



## Characteristics of Oscillatory Actuators

### Linear Oscillatory Actuator

Generate reciprocating motion directly

### High Efficiency

Low friction loss  
High-efficiency with resonance

### Small/High-Frequency drive

No rotary-linear conversion device

### Example of the application



Air compressor



Electric shaver



Electric toothbrush



Artificial heart

## Research Brief

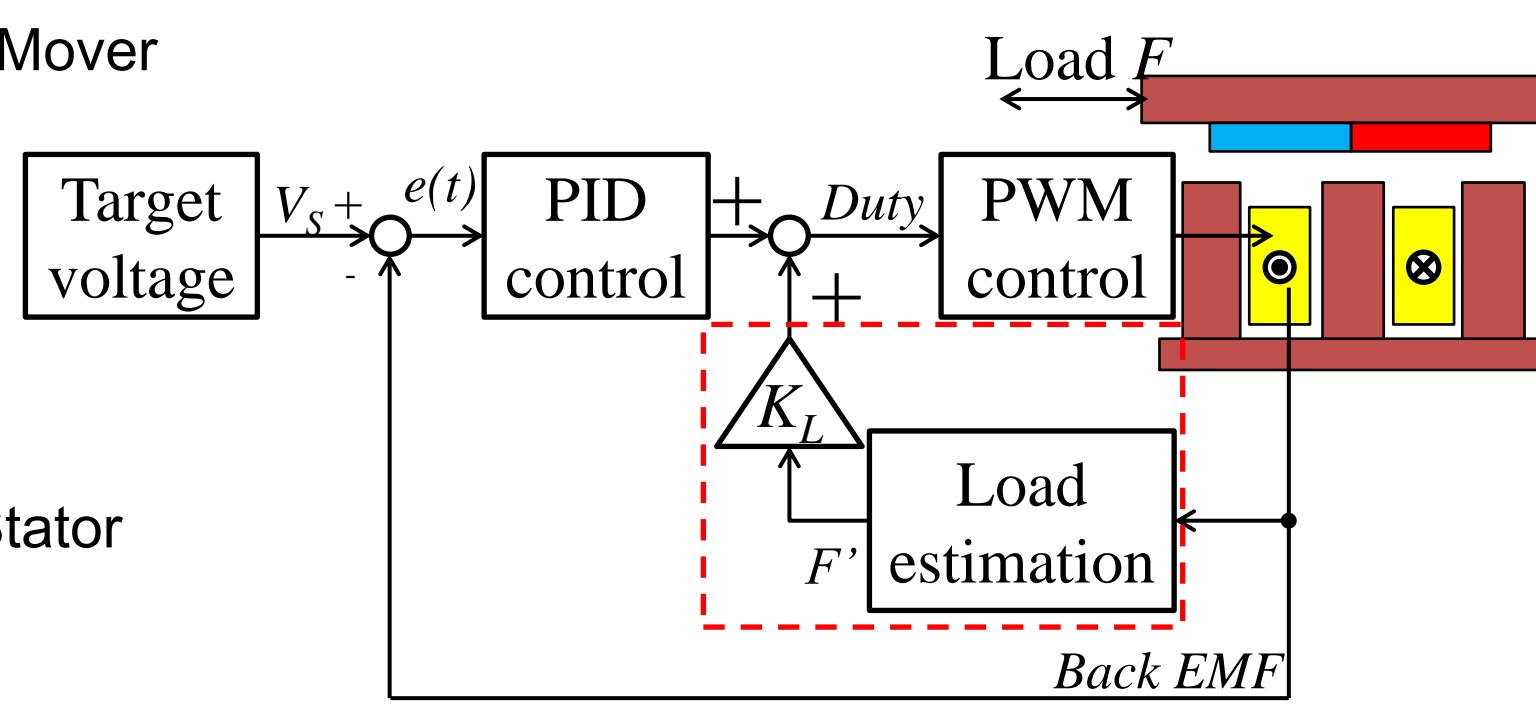
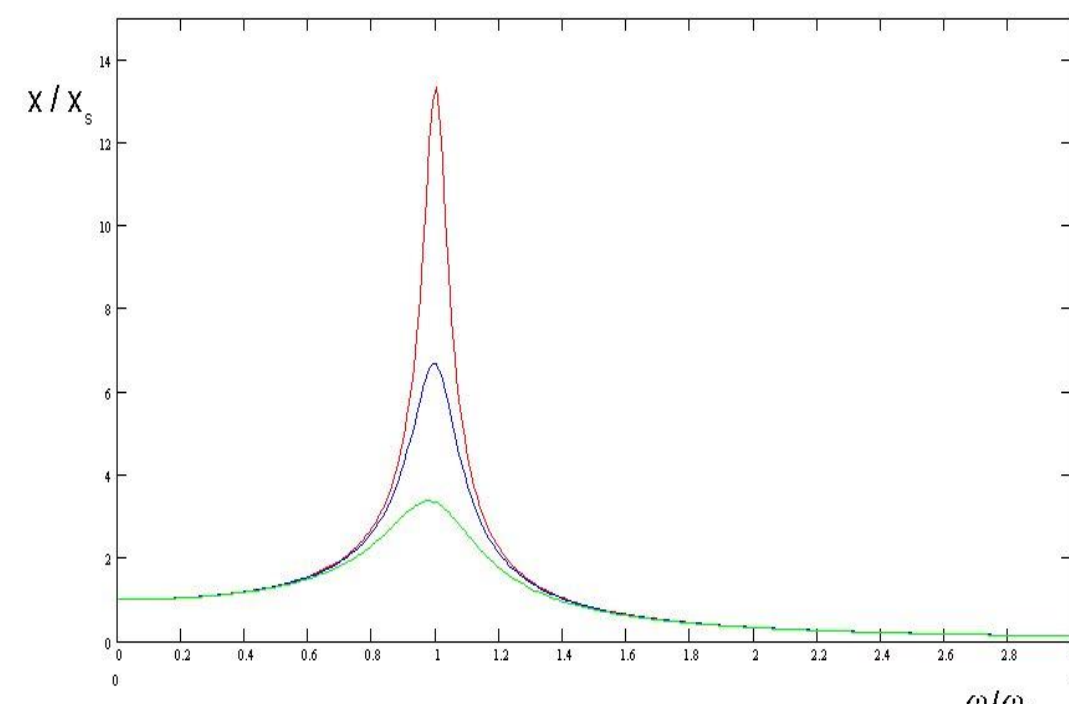
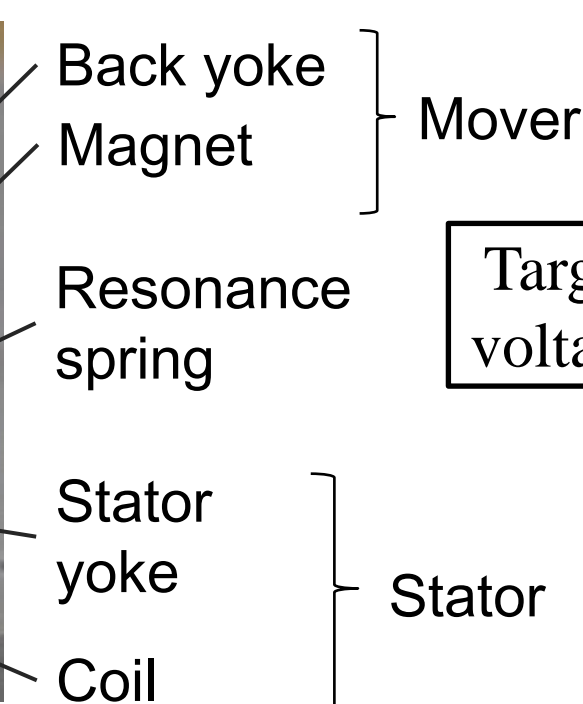
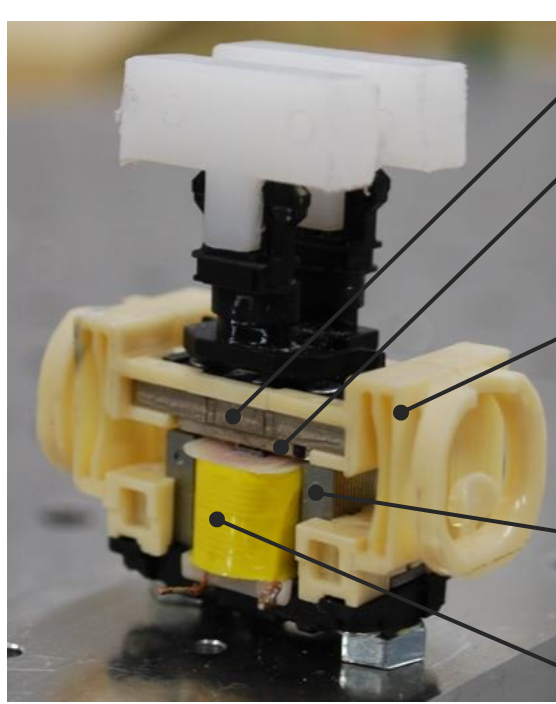
### 1-DOF Resonant Actuator

