SILVER (Seabed-Interaction Legged Vehicle for Exploration and Research)

SILVER is a four-legged underwater vehicle. Each leg is based on a crank-slider mechanism with a serial spring, and two rotational joints at the hip (3 DoF each leg). Twelve Dynamixel AX-12a smart servomotors are connected in daisy chain, and powered by a LiPo battery for an average autonomy of 2 hours. The structure in PVC can hold sensors such as cameras, laser scan, salinity, pressure and temperature sensors, etc., or it can mount robotic arms or grippers. Matlab controllers, running on an external (out of water) laptop, enable SILVER with hopping, walking and crawling gaits.The self-stabilizing gaits, the reduced disturbances induced on sand during locomotion, and the peculiar underwater capability grants to the robot unique features for the investigation of seabed or for the study of legged locomotion in reduced gravity environment.

Key Features

- Standing capability: precise station keeping with low energy consumption
- Reduced disturbance: precise positioning of the feet when required, and no sand displaced
- Agile locomotion: capable of diverse gaits, including self-stabilizing gait
- Light weight and small: easy to deploy from small boat or inside swimming pools
- RS-232 (over USB) and Bluetooth communication

Possible Applications

- SILVER as a platform: the robot could be used to test novel control algorithms or to change essential components (change and test novel legs design, add buoyancy systems, etc). As examples: investigate difference between terrestrial and underwater legged locomotion, evalute novel design of the legs for paddle like swimming, implement novel gaits and/or navigation algorithms
- SILVER as a tool: the robot could be employed to perform underwater mission (related to biologic, sea monitoring, photography, etc.). As examples: sample sediments through a novel manipulator
- Visual inspection of underwater structures
- Tri-dimensional reconstraction of sea-life (fishes, corals, etc.)

Access information

Corresponding infrastructure	School of Advanced Studies Sant'Anna The BioRobotics Institute
Location	Viale Rinaldo Piaggio, 34 56025 Pontedera PI, Italy
Unit of access	Working day

Technical specifications

Low Level Control	3 Different gaits (Hopping – Walking – Crawling) + Rotational Gaits
System Requirements	Works on a laptop through Matlab (Custom user interface)
Communication	TTL
Propulsion	4 Legs (3 DOF each leg)
Actuators	12 AX-12a Dynamixel Smart Servomotors
Nominal Runtime	3 to 4 hrs under normal operation
Depth Rating	50 m [tested up to 15m]
Battery	11.5V 2.2A LiPo
Weight	3.40 kg [ballasted for freshwater], 3.485 kg [ballasted for seawater]
Dimensions	410 mm X 205 mm X 86 mm
Available Lengths	20 m
Buoyancy	Customizable, but slightly negative in seawater
Sensors	Camera for video recording

Additional information

One video of the robot is available here

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