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Fusion Hybrid Linear Actuator: Concept and Disturbance Resistance Evaluation

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***Abstract*— The response of robot actuators to various dynamic interactions during contact tasks is not trivial because there exists a tradeoff between actuator-thrust force density and back-drivability. Although hybrid actuation approaches are promising, complex transmission mechanisms are necessary to synthesize forces from heterogeneous actuators. This study presents a novel concept of a fusion hybrid linear actuator to address the fundamental problems in conventional hybrid actuation approaches. The concept embodies an integrated structure of an air cylinder and a linear motor and shares the moving spaces of the piston and moving part of the linear motor inside the compact housing of the actuator. Herein, the design strategy requirements and its structural optimization processes are discussed. A kinetic friction model of a pneumatic cylinder that considers a piston structure is proposed to improve the force characteristics during dynamic interaction. Furthermore, a quantitative benchmark test is developed to maintain the contact force constant against a load actuator, to evaluate the disturbance resistance under a wide range of target contact force conditions. The concept and performance were validated by experiments comparing the proposed hybrid actuation condition with conventional pneumatic actuation conditions.**

Citation & link

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