Multirate control for high accuracy and low cost: dual-stage experiments

Dual stage systems
High position accuracy over a large range
- example: long stroke – short stroke in wafer stages
- different performance requirements for different control loops (e.g., µm vs nm)
- performance requirements determine sampling rate

Multirate approach: high accuracy at low cost
Different sampling rates in different loops
- balance performance and hardware cost (sensors, actuators, AD/DA converters)

Control of multirate systems
- Aim: systematic control design approach
- Challenge: linear periodically time-varying (LPTV)
  → frequency-domain approaches not applicable

Contribution: multirate feedforward control
- Focus of this work: feedforward control
  - dominant in control performance
- Multirate feedforward for slow control loop
  - key aspect: feedforward at high rate for same price
    (no extra sensors or actuators needed)

Experimental dual-stage system
Two air-guided stages
- 1 translational degree of freedom

Experimental results: high accuracy at low cost with multirate control

Conclusion
Multirate control: high performance at low cost
- Experimental validation multirate control approach
Related work:
- Feedback control of LPTV systems [2]
- More resource-aware control design [3]

References