Starten Sie Ihre Mission beim DLR.

Das DLR ist das Forschungszentrum für Luft- und Raumfahrt sowie die Raumfahrtagentur der Bundesrepublik Deutschland. Rund 8.000 Mitarbeiterinnen und Mitarbeiter forschen gemeinsam an einer einzigartigen Vielfalt von Themen in Luftfahrt, Raumfahrt, Energie, Verkehr und Sicherheit. Ihre Missionen reichen von der Grundlagenforschung bis hin zur Entwicklung von innovativen Anwendungen und Produkten von morgen. Wenn auch Sie sich für die Welt der Spitzenforschung in einem inspirierenden, wertschätzenden Umfeld begeistern, starten Sie Ihre Mission bei uns.

Für unser Institut für **Robotik und Mechatronik** in **Oberpfaffenhofen** suchen wir eine/n

Student*in für eine Master's Thesis

Optimal energy conversion in elastic bipedal gaits

Your Mission:

In nature, there is a vast variety of locomotion strategies. Horses use multiple gaits to accomplish locomotion at different velocities energy-efficiently. When they accelerate while walking, they switch naturally to trotting and, at even higher speeds, to galloping for a more energy-efficient gait. One can observe similar behaviors in humans and terrestrial birds, which utilize walking and running depending on the velocity to save energy. Humans profit hugely from the compliant muscle-tendon system, such that the tendons contribute up to 75% of the positive work generated around the ankle while running. In particular, the tendons store energy after touching down while vertically decelerating and release this energy when vertically accelerating.

Comparable compliant structures gain more attention in robotics. However, leveraging elastic elements to ensure an efficient and continuous energy conversion along the gait is still an open research topic. Optimal energy conversion and efficiency are considered to be among the most crucial current engineering problems [Van der Schaft CDC 2021]. The thesis aims to find and stabilize energy-efficient gaits that utilize elastic elements. For this, the energy distribution along the gait should be analyzed, and a cost function should be designed to purposefully influence the energy flow over the gait cycle.

Nonlinear optimization and machine learning are compelling numerical tools for designing gaits. These tools, combined with bio-mechanical data, can be used to find initial gaits. Based on this, the thesis will optimize the gaits for the elastic biped. The results should be validated in numerical simulations and experiments on existing hardware. In both cases, the energy flow and the cost of transport (CoT) should be analyzed, and the effectiveness of the designed cost function should be discussed.

Your Qualification:

- Strong background in robotics, machine learning, and optimization theory
- Experience in Python programming and git version control
- Motivation to work on a deeper understanding of dynamics and machine learning

Your Start:

The thesis will be conducted at the Institute of Robotics and Mechatronics in Oberpfaffenhofen. Envisioned starting date is May 2025. We give preference to severely disabled applicants if they are professionally suitable. Contact: Fabian Beck, fabian.beck@dlr.de

DLR Deutsches Zentrum für Luft- und Raumfahrt

Zertifikat seit 2002 audit berufundfamilie

trendence Graduate Barometer 2013 DEUTSCHLANDS 100 Top-Arbeitgeber