# Advanced motion control for high-precision motion systems

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## Preactuation perfect tracking control for system with unstable zeros



### **Unstable zeros problem**

- Unstable poles in inversion system
- Undershoot in step response Example: High-precision stage, boost converter, airplane...

### Solution

Stable inversion by

Time axis reversal & Imaginary axis flipping

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Multirate feedforward



# High-precision motion control by pneumatically actuated stage

∃ 0.0

Position 0.2

0.3



#### **Pneumatic actuation**

#### <u>Advantages</u>

- High power to weight ratio
- Low heat generation
- Low cost

Time delay compensation by modified Smith predictor



### Acoustic wave equation based modeling and vibration cancellation



#### **Disadvantages**

- Time delay
- Position-dependent resonances
- Valve & air dynamics nonlinearity





Resonance cancellation by wave equation based SINGLE filter