［様式－学 5］

Abstract of Doctoral Thesis

Title：Study on Electrostatic Force Generation and Position Feedback Control for High Performance of Electrostatically Controlled Linear Actuator

Doctoral Program in Integrated Science and Engineering
Graduate School of Science and Engineering
Ritsumeikan University

ぐぇん あん ちゅあん
NGUYEN ANH TUAN

This thesis studies on the electrostatic force generation and position feedback control for high performance of an electrostatically controlled linear actuator (ECLIA). The ECLIA consisting of a piezoactuator (PZT), driving and holding electrodes, and sliders provides precise motion and large stroke. In literature, novel technologies have been studied for improvements of the actuator. Among these, a micro-potentiometer using a probe dipped in μpool (PDP) was proposed and employed to detect position of the slider. As a development stage, this thesis reports on the following issues aiming higher performance of the ECLIA: (1) Introducing a flexible electrode with a sandwich structure for higher electrostatic-force generation, (2) Increasing the pushing force using a fishbone structure mounted on the flexible slider, and (3) Position feedback control using a micro-potentiometer and microcontroller.

This thesis consists of six chapters. The first chapter introduces the background, and objective of the study. In chapter 2, the structure and working principle of the ECLIA are described. Chapter 3 presents the flexible electrode having a conductive layer sandwiched between insulating layers. The flexible electrode could deform and fit to the contact electrode for higher efficiency of electrostatic-force generation. Therefore, the flexible electrode exhibited a significant improvement in the electrostatic clutching force in comparison with the Si electrode. In chapter 4, a design of the fishbone structure for improving the longitudinal stiffness of the flexible slider is presented. The fishbone slider showed a higher performance in terms of the pushing force than that of the Si slider. Chapter 5 describes the design and implementation of a position feedback controller using a micro-potentiometer and a microcontroller. It was indicated that the feedback control with tuning gains performed a significant improvement compared to that without tuning gains. The final chapter summarizes this thesis.