Robust Safe Motion Control for Compliantly Actuated Robots via Disturbance Observers

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Abstract-Compliant actuators are commonly utilized in physical interactions between humans and robots, and it is of great significance to focus on safety control issues. This article introduces a robust safe motion control (RSMC) framework that employs control barrier functions (CBF) for robots driven by compliant actuators. Compliantly actuated robots are commonly subject to both matched and mismatched time-varying disturbances, including external environmental disturbances, imprecise link parameters, and unknown loads. These factors and their higher-order derivatives can have adverse effects on CBF-based safety control, resulting in safety violations and degraded control performance. To ensure robustness of safety against disturbances, a new disturbance estimates-based highorder control barrier function (DE-HoCBF) is constructed by fully utilizing both the disturbance estimates and the upper bound of the estimation error. On the basis of the constructed DE-HoCBF, the RSMC law is established by solving a quadratic programming (QP) problem. Compared to other worst-casebased robust CBF methods, the RSMC method proposed in this paper achieves a better trade-off between robustness and safety. Experimental results are provided to validate the effectiveness of the proposed method.

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