2024 IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM)
July 15-19, 2024. Boston, MA, USA

Thermal Characteristic Modeling and Compensation for the Improvement of Actuator Homeostasis

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***Abstract*— The operation of electric actuators across a wide temperature spectrum poses a formidable challenge in maintaining actuator homeostasis—the ability to generate a consistent response for a given input. This challenge arises mainly due to torque constant variations resulting from changes in magnetic flux density with temperature fluctuations. This study introduces a novel method to predict and compensate for these variations by developing a thermal model for the actuator, which allows for real-time estimation of the temperature of the inaccessible rotating magnet for effective compensation. The research seeks to advance actuator homeostasis beyond conventional methods that rely solely on the temperature of static components such as the stator or housing. The effectiveness of the proposed algorithm is verified through comparison with the conventional open-loop torque control algorithm. Additionally, the stability of the closed-loop system, focusing on temperature convergence with the proposed algorithm, is analyzed. This methodology suggests a promising path for developing drive systems that maintain actuator homeostasis in diverse conditions, addressing the root causes of system variability.**

*This work was supported by National Research Foundation of Korea grant(NRF) funded by the Korean government (Grant 2022R1A3B1077880)

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