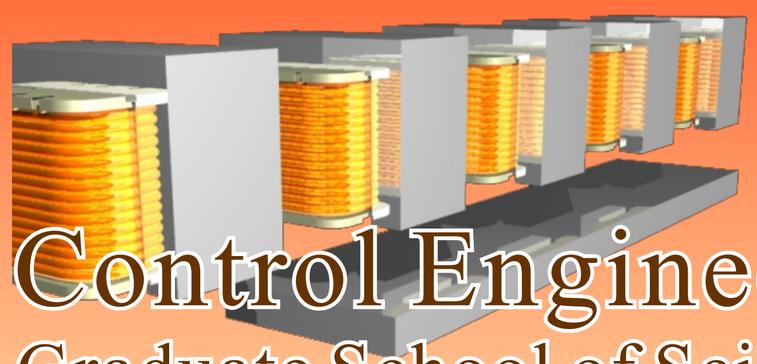

Study of Micro Force Measurement Using a Zero-compliance Mechanism

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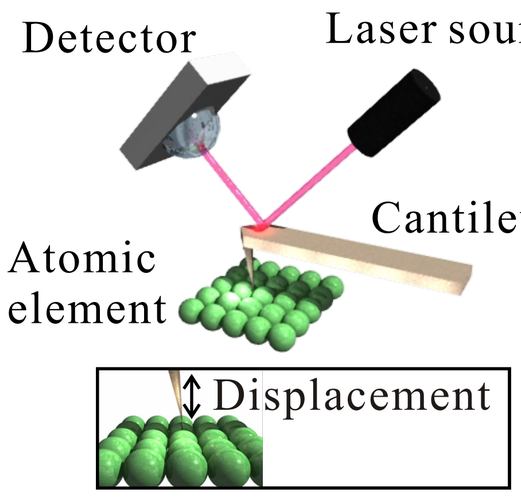
Abstract

The force measurement system using zero-compliance mechanism measures force from displacement of the detection point without displacing the point of force.The aim of this study is to confirm the efficiency of zero-compliance mechanism using a double series magnetic suspension system.

Introduction

Conventional micro force measurement



Force measurement from the deflection of the cantilever

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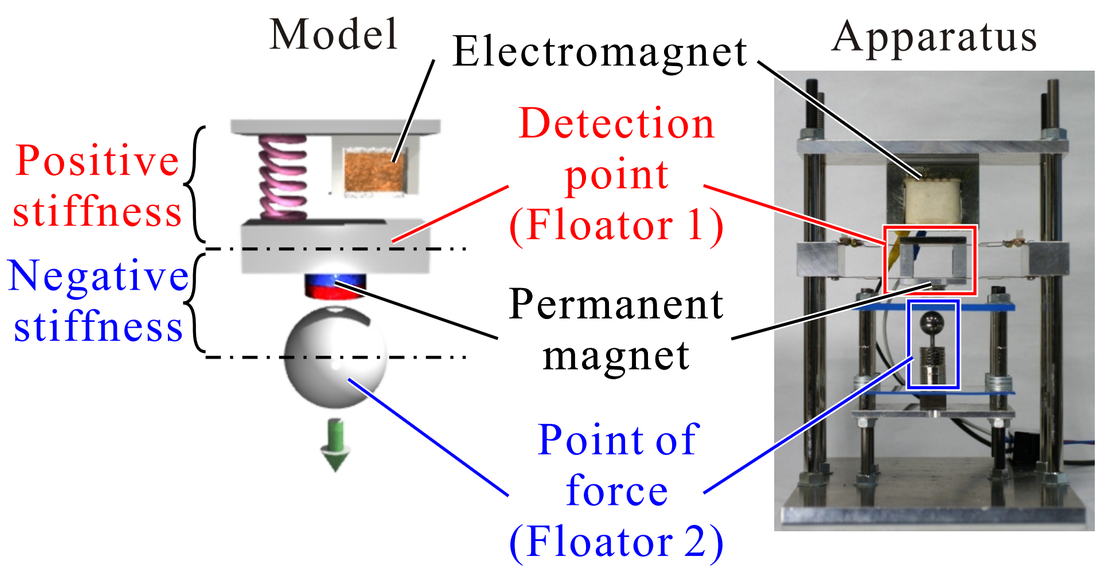
Problem
Displaced Point of force affect the force measurement

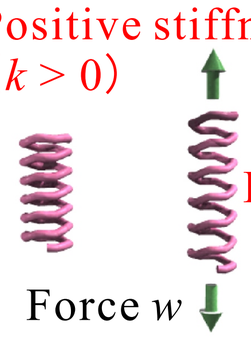
Force measurement apparatus using double series magnetic suspension



Electromagnet + Spring + Permanent magnet

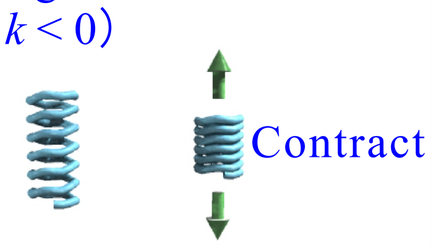
Zero-compliance Mechanism

Positive stiffness ($k > 0$)

