Simscape Model - Nano Active Stabilization System

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Contents

From last sections:

- Uniaxial: No stiff nano-hexapod (should also demonstrate that here)
- Rotating: No soft nano-hexapod, Decentralized IFF can be used robustly by adding parallel stiffness

In this section:

- Take the model of the nano-hexapod with stiffness 1um/N
- Apply decentralized IFF
- Apply HAC-LAC
- Check robustness to payload change
- Simulation of experiments

Sections	**Matlab File**
Section **??**	`nass_1_.m`

Table 1: Report sections and corresponding Matlab files

1 Control Kinematics

- Explain how the position error can be expressed in the frame of the nano-hexapod

  positioning_error: Explain how the NASS control is made (computation of the wanted position, measurement of the sample position, computation of the errors)

- Control architecture, block diagram
- Schematic with micro-station + nass + metrology + control system
- Zoom in the control system with blocs
- Then explain all the blocs
- Say that there are many control strategies. It will be the topic of chapter 2.3. Here, we start with something simple: control in the frame of the struts

1.1 Micro Station Kinematics

- from ??, computation of the wanted sample pose from the setpoint of each stage.

1.2 Computation of the sample's pose error

From metrology (here supposed to be perfect 6-DoF), compute the sample's pose error. Has to invert the homogeneous transformation.

1.3 Position error in the frame of the nano-hexapod

Explain how to compute the errors in the frame of the struts (rotating)

2 Decentralized Active Damping

- How to apply/optimize IFF on an hexapod? ()
- Robustness to payload mass
- Root Locus
- Damping optimization
- [ ]control_active_damping
- [ ]active damping for stewart platforms
- [ ]Vibration Control and Active Damping

2.1 IFF Plant

- Show how it changes with the payload mass (1, 25, 50)
- Effect of rotation (1rpm, 60rpm)

2.2 Controller Design

- Apply IFF
- Show Root Locus
- Choose optimal gain. Here in MIMO, cannot have optimal damping for all modes. (there is a paper that tries to optimize that)
- Show robustness to change of payload (loci?)
- Reference to paper showing stability in MIMO for decentralized IFF

2.3 Sensitivity to disturbances

- Compute transfer functions from spindle vertical error to sample vertical error with IFF (and compare without the NASS)
- Same for horizontal
- Maybe noise budgeting, but may be complex in MIMO...

3 Centralized Active Vibration Control

uncertainty_experiment: Effect of experimental conditions on the plant (payload mass, Ry position, Rz position, Rz velocity, etc...)

- Effect of micro-station compliance
- Effect of IFF
- Effect of payload mass
- Decoupled plant
- Controller design

From control kinematics:

- Talk about issue of not estimating Rz from external metrology? (maybe could be nice to discuss