

Topic Areas:

Hardware Design, CAD, Legged Robots

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Prerequisites/Prior Knowledge:

CAD, Experience with motors, sensors and microcontrollers

The behavior of a robot is strongly influenced by its mechanical design. Properties such as link length, mass distribution, gear ratio, and joint elasticity determine how suitable a robot is for a specific task. A modular hardware design therefore makes it possible to adapt the same robotic system to different behaviors and applications.

In this project, you will develop a modular robotic actuation unit, similar to [1], based on already given specifications such as robot size and actuator type. Its mechanical properties can be varied using interchangeable links, masses, transmissions, and series- or parallel-elastic elements. Two units will be combined into a two-link system that can represent either a robotic arm or a legged-robot limb.

The focus is on designing modular hardware that enables different robot behaviors, as in [2]. As a proof of concept, the two-link system will be assembled and demonstrated in a pick-and-place task.

Your tasks include:

- Parameterized CAD of the modular unit
- Design of interchangeable links, masses, transmissions, and elastic elements
- Assembly and integration of two units into a two-link system
- Experimental demonstration of a pick-and-place task

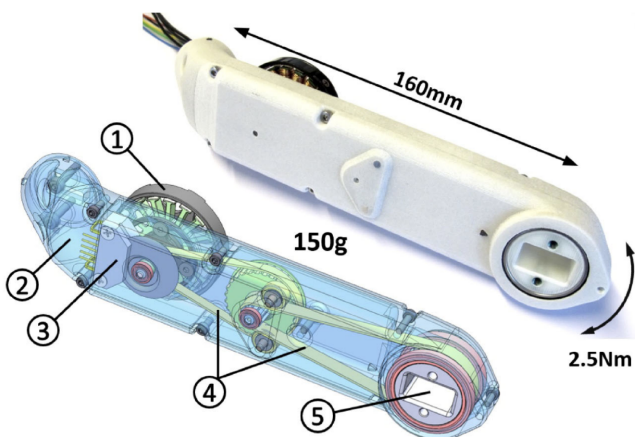


Figure 1: Actuation unit of Open Dynamic Robot Initiative [1].

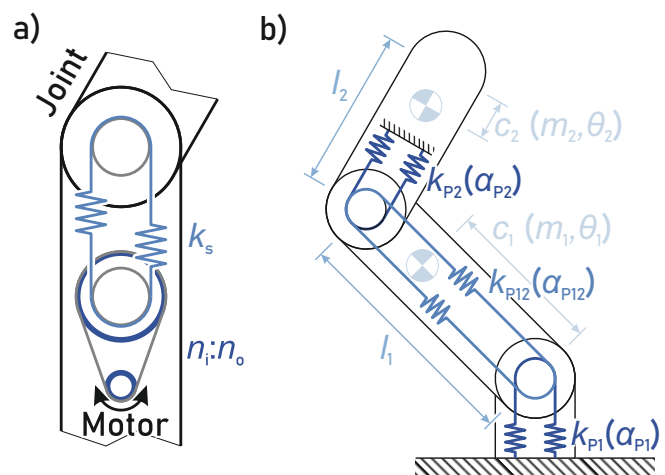


Figure 2: Conceptual drawing of a modular actuation unit

- [1] Grimminger, Felix, et al. *An open torque-controlled modular robot architecture for legged locomotion research*. IEEE Robotics and Automation Letters 5.2 (2020): 3650-3657.
- [2] Urs, Karthik, et al. *The Robot Of Theseus: a modular robotic testbed for legged locomotion*. Bioinspiration & Biomimetics 21.1 (2026): 016028.