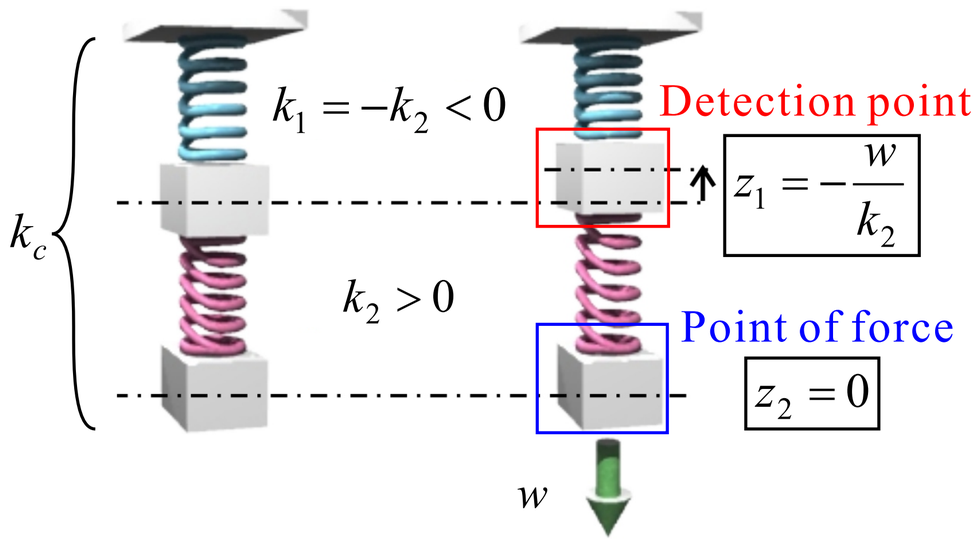


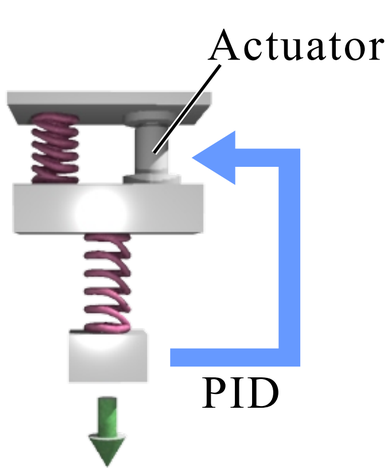
+

Negative stiffness ($k < 0$)



Zero-compliance ($k_c = \infty$)





Realization of negative stiffness causes destabilization of the system

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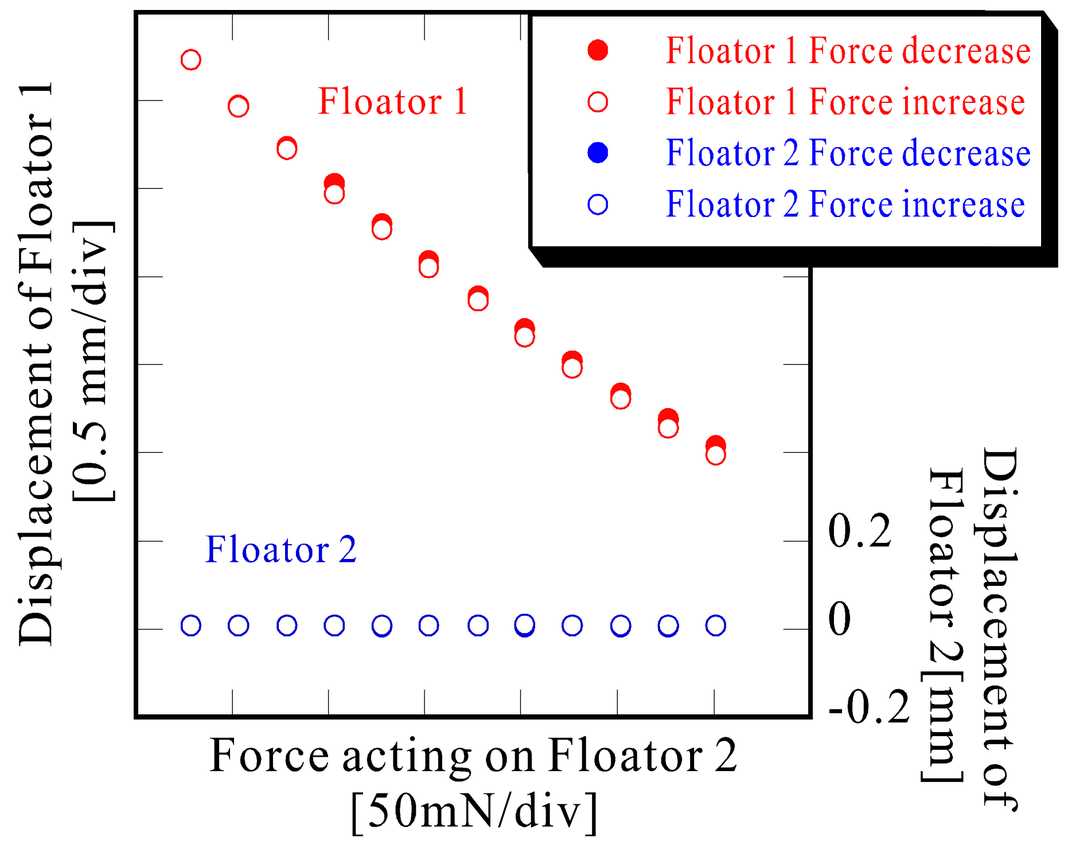
Equivalent negative stiffness by PID control of the point of force

Use of double series magnetic suspension system

Static force measurement



Detection point : Linearly displaced according to a force
Point of force : Invariant to force

→ Enable force measurement from detection point displacement

Applications

- Dynamic force measurement
- Multi-DOF measurement
- Force measurement in cantilever
- Torque measurement

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