#### Use Resonance

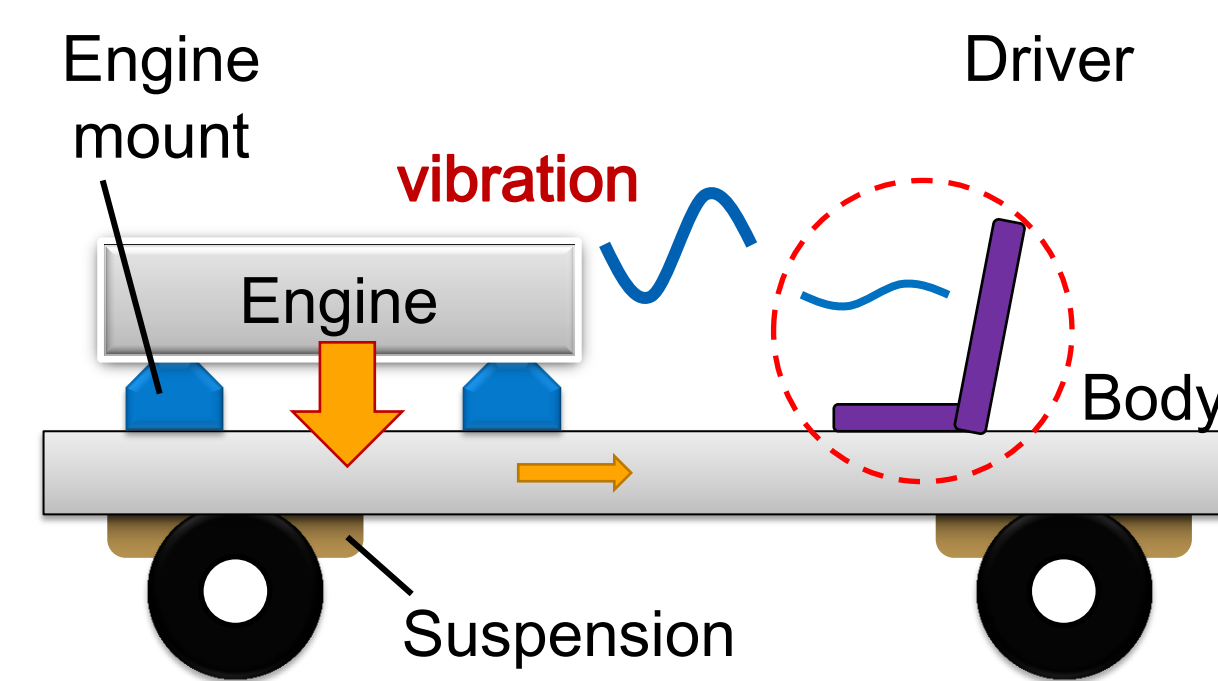
- High-efficiency
- △ Amplitude decreases rapidly when load is increased

