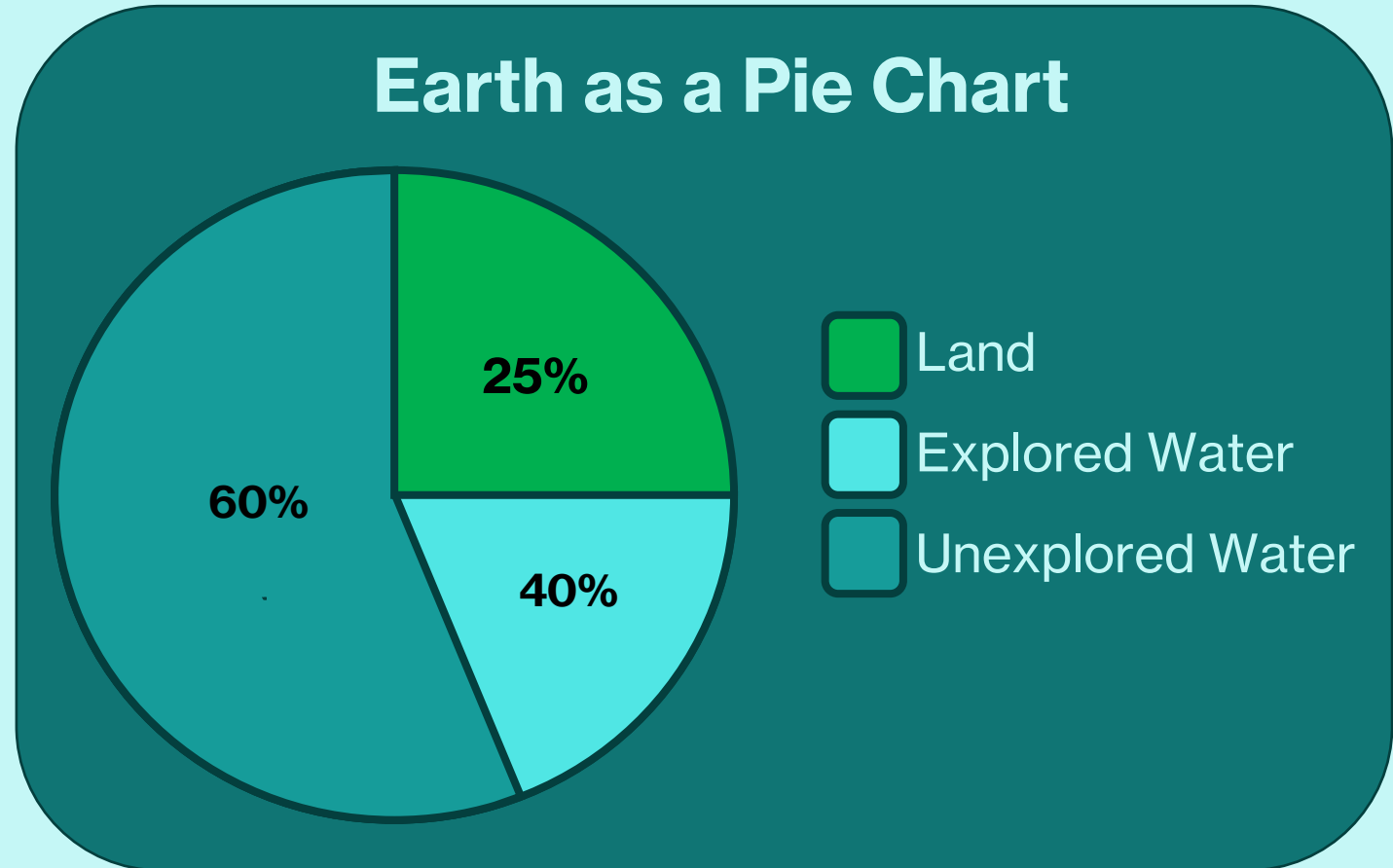
Overview ^[1]



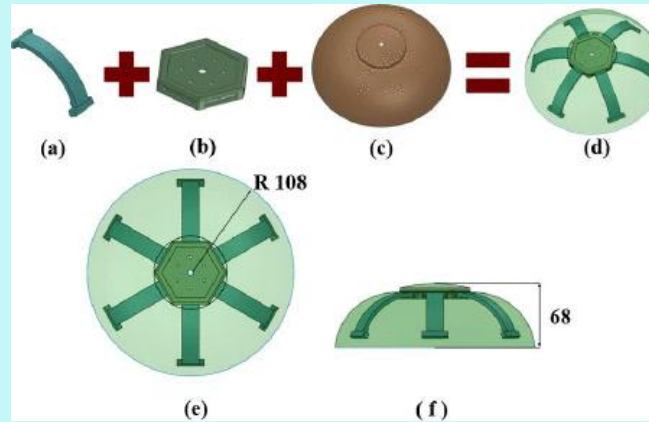
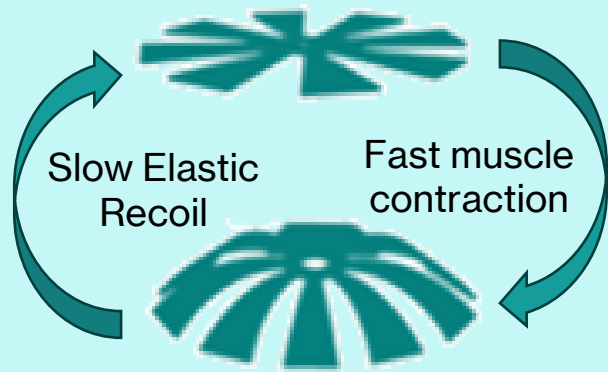
My literature review focuses on various styles of aquatic soft locomotion.

