Full 3D printed hexapod robots with energy efficient joints

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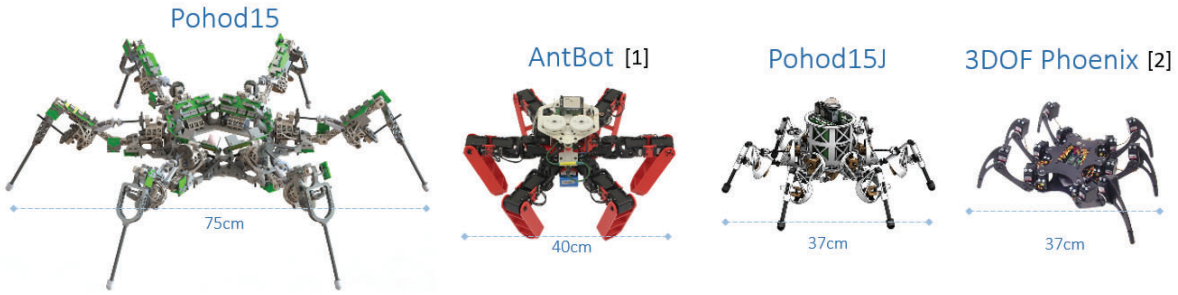
Nowadays, servomotors are classically used as actuators for actuating small legged robots [1,2]. Their advantages are numerous: simple to control, miniature size, and a large choice of various dynamic models, which permits to choose the best speed and torque tradeoff for robot joints. However, the main drawback of servomotors is their permanent energy consumption, due to the permanent effort required to keep joint angle constant, for example when the robot stays on the spot. In addition, the dramatic heating of the servo case and gears can break the robot.

The goal of our project is to design a new energy efficient robot's leg for full 3D printed hexapod robots, called Pohod15 and Pohod15J (Fig. 1). The principle of our new leg structure is based on an irreversible mechanism inside each joint (an actuated lead screw), which will drastically reduce the robot's power consumption by half, compared to our previous one version, called AntBot [1]. The design of this new leg is directly inspired by insect leg structure [3,4]. As a fair return, it will provide an efficient robotic tool for biologists to test both ant-based pattern of locomotion and insect-based navigation across long range without servomotors limitations, therefore saving energy resource.



Mass	2 kg	2,3 kg	0,8 kg	1,3 kg
Autonomy	40min	15min	60min	20min
Max joint speed	50 rpm	90 rpm	50 rpm	50 rpm
Max charge	1500 g	700 g	500 g	700 g
Price	1,5k€	2k€	0,5k€	1k€

Fig. 1: Comparison table of hexapod robots specifications. Pohod15 and Pohod15J are currently developed in our lab with built-in irreversible joints.

[1]. Dupeyroux, J.; Serres, J. R.; Viollet, S. AntBot: A six-legged walking robot able to home like desert ants in outdoor environments. Science Robotics, 2019.
[2]. Barron-Zambrano, J. Hugo;Torres-Huitzil, C.; Girau, B. Perception-driven adaptive CPG-based locomotion for hexapod robots, Neurocomputing, Volume 170, 2015.
[3]. Kaliyamoorthy, S; Roger, D. Quinn; Zill, Sasha N. Force Sensors in Hexapod Locomotion. The International Journal of Robotics Research, 2005
[4]. Zill, S.; Schmitz, J.; Büschges, A Load sensing and control of posture and locomotion. Arthropod Structure and Development, 2004.