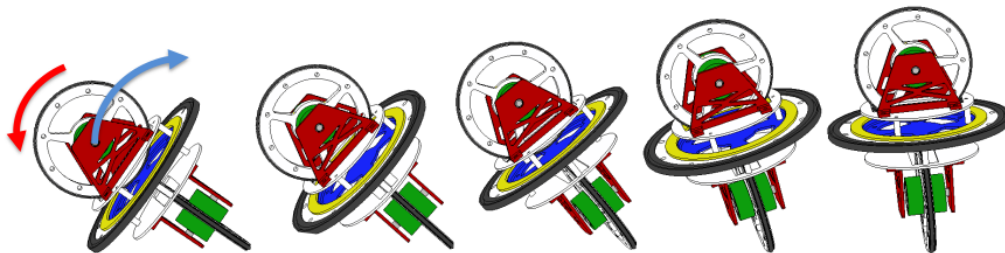Student project (Hiwi, Bachelor, Master):

Embedded System Design of an Agile Mobile Robot

Development of a flywheel-driven testbed for non-linear learning control

The abilities to self-erect and maneuver around moving obstacles are crucial steps towards the deployment of fully autonomous mobile robots acting in uncertain environments. With this perspective in mind, learning algorithms for robotics must be tested on real-world systems, as hardware raises a multitude of additional challenges. In the field of machine learning and control, the preferred testbed for algorithms are either rotorcrafts (quadrocopters) or stationary systems (robot arms, pendulums). While research on such testbeds led to breakthroughs in learning control and motion planning, analyzing learning algorithms for naturally unstable non-holonomic systems [1] has been rarely investigated. With representatives such as motorcycles and airplanes – the development of a simple small-scale non-holonomic testbed is of great significance for research on learning control and finally feasible due to steady advances in technology.

In this project, a first prototype of a highly maneuverable robot that utilizes state-of-the-art hardware shall be developed. Core aspects of this project are the software development and hardware configuration. While most of the hardware components (μControllers, Sensors, Brush-less DC Motors) are provided, open questions on the software architecture and system design must be answered. Optionally, the student is encouraged to transfer existing controllers from simulation to the real system. Different project types are available (Hiwi position, Bachelor, Master) and can be discussed based on the interest of the candidate.

MPI for Intelligent Systems, Intelligent Control Systems (`https://ics.is.mpg.de/`)
The project will be carried out at the Max Planck Institute for Intelligent Systems (MPI-IS) in Stuttgart. The MPI-IS is a young, highly dynamic, and internationally oriented research institution with close ties to several national and international partners (e.g., University of Stuttgart, University of Tübingen, ETH Zürich, KTH Stockholm). Further, the student will be supported by the ZWE Robotics Lab [2] providing additional support and an extensive infrastructure for embedded system design. This project is open to students from any institution. Accommodation at the institutes guest house may be available for the duration of the project, and the MPI can support travel to international conferences if the project leads to such publications.

Prerequisites: High motivation and excellent technical skills. Good programming skills (e.g. C/C++, Python or Matlab). Experience with embedded systems.

Contact: Do not hesitate to contact us if you are interested in this project. When applying, please include your CV, grade transcript, and optionally other documents helpful to evaluate your background.

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[1] A non-holonomic system in physics is a system whose state depends on the path taken in order to achieve it.
[2] `https://is.mpg.de/robotics`