Actuation system inspired by a marine organism

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Ph.D Program in BioRobotics

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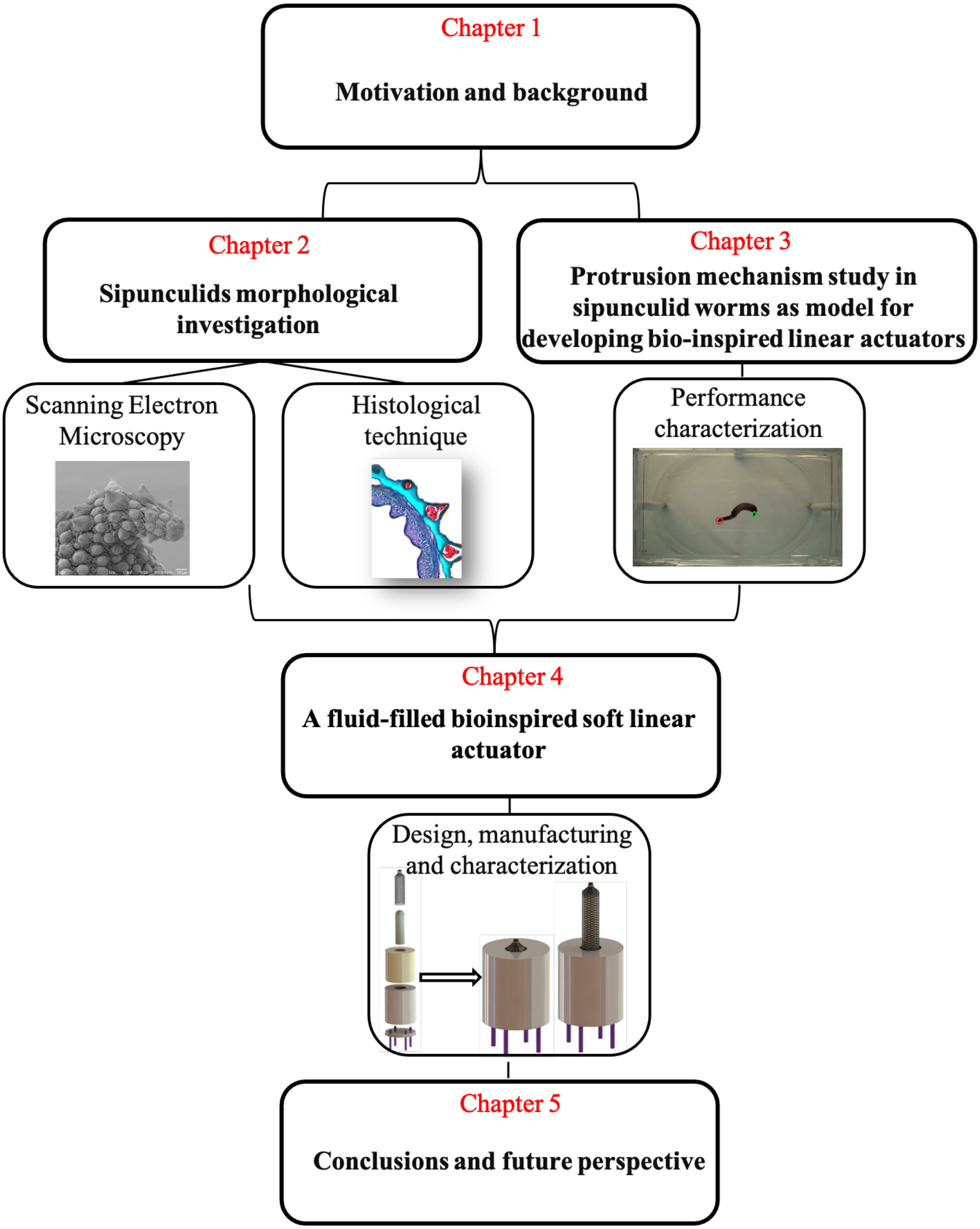
Abstract

Nature is a great source of inspiration for designing new systems useful in a broad range of real-world applications. Living organisms and invertebrates in particular, can inspire non-conventional navigation strategies and shape-morphing mechanisms in unstructured environments, to face current challenges in robotics. Soft robots have benefited from nature-inspired designs. However, major efforts are still needed to make bioinspired soft devices suitable to real tasks execution. In particular, exploiting bioinspired soft technologies to develop general purpose actuators that can be scalable in size, can pave the way to a wider adoption of bioinspired soft devices and to more efficient robotic solutions. In this framework, this Thesis addresses the study of a particular species of marine worms, by shedding the light on their working principle and gaining useful insights to develop a new bioinspired fluidic actuation system. Starting from the morphological characterization – by using histological techniques and electron microscopy – and the quantitative study of the species *Phascolosoma stephensoni* (Sipunculidae, Annelida) burrowing performances, a soft linear actuator inspired by their protrusion mechanism was realized. In particular, by resembling the hydrostatic skeleton operation combined with muscle activity to produce body elongation, the developed actuator combines an active pneumatic unit and a passive hydraulic chamber, to produce linear motion with a soft and shape adaptable design. Moreover, rigid and soft materials are also combined, allowing for greater output forces and higher controllability.

Overall, the Thesis proposes an innovative approach in the soft robotics framework, setting the stage for future linear fluidic actuators, featured by lightweight, high efficiency and suitability for miniaturization. In addition, the proposed actuators are able to double their initial size and produce large output forces.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