

STUDY OF SENSORLESS LOAD ESTIMATION METHOD FOR DISTURBANCE COMPENSATION CONTROL OF LINEAR RESONANT ACTUATOR

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Introduction

Linear resonant actuators (LRAs) are reciprocating actuators that are excited by alternating currents.



◆ Problem

It had taken time until it returned to the steady state amplitude after the amplitude of LRA decreases once by external load.

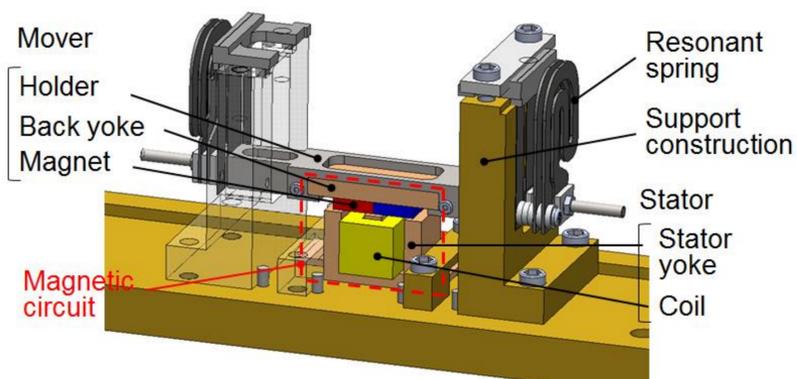
◆ Purpose

We propose the **external load estimation method** for a LRA using two signals of the back-EMF.

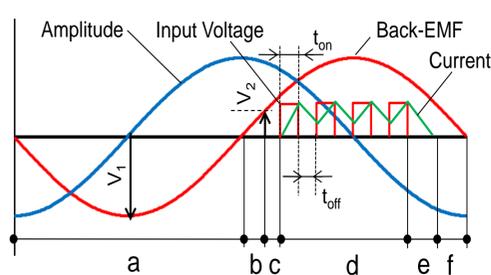
Moreover, we propose the **disturbance compensation control method** which controls depression of the amplitude.

Proposed control

Basic structure of the LRA



Load Estimation PWM Feedback Control



● Load estimation function

$$F' = \frac{K_a \{V_1 \exp(-\xi\pi) - K_v V_2\}}{2\{\exp(-\xi\pi) + 1\}} K$$

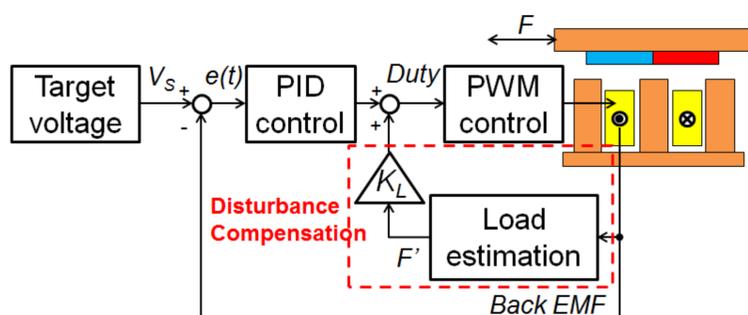
F' : estimated load

ξ : damping ratio

K_a, K_v : constants

Load estimation method uses two back-EMF signals: V_1 and V_2 .

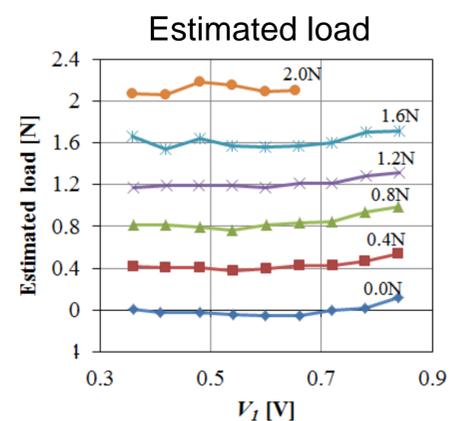
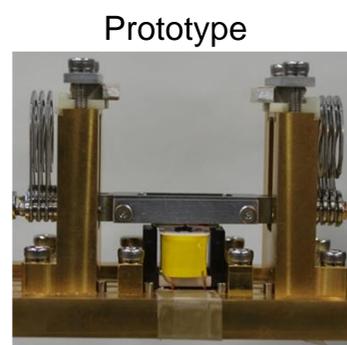
Disturbance Compensation Control



Duty determined by PID control and disturbance compensation control using estimated load.

Experimental results

Load Estimation results

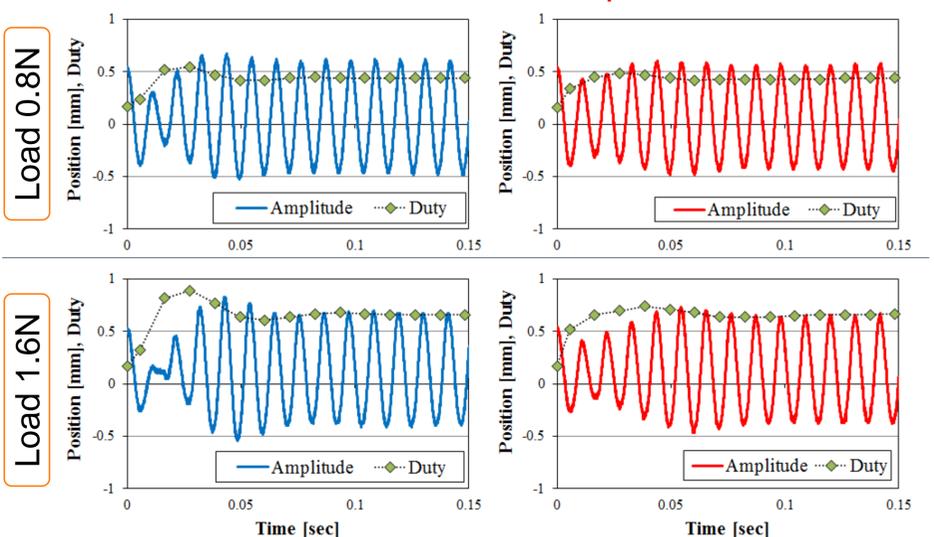


External load is estimated correctly without extra sensor.

Disturbance Compensation Control results

• Only PID control

• With disturbance compensation control



Duty is increased quickly. Decreasing in amplitude is reduced by disturbance compensation control.

Conclusion

We proposed an external load estimation method and the disturbance compensation control method. The effectiveness of this new control method was certified by experiment. From the estimated load, it became possible to control depression of the amplitude of LRA according to the estimated external load.