Why Underwater Soft Robots? ^[2]

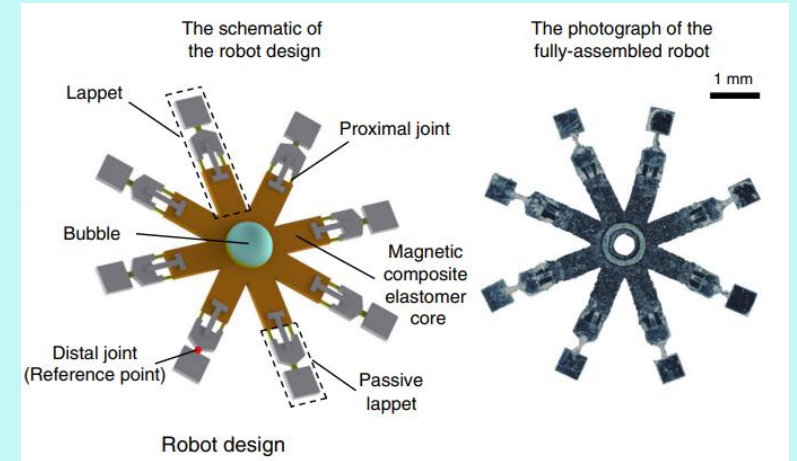
- 80% of the ocean is unexplored.
- See animals in their habitat.
- Mimicking organic movement



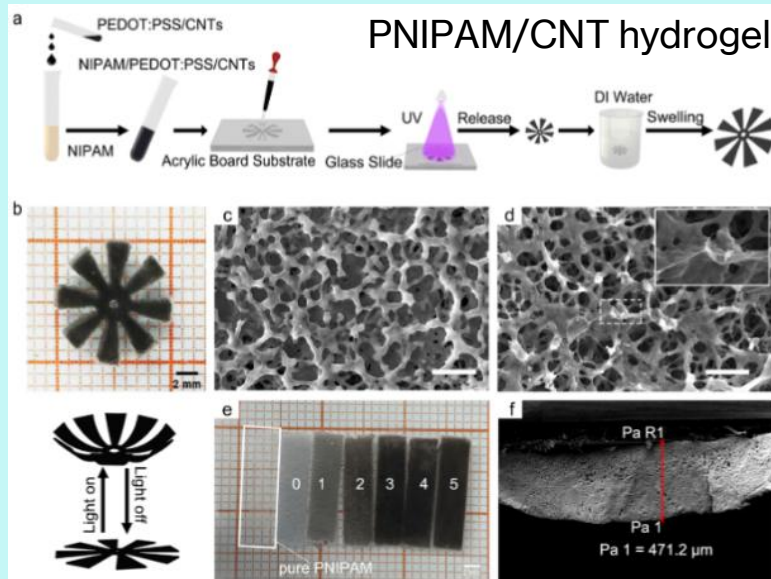
Jellyfish: Jet Propulsion ^{[3], [4], [5], [6]}