#### Load estimation

#### Disturbance Compensation

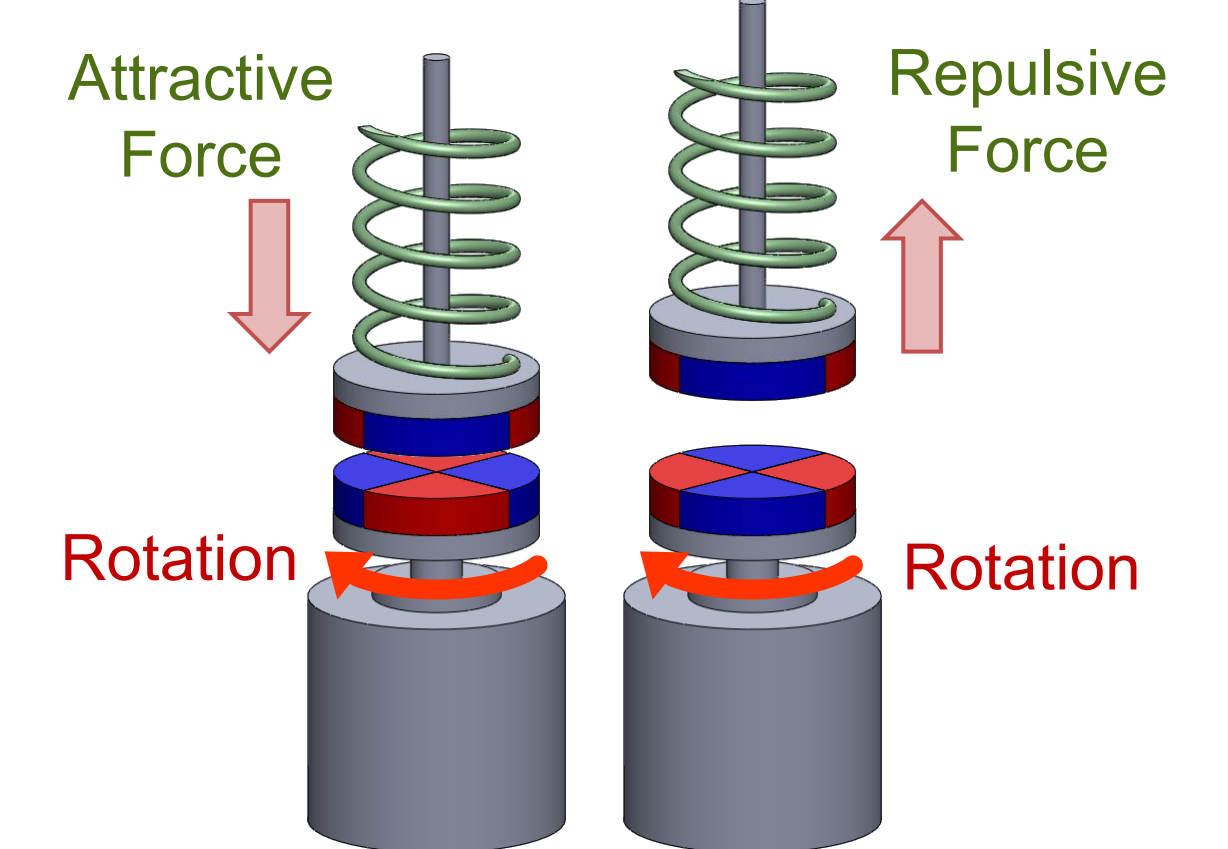
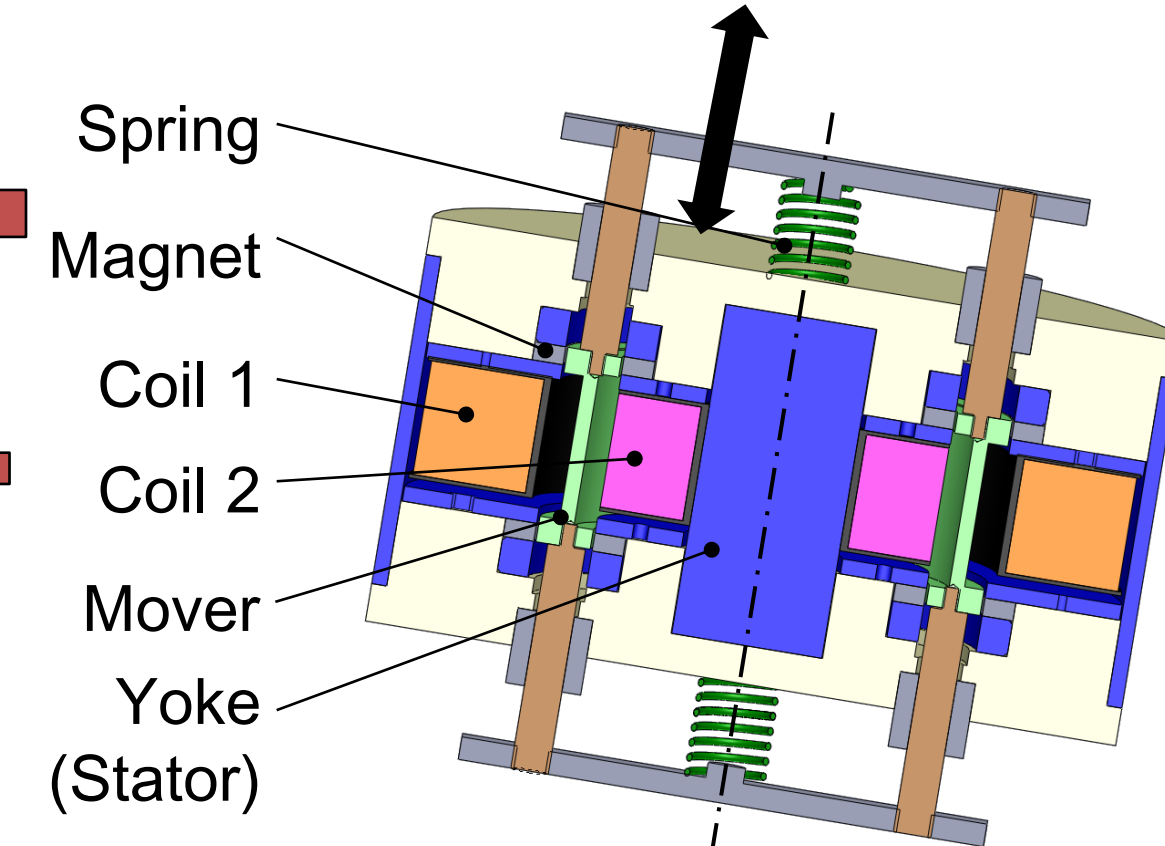


