Preliminary Result of Cury: A Backdrivable Leg Design Using Linear Actuators

Zhongtao Guan, Yiming Chen, Junlei Zhu, Yu Hu, Weibang Bai, and Jiahao Chen*
School of Information Science and Technology, ShanghaiTech University, Shanghai, China

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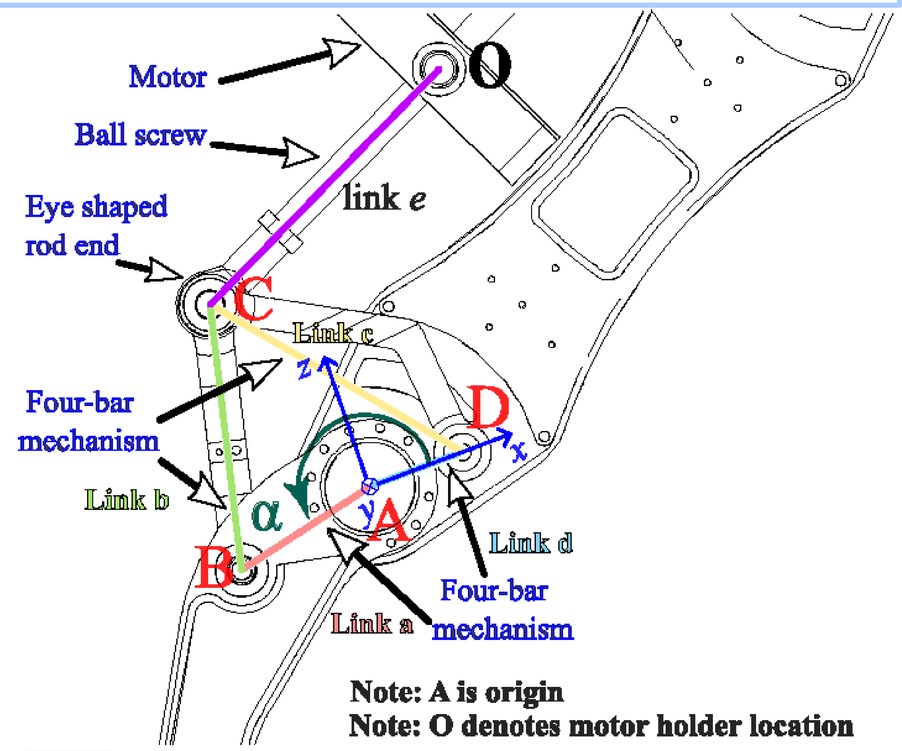
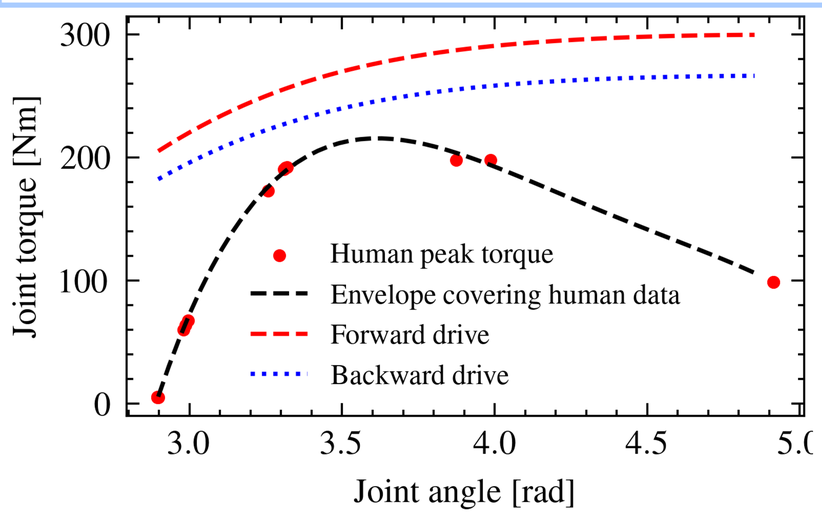
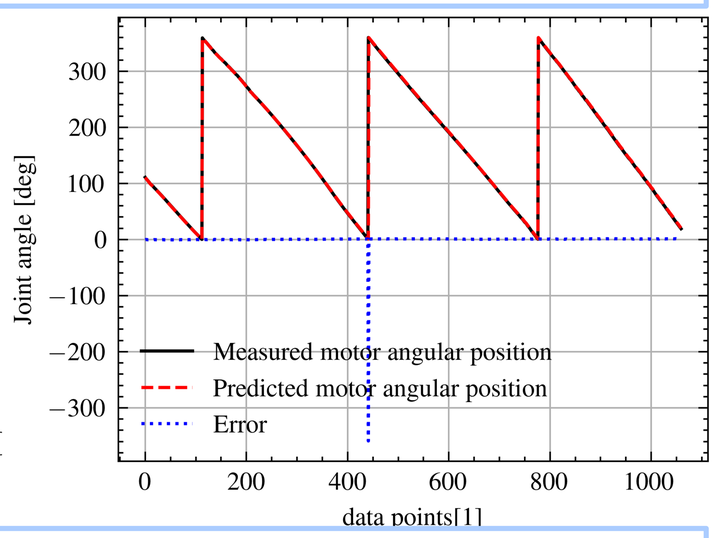
Abstract— This article reports a leg design that features backdrivability, and small clearance showing potential for energy recovery, and fewe encoders for joints. Thanks to the design of AC motor, motor driver and parameters optimization of four-bar linkages, the leg can meet xxx% torque requirements of human walking, follow given trajectory and hold extra payload to xxxkg.