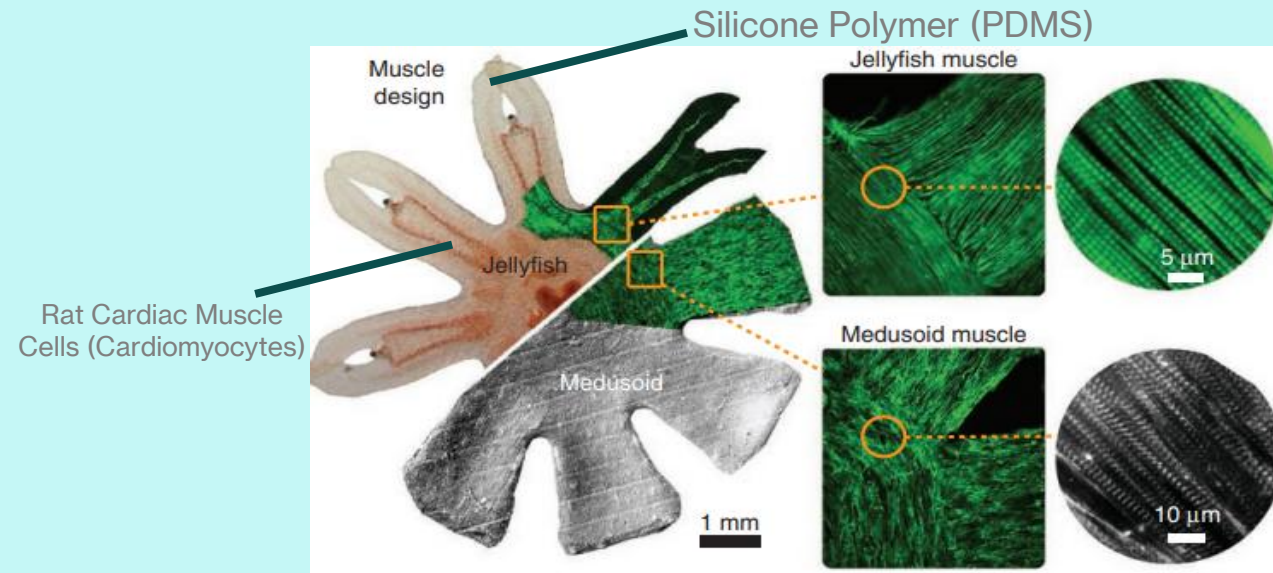
Electro-Deformation Actuation



Magnetic Field Actuation



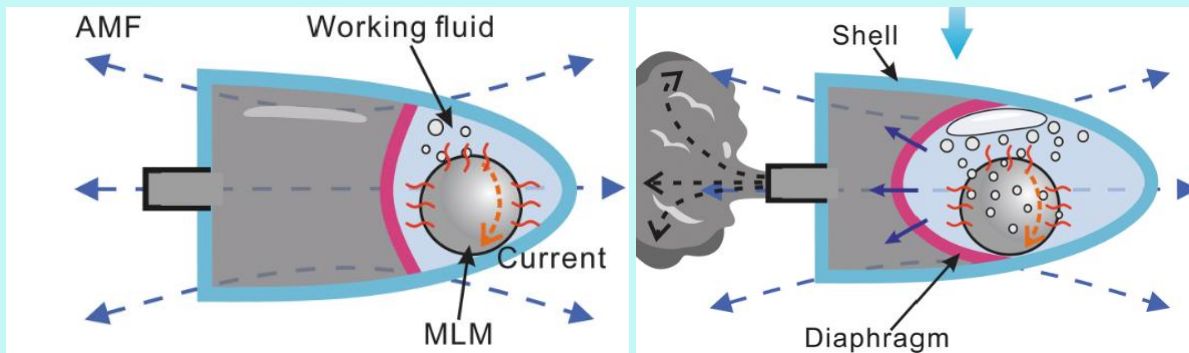
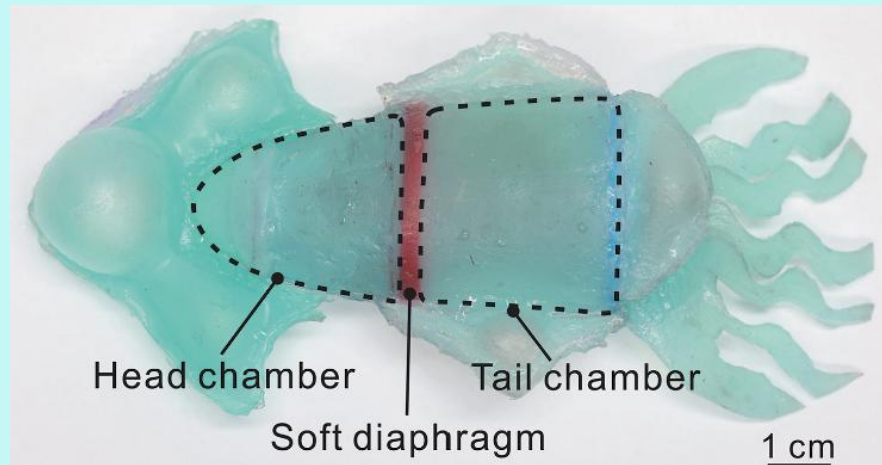
Visible-Light Actuation



Cardiomyocyte Actuation

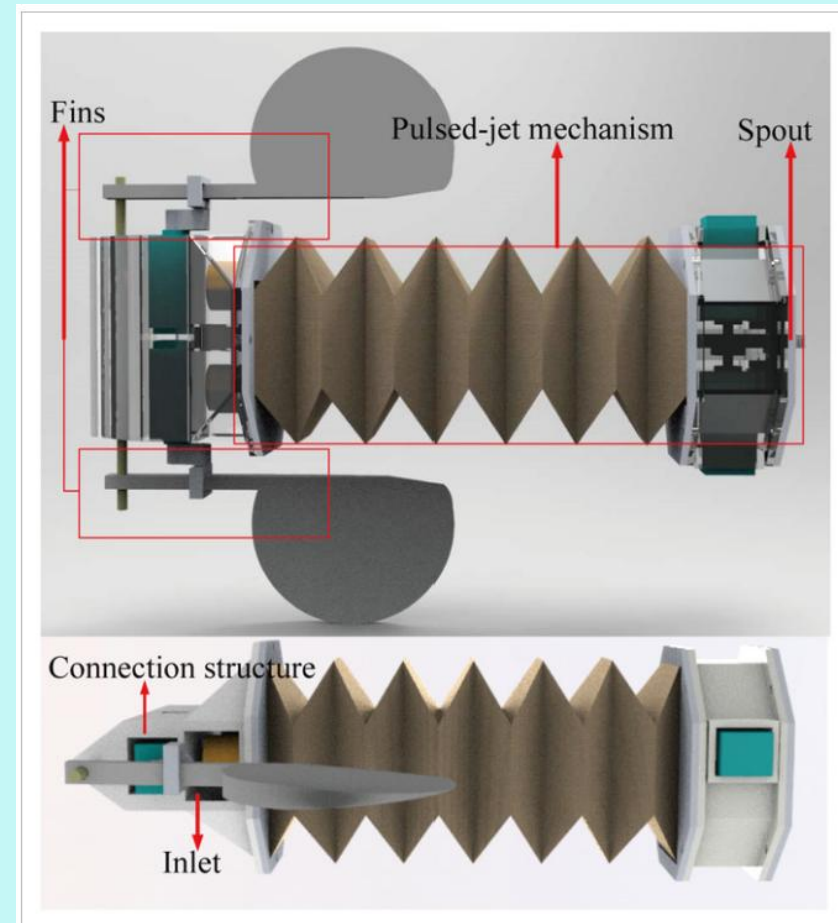
Squids: Jet Propulsion ^{[7], [8]}

MAGNETIC



Magnetic Liquid Metal (MLM) - Gallium-based alloy

ORIGAMI



Octopus: String Jet Propulsion and Crawling^[9]

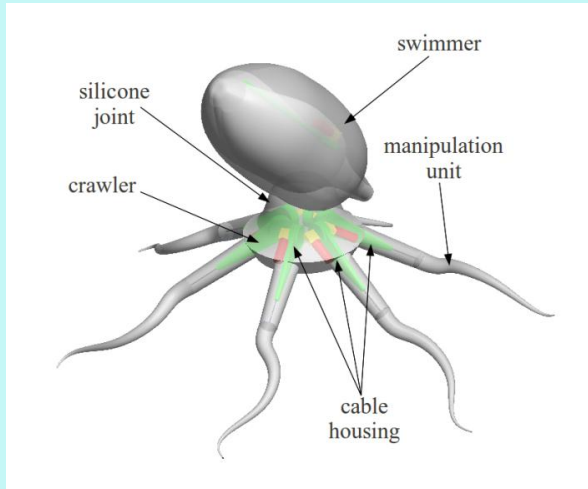


Fig. 7. A concept design of the integrated Soft Unmanned Underwater Vehicle PoseiDRONE in its intended final configuration.