### Active Vibration Control



Vibration reduction using ACM (Active Control Engine Mount)

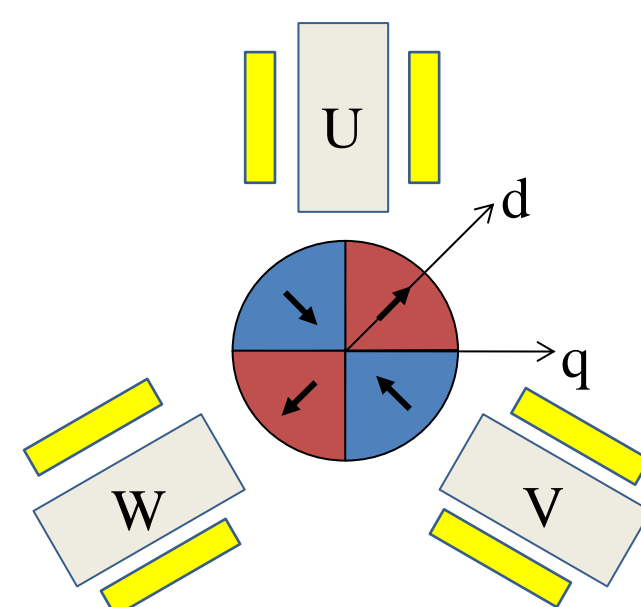
Reduce in-car noise  
Relief psychological load  
Provide stable driving