I. Mechanical Design

To meet the torque and motion range requirements for human walking, while ensuring backdrivability and minimizing clearance compared to traditional gearbox actuators, the design in this paper is based on human gait data. The actuator system incorporates a ball screw mechanism and four-bar linkages. The linkage lengths are optimized using multi-objective optimization, aiming to reduce weight while fulfilling the necessary joint angles and torque demands.

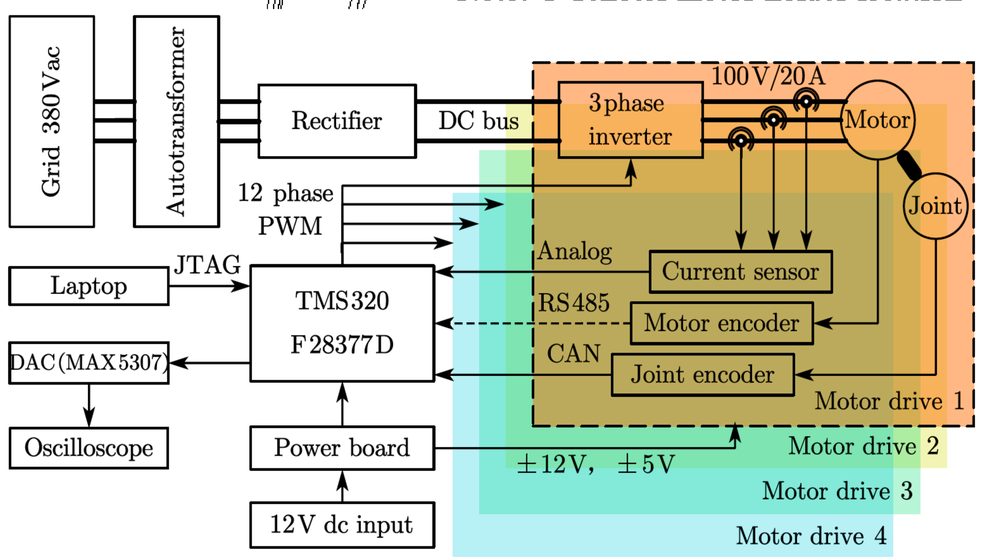






IV. Electrical design

To simplify the electrical system while feeding Ac motors with enough power, we designed a highly-integrated motor drives that can drive 2-4 motors with one MCU. High-level control commands is issued by the host computer and low-level MCU will deal with fundamental position, current control, etc.



IV. Simulation and Experiments

To accurately simulate the four-bar linkages, we import the open-loop chains model from SolidWorks to Webots as a 'Proto' than close the loop using 'SolidRefernce'. Compared to other popular simulators such as MuJoCo, Webots requires no parameters tunning for the elastic model.

In the experiments, the prototype shows the ability to follow given trajectory and hold extra payload up to xxx kg.