Long-Range Piezo Actuators:

Compensating Hysteresis and Commutation Angle Reproducible Disturbances

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Abstract

Piezo-stepper actuators consist of piezo elements that are able to displace a mover over an infinite stroke through walking while maintaining the high accuracy and high stiffness properties of the piezo elements. In Figure 1, a schematic representation of a piezo-stepper actuator is depicted.

Two key challenges when implementing a piezo-stepper actuator include:

1. Dealing with the nonlinear hysteresis, which is inherent due to the nature of the piezo elements.
2. Dealing with disturbances introduced by the walking behaviour.

Regarding 1, due to the hysteric behaviour depending on past input profiles, direct compensation exploiting an inverse-model feedforward is typically hard. To overcome this, we have developed a new intuitive feedforward approach, exploiting the unique inverse of a hybrid MEM-element.

Regarding 2, the disturbance introduced by the walking behaviour is not reproducible in the time domain. However, this disturbance is highly reproducible in the position domain. We have developed a new data-driven approach based on iterative learning control that can effectively compensate for this type of disturbances, see [1] for details.

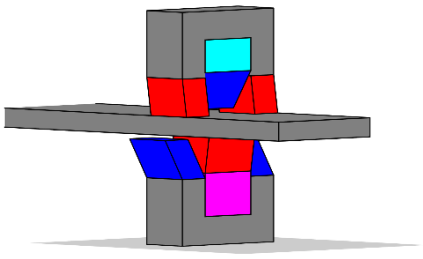

Figure 1: Schematic representationof a piezo-stepper actuator

[1] Strijbosch, N., Tacx, P. J. M. M., Verschueren, E., & Oomen, T. A. E. (2019). Commutation angle iterative learning control: enhancing piezo-stepper actuator waveforms. *In Joint Conference 8th IFAC Symposium on Mechatronic Systems (MECHATRONICS 2019), and 11th IFAC Symposium on Nonlinear Control Systems (NOLCOS 2019)* (pp. 1451-1456)

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