

SEGMENT ACTUATED SHAPE MEMORY ALLOY BASED SMART FLEXIBLE MANIPULATOR

IITM Technology Available for Licensing

Problem Statement

- Underwater ROVs face significant challenges in **stability and control due to the complex interactions** between the manipulator and the ROV, compounded by buoyancy, fluid pressure, wave interactions, and drag forces.
- Conventional manipulators are too large and heavy to be effectively used on miniature ROVs**, limiting their applicability in confined underwater environments.
- Traditional electric motor and hydraulic actuators are unsuitable for small ROVs due to their size and weight, while flexible manipulators, though lighter, still pose installation challenges.

Intellectual Property

- IITM IDF Ref. 1962
- IN 495614 - Patent Granted

Technology Category/ Market

Category- Miniature ROV Manipulators, Robotics & Automation

Applications - Precision Remote Operated Vehicles (ROVs), Smart Actuation Systems

Industry- Oil and Gas. Environmental Monitoring, Underwater Construction, Maritime and Naval Defense.

Market - Global observation mini ROV market size was USD 72.43 million in 2021 and the market is projected to touch USD 263.26 million by 2032 at a **CAGR of 12.45%**.

TRL (Technology Readiness Level)

TRL - 3, Proof of concept stage.

Research Lab

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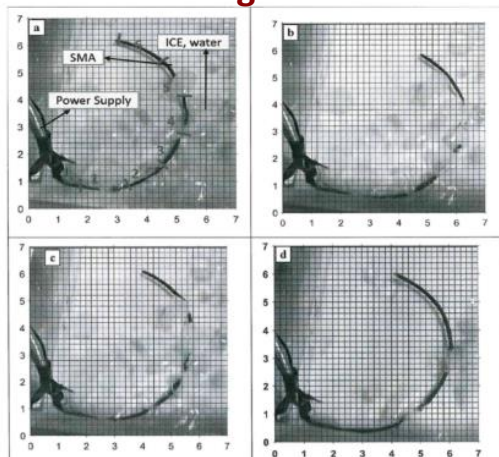


Fig.1. Depicts different positions of the SMA manipulator tip for random actuation states.

Technology

The present invention relates to the **field of compliant robotic manipulators**. In particular, it relates to smart and flexible manipulators based on shape memory alloys.

1 Smart Material-Based Manipulator:

- The invention introduces a light-weight manipulator for small ROVs, utilizing shape memory alloy (SMA) wires to reduce fluid interaction and enhance control and stability.

2. Flexible and Independent Actuation:

- The SMA-based manipulator features segmented actuation coils that allow different segments of the manipulator to change shape independently, improving maneuverability and precision.

3. Two-Way Shape Memory Effect:

- The SMA wires provide a two-way shape memory effect, enabling the manipulator to alternate between two shapes based on temperature changes, facilitating diverse manipulation tasks without the need for fixed support structures.

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Key Features / Value Proposition

- **Enhanced Precision and Control**

Independent segment-wise actuation of the SMA wire ensures precise and stable manipulator movements.

- **Lightweight Design**

The SMA-based manipulator weighs less than 100 grams, ideal for small observation class ROVs without needing support structures.

- **Versatile Shape Memory Effect**

The two-way shape memory effect allows the manipulator to switch between predefined shapes for diverse tasks.

- **Increased Reachability**

Segmented design allows the manipulator to reach 2n positions, enhancing operational flexibility and range.

- **Simplified Actuation**

Electric current-based actuation simplifies the control mechanism compared to traditional motor or hydraulic systems.

- **Scalable Solution**

Increasing the number of segments significantly multiplies the reachable points without adding weight or complexity.

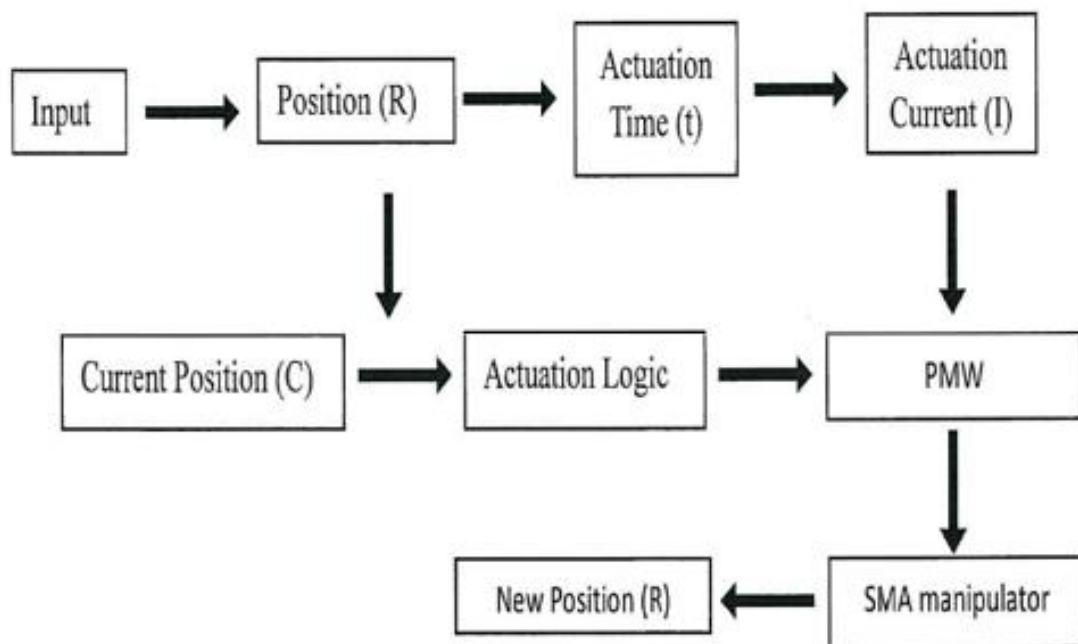


Fig.2. Depicts the flowchart for the actuation process of the SMA manipulator.

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