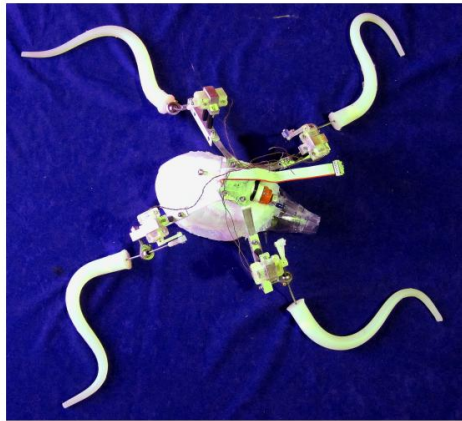


Fig. 8. The first working prototype of the PoseiDRONE, referred to here as the PDR1.

POSEIDRONE

A SOFT-BODIED
UNDERWATER
REMOTELY
OPERATED
VEHICLE

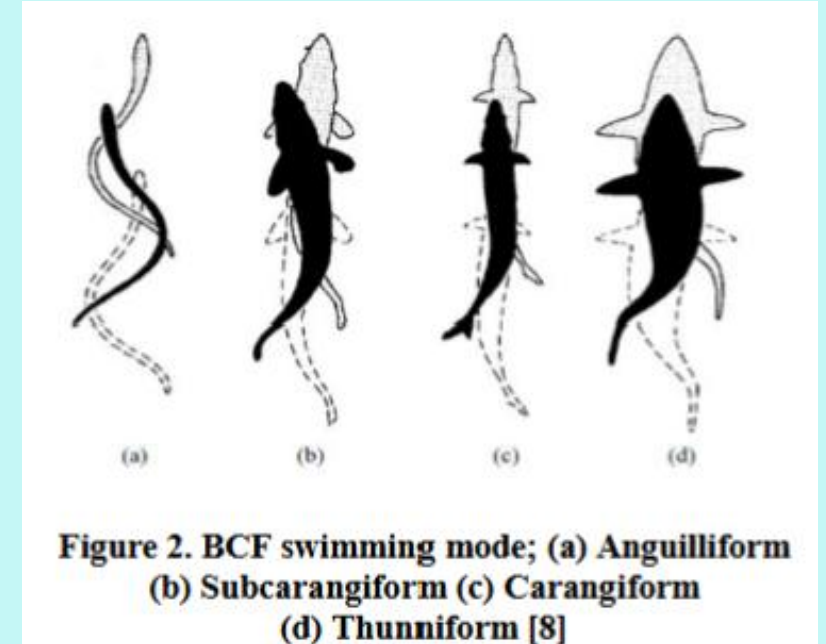


Fishes/ Eels Motion^[10]

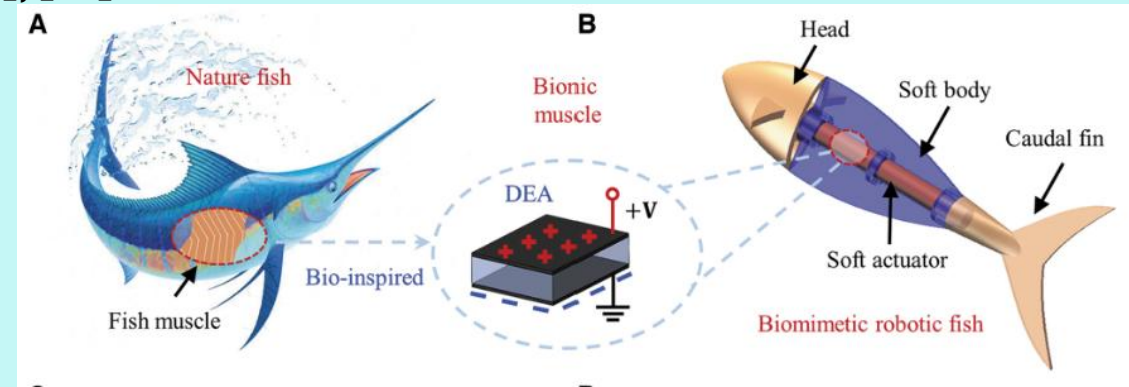
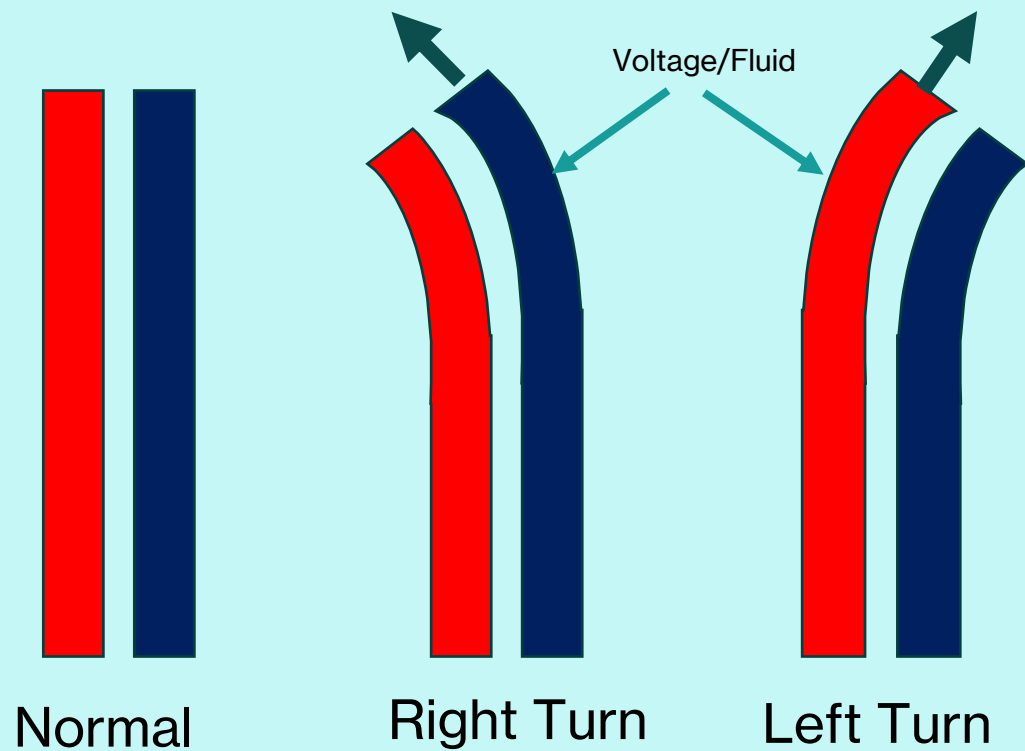
High Control