### Multi-DOF Drive

#### Broaden the field of application

New application: haptic device



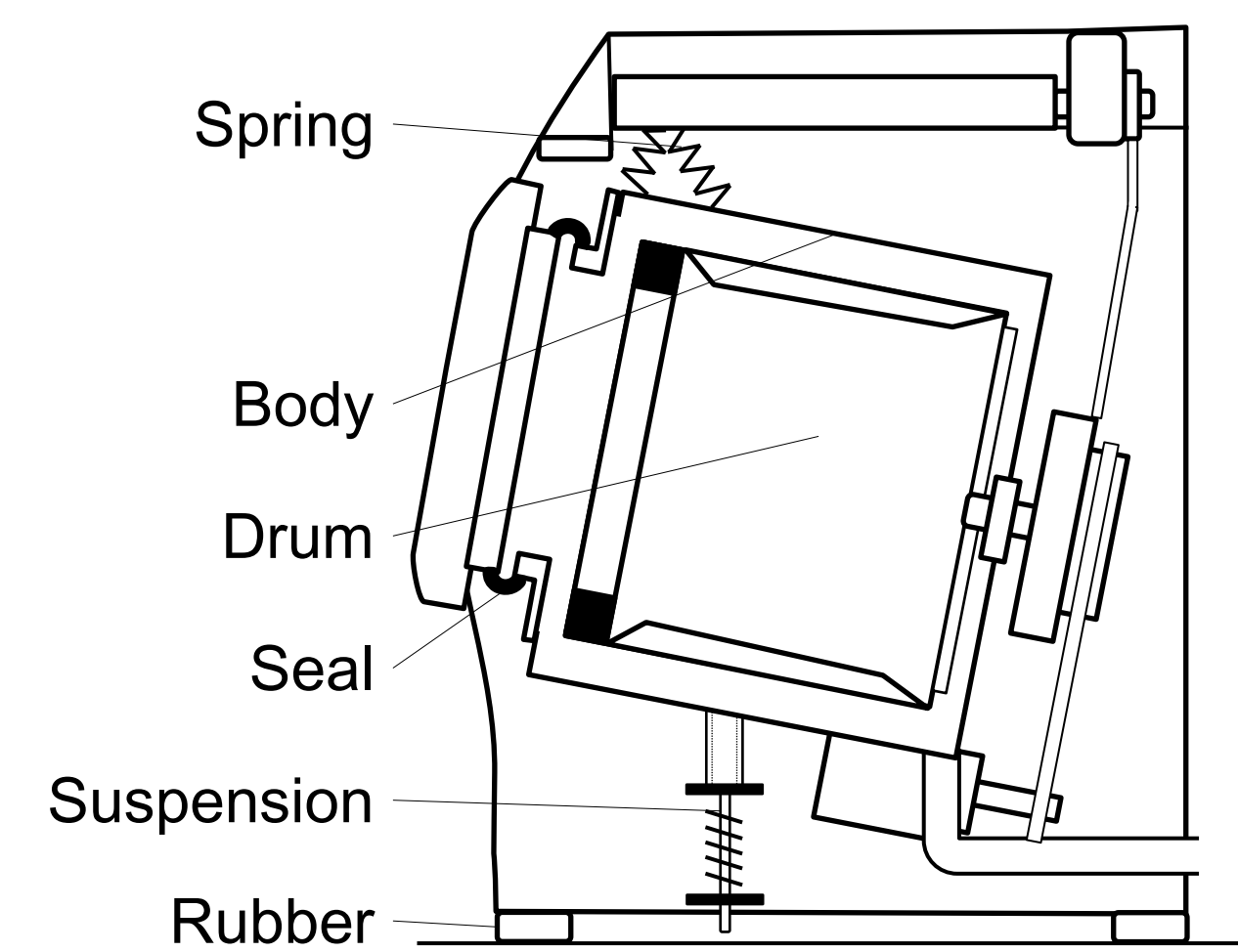
Apply rotation machine's method

### Vibration Control

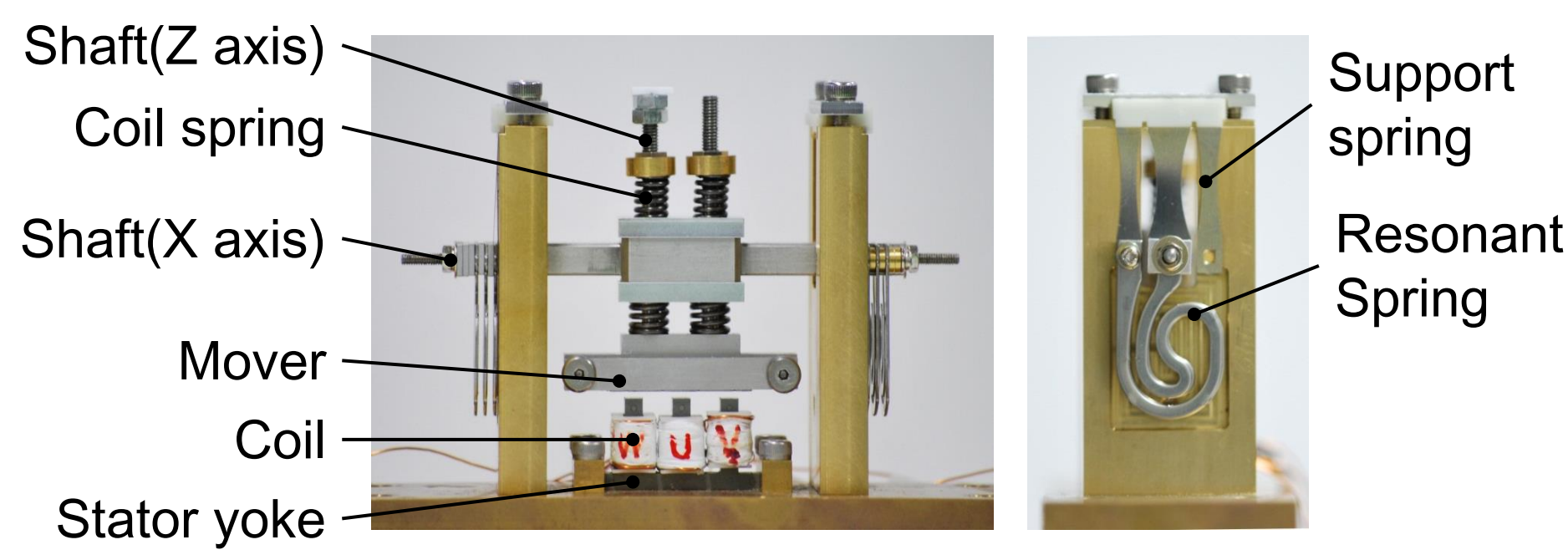
Irregular vibration caused by eccentric load

