Custom Brushless Motor Design for Legged Robot

Context:

The EPFL Xplore Research Pole has the objective of building a legged robot. The robot is designed to autonomously navigate through challenging terrain using its on-board sensors. For the first iteration of the actuator, we used a frameless motor from the market.

Project description:

The semester project aims to develop a custom brushless motor tailored for application in legged robots, specifically designed as a direct drive brushless DC motor with a focus on achieving high torque, reduced transmission ratio, excellent transparency, and lightweight characteristics. The project will be conducted as part of a larger initiative within our association dedicated to advancing legged robot technology.

Furthermore, the student will be an integral part of the Xplore Legged Robot Team, actively participating in its weekly meetings and working sessions. This collaboration will facilitate close interaction with other team members, and the student is expected to share their findings and progress with the team regularly.

Tasks:

The project involves a series of tasks, outlined below (note that this list is not exhaustive):

- Literature Review and Preliminary Research
    - Review existing literature on direct drive brushless DC motors.
    - Identify key design considerations for legged robot applications.
    - Understand the specific requirements and constraints for implementing such motors in legged robots.
- Finite Element Simulation
- Prototyping Planning
- Motor Fabrication

Expected Outcomes:

- A thorough understanding of direct drive brushless DC motor designs.
- Proficiency in finite element simulation tools for motor geometry optimization.
- Hands-on experience in material selection and manufacturing processes for custom motor fabrication.
- Successful creation of a functional first version of the custom brushless motor.

References

G. Kenneally, A. De and D. E. Koditschek, "Design Principles for a Family of Direct-Drive Legged Robots," in *IEEE Robotics and Automation Letters*, vol. 1, no. 2, pp. 900-907, July 2016, doi: 10.1109/LRA.2016.2528294.

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