- Anguilliform: Almost entire body undulates
- Subcarangiform: Rear half of body undulates
- Carangiform: Rear third of body undulates
- Thunniform: Only the tail moves

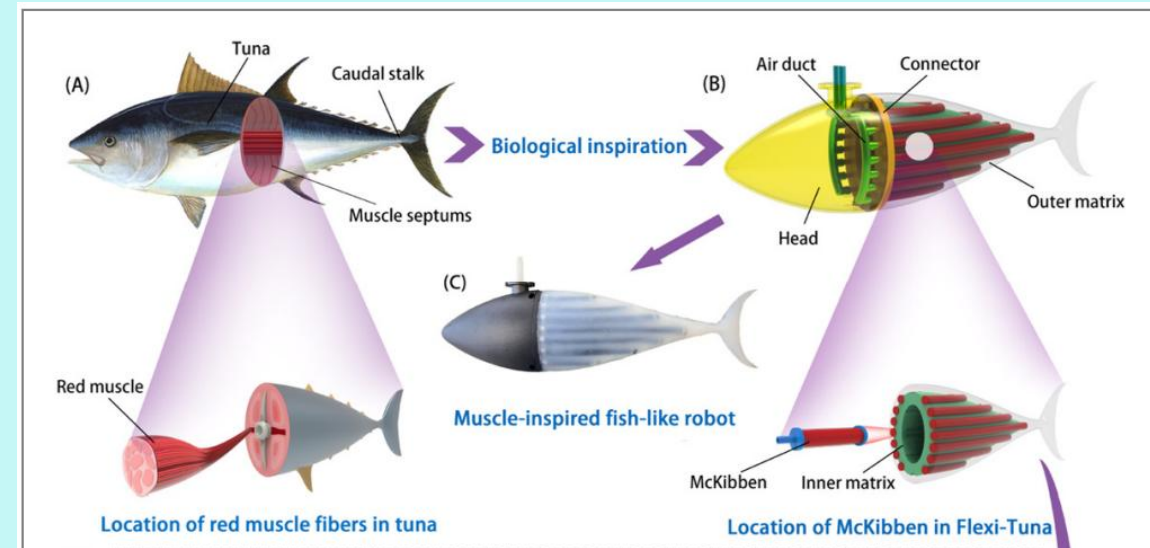
High Speed



Fishes/ Eels: DEAs, FEAs ^{[11], [12]}



Cylindrical DEAs

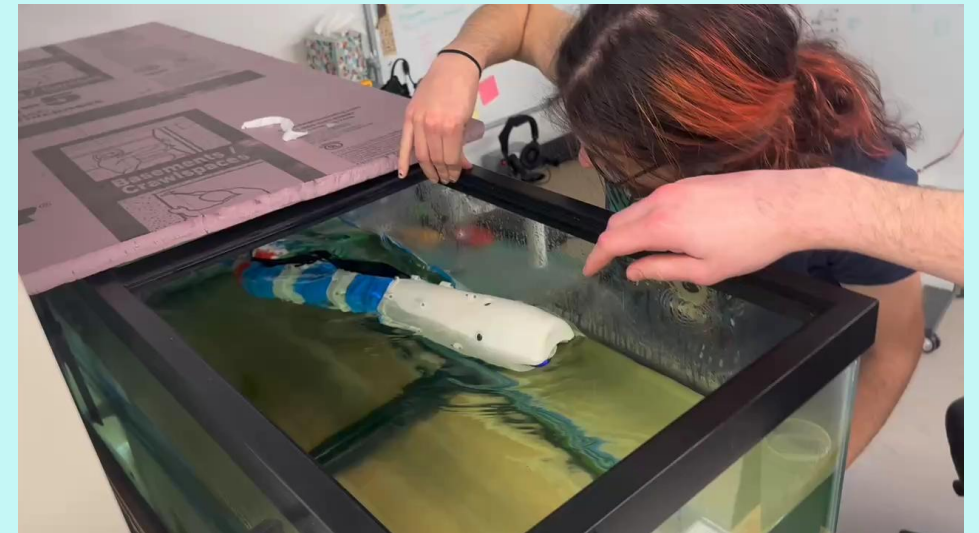
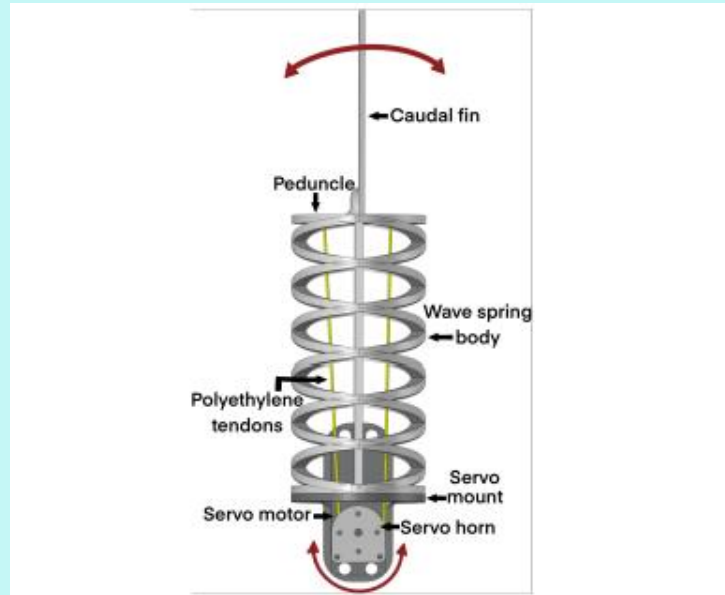


