METHOD FOR CONTROLLABLE VARIABLE BUOYANCY SYSTEM BASED ON ACTUATED FLEXIBLE MEMBERS OR STRUCTURES FOR UNDERWATER SYSTEM

IITM Technology Available for Licensing

Problem Statement

- **Existing variable buoyancy systems** for underwater vehicles **lack precise control over depth positioning** and often suffer from inefficiencies in adjusting buoyancy, **leading to suboptimal performance** and **limited applicability.**
- A need for a **precise and efficient variable buoyancy** system that can control the **depth of underwater vehicles and systems with high accuracy.**
- The versatile buoyancy control solution that can function as both a standalone system for sensor station depth control and as an add-on for various underwater vehicles, enhancing their maneuverability and performance.

Technology Category/ Market

Category – Robotics & Automation, Mechanical Engineering, Marine & underwater technology.
Applications – Energy/ Infrastructure, Environmental Engineering.
Industry – Ocean Exploration, Oil and gas industry
Market - The global autonomous underwater vehicle market size was valued at USD 1,563.9 Mn in 2021 and is projected to reach USD 5,063.0 Mn by 2030, expanding at a CAGR of 14.3% during, 2022-2030.

Key Features / Value Proposition

Technical Perspective:

- This invention introduces a novel approach to buoyancy control using bellows and linear actuators, ensuring fine-tuned depth adjustments and addressing limitations in existing underwater vehicle systems.

User Perspective:

- This invention translates to more accurate data collection, increased operational range, and simplified depth control, making underwater exploration, research, and tasks safer and more effective.

Intellectual Property

- IITM IDF Ref. 1318
- IN 399832 (PATENT GRANTED)

Technology

Actuated Buoyancy:
The invention employs bellows with linear actuators for precise buoyancy control in underwater systems.

Depth Precision:
Actuation at neutral position achieves accurate positive or negative buoyancy for precise depth manipulation.

Customized Bellows:
The design incorporates bellows parameters determine expansion and compression, tailoring buoyancy changes.

Integrated Hull Design:
Rigid hull integrates actuators, ensuring system stability and restricting pitch and roll movements.

Modular Scalability:
Incorporates multiple bellows and actuators for higher buoyancy levels, adaptable to AUVs, ROVs, and submarines.

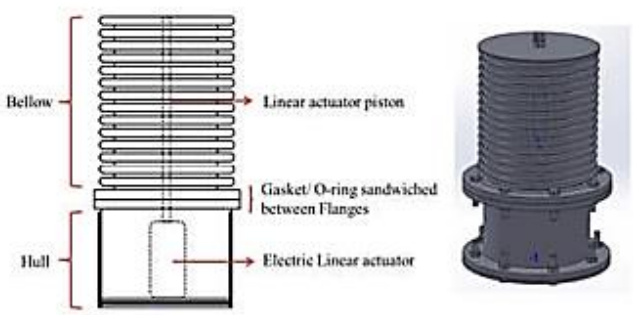

Fig. 1 shows single bellow variable buoyancy system

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Image

Fig. 2 depicts double bellow variable buoyancy system.

Advantages of the invention:

1. Since the variation in **buoyancy is momentary**, the power consumed to actuate the linear actuator is very less.
2. The **Linear actuator** can be made **nonback-drivable by design**, in which case, the force on the **bellow** due to external pressure cannot compress the bellow. This makes the bellow operable at larger depths.
3. The heave velocity depends on the difference between weight and the buoyancy of the system. With this invention the **buoyancy can be increased or decreased** to a larger extent which will make the **system move faster in the depth column.**
4. Since this is a **standalone variable buoyancy system**, it can be used as an add-on to the existing underwater vehicles to vary the buoyancy.
5. Manipulation of underwater systems **for precise movement and positioning can be easily achieved.**

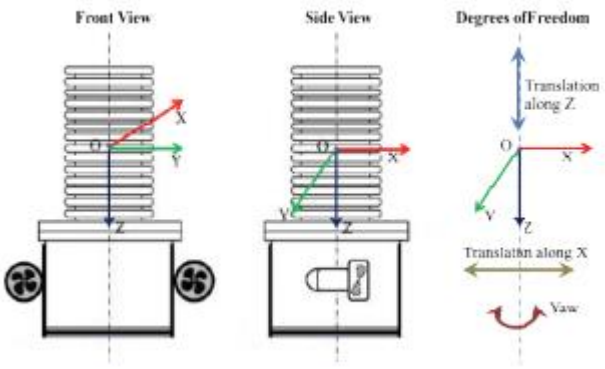

Fig. 3 depicts single bellow 3 degrees of freedom (DoF) variable buoyancy AUV/ROV

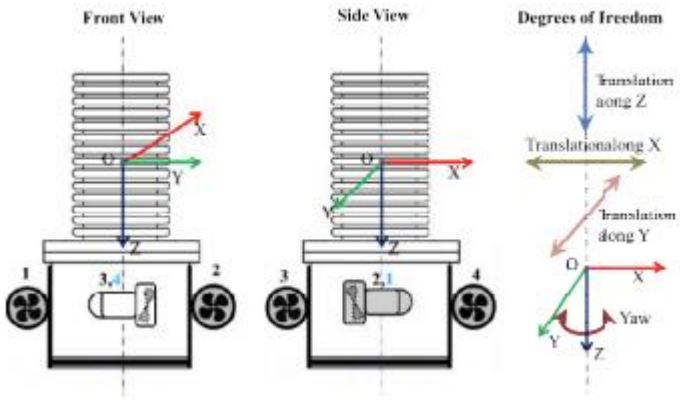

Fig. 4 depicts single bellow 4 degrees of freedom (DoF) variable buoyancy AUV/ROV.

TRL (Technology Readiness Level)

TRL- 4, Technology validated in lab.

Research Lab

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