Robotics and Embedded Systems

Human Brain Project

Master/Bachelor Thesis - Semester Project

Design and Control of a Rat Robot with Actuated Spine and Ribs

Background

Rats are agile animals that they can walk, jump, swim and they even can fit through a surprisingly small hole the size of a dime (20 mm), but it is not because they have collapsible skeletons or soft bones [1]. Rats can fit through small holes because their bodies are long, flexible, and cylinder in shape. Rats determine whether they can fit through a hole using their whiskers. A fleeing rat makes this judgment very quickly, by just poking its nose into a hole and dashing through if it is large enough. If a rat can fit its head through, the rest of the body can also squeeze through it, this can contribute to its body structure. On the one hand, when squeezing through a constricted space, the pressure causes the ribs to give away. At the spine, the ribs are hinged allowing them to effortlessly collapse [2]. On the other hand, its spine will extend its body along the longitude direction of the body to a cylinder-like shape. Within the framework of HBP, we have developed a biomimetic mouse robot with a soft body and an actuated spine [3].

Your Tasks

In this thesis, you will design a biomimetic mouse robot with an actuated spine and ribs that can enable the robot to go through narrow holes. To be specific:

1. You will design a prototype with CAD software.
2. You will develop some controllers to enable the movement of the spine and ribs.
3. You prototype can fit itself through narrow holes with your controller.

Requirement

- High self-motivation and passion on research.
- Six month working time.
- Good knowledge of CAD (depending on the selected task)

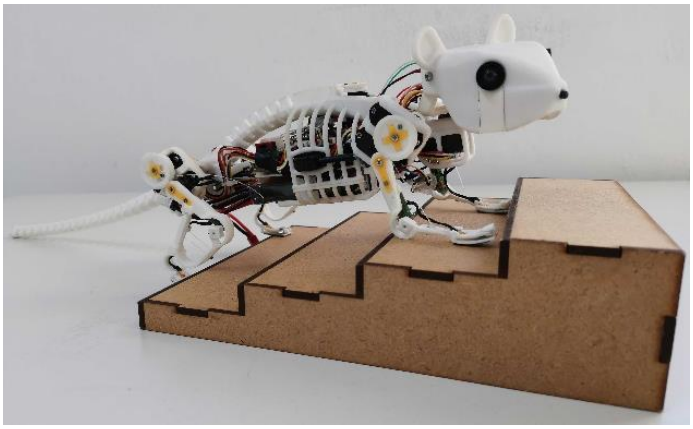

Fig 1. HBP Mouse Robot.

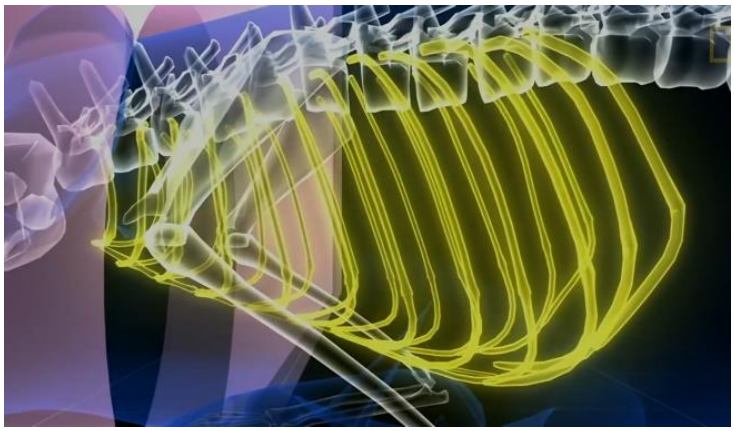

Fig 2. Illustration of hinged ribs.

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[1] *Rat Biology.* http://www.ratbehavior.org/RatBiologyMain.htm
[2] *See How Easily a Rat Can Wriggle Up Your Toilet | National Geographic.* https://www.youtube.com/watch?v=0t2VPBF6Kp4
[3] *Lucas, Peer; Oota, satoshi; Conradt, Jörg; Knoll, Alois: Development of the Neurorobotic Mouse. Proceedings IEEE International Conference on Cyborgs and Bionic Systems, 2019*