Flexi-Tuna (FEAs)

Fishes/ Eels: DEAs, FEAs^[13]

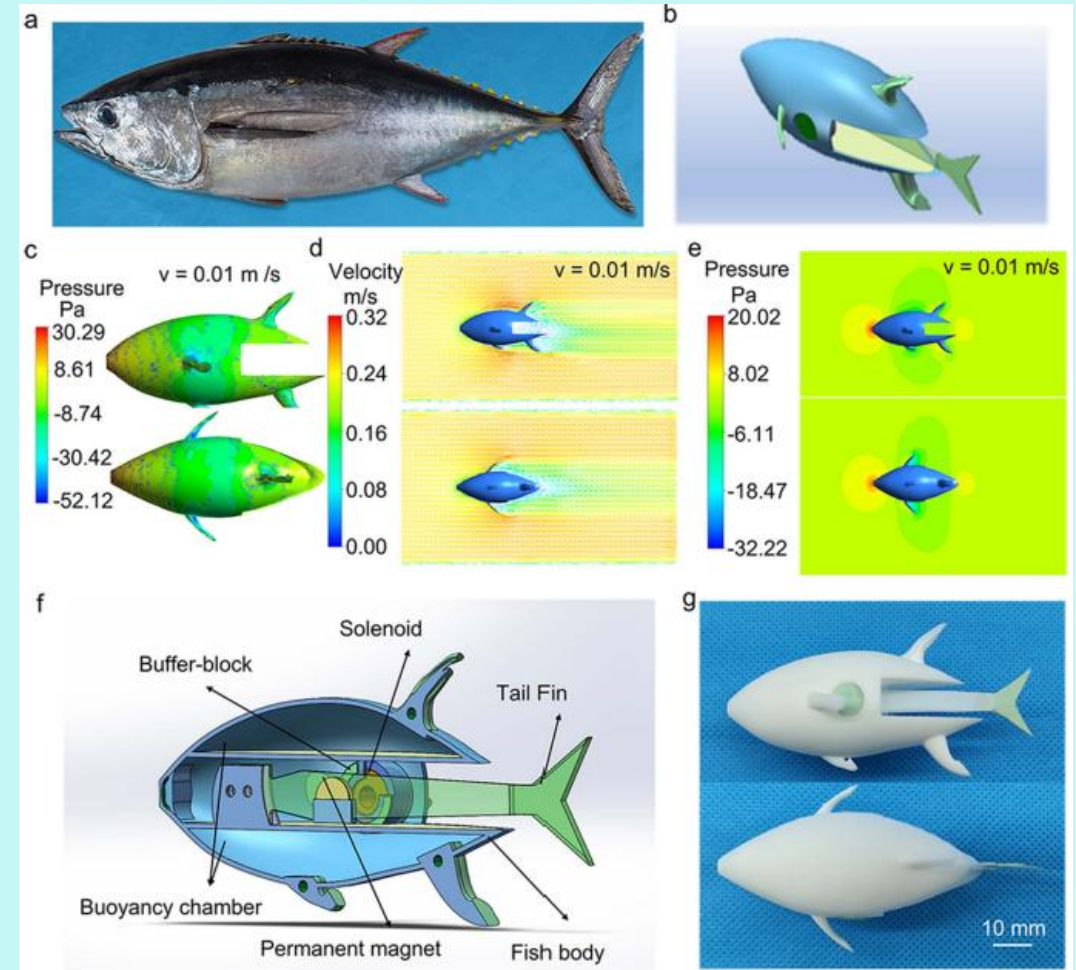
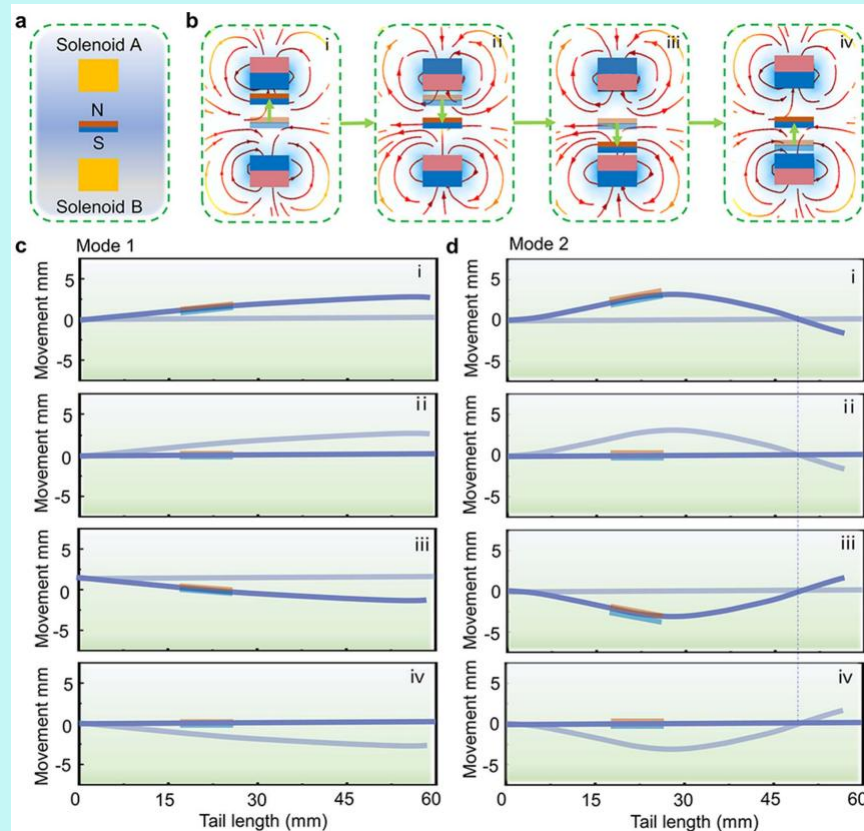


Fishes/ Eels: String actuation ^{[14], [15]}



Fishes/ Eels: Magnetic Actuation^[16]

- Uses 2 solenoids on either side



MAGFLE

Fishes/ Eels: Depth Control^{[17], [18]}

SWIM BLADDERS

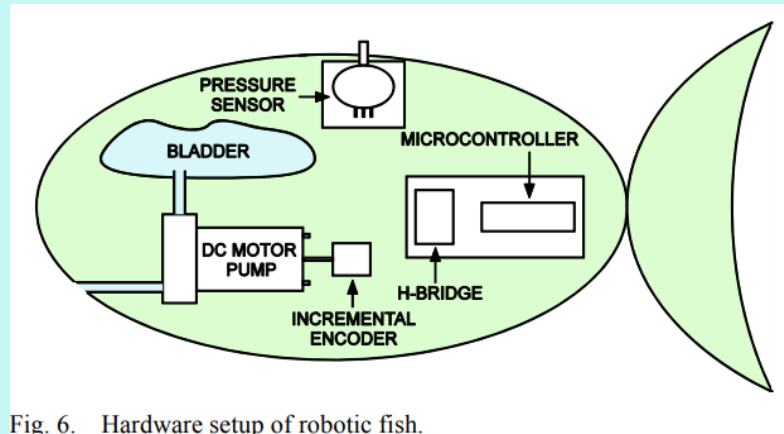
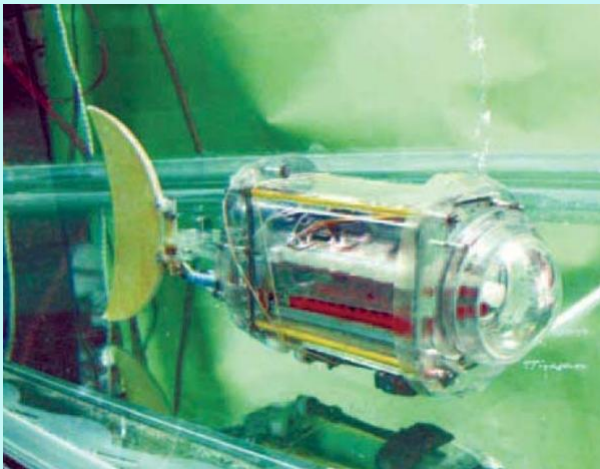


Fig. 6. Hardware setup of robotic fish.



FINS

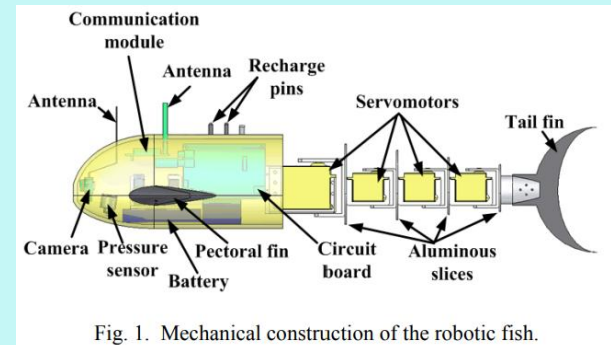
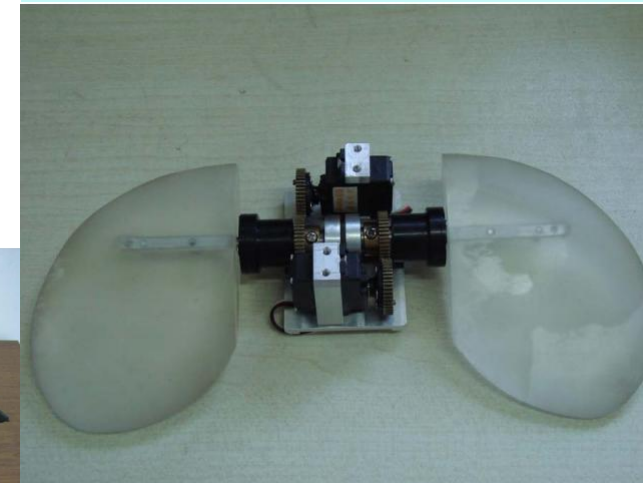
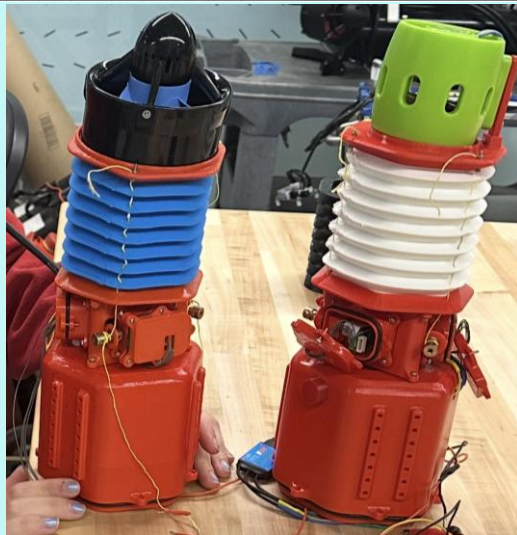
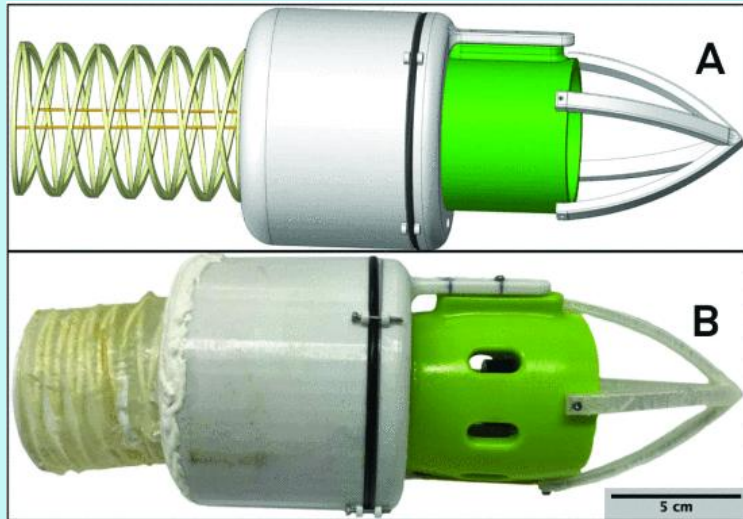


Fig. 1. Mechanical construction of the robotic fish.

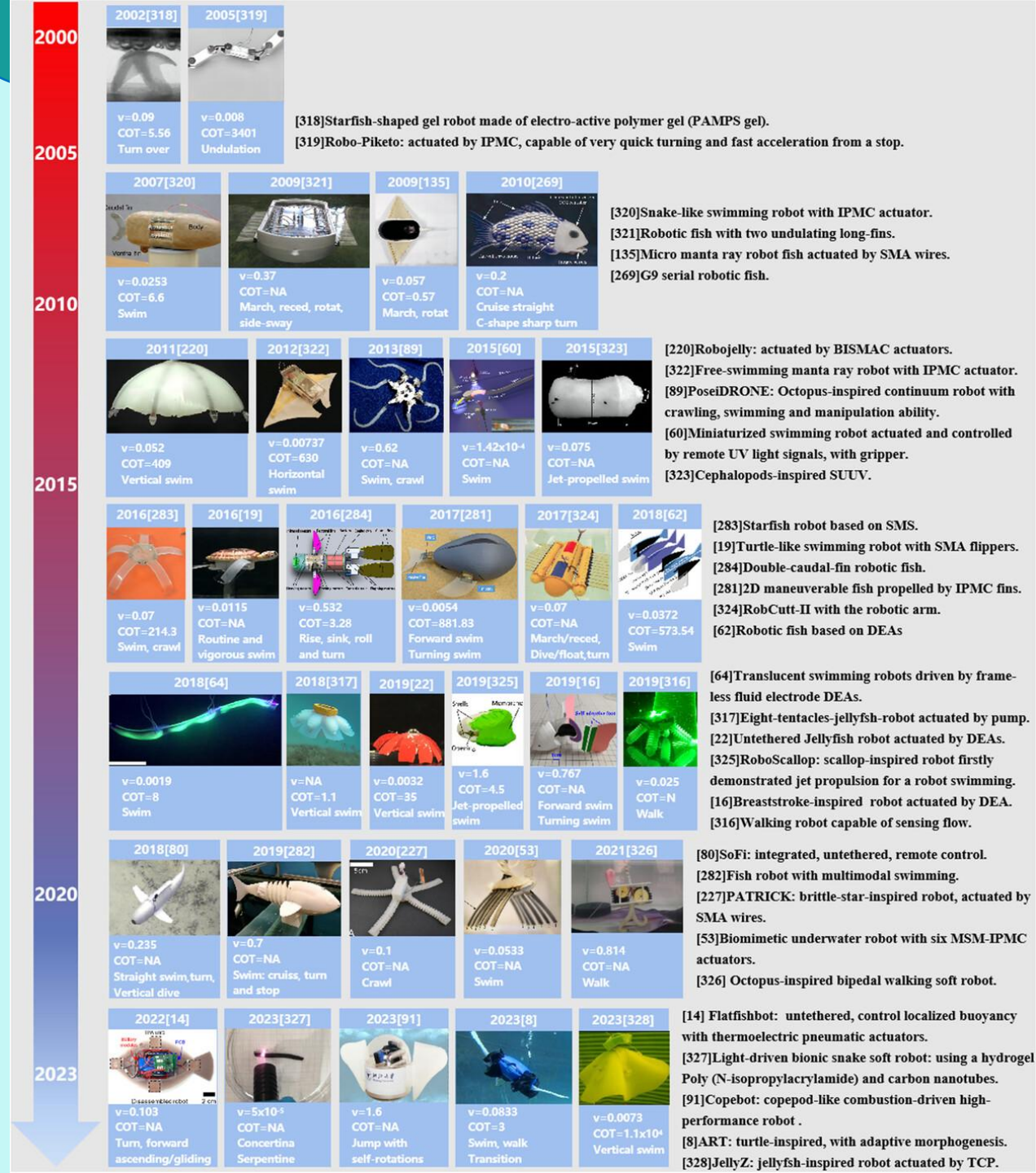


Other: Deformable Robot for Agile Guided Observation and Navigation (DRAGON)^{[19], [20]}



Future Trends ^[21]

- Rise in anguilliform robot research as they have higher controllability.
- Multimodal locomotion – PoseiDRONE
- Tetherless
- Swarm locomotion – Fish schools



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Any Questions?