Fluid balancer + Electromagnetic actuator

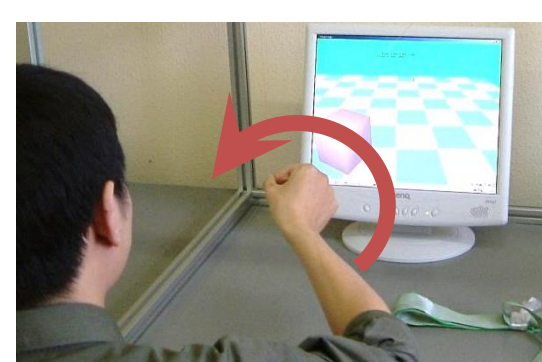
→ Active Control



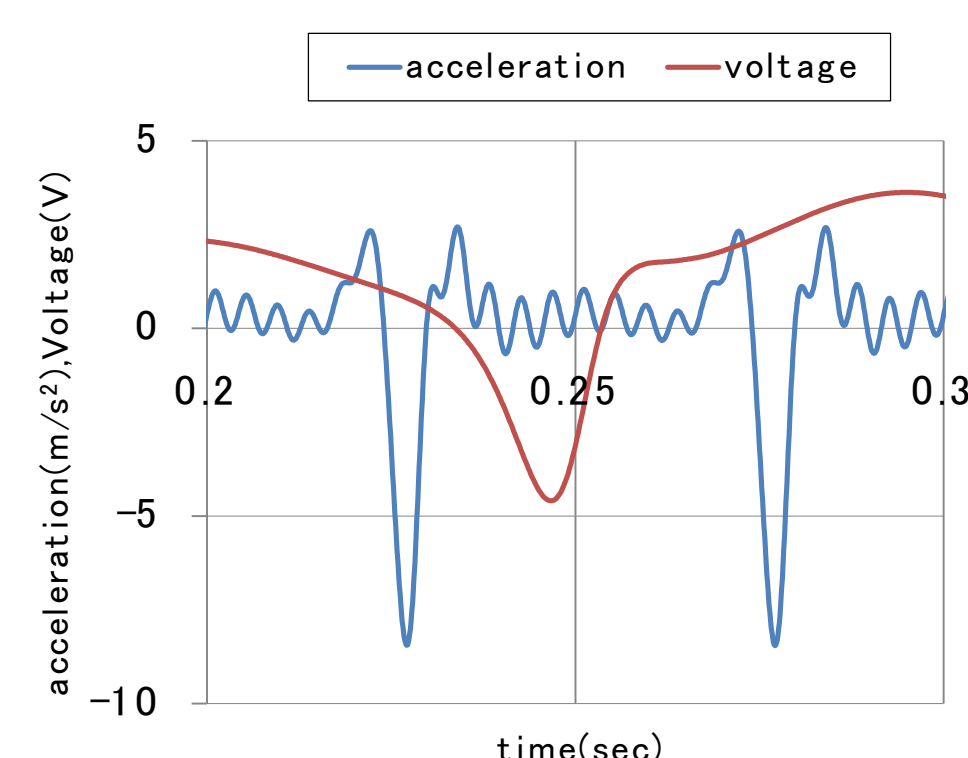
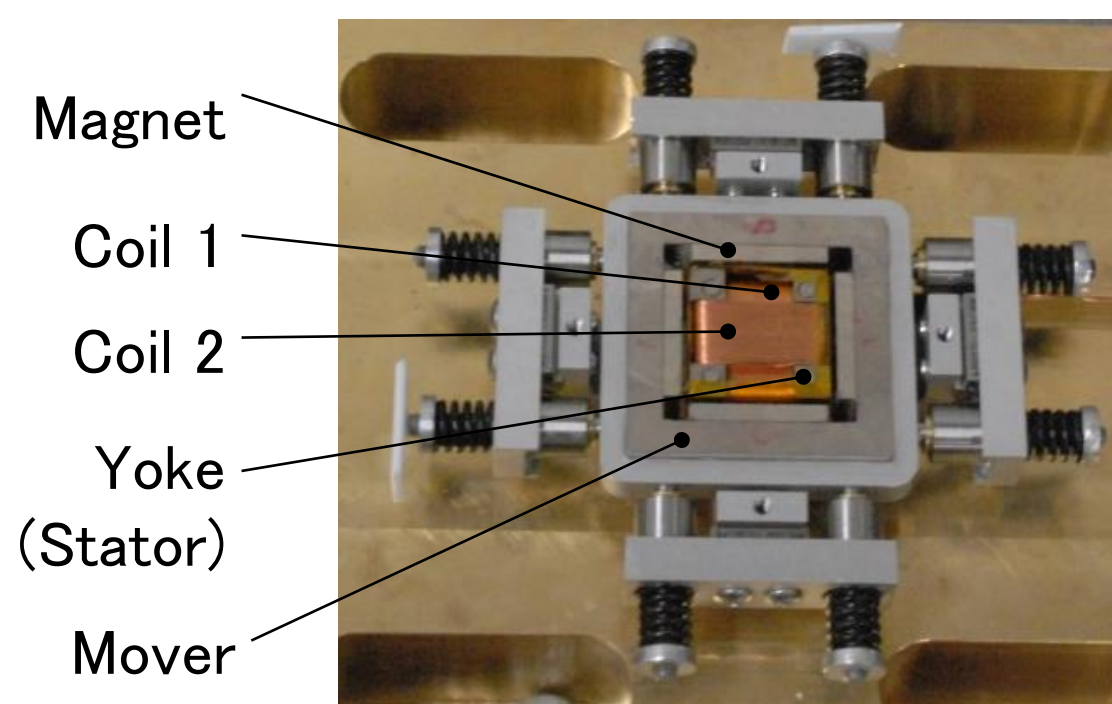
### 2-DOF Resonant Actuator with Vector Control



### Haptic Feedback



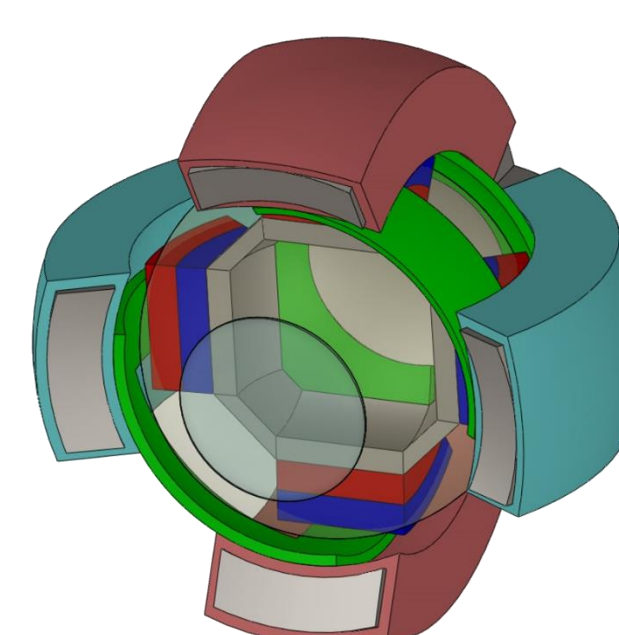
Navigation device CAD, Computer game for visually impaired



### 3-DOF Actuator

#### Control Unit of Camera Shaking

	Lens Shift	Image Sensor Shift	Lens Unit Shift
Wide angle drive	×	×	○
Correct shaking	×	○	○
Confirm effect of correction on finder image	○	×	○
Small size	○	△	×



Propose 3-DOF actuator  
Evaluate its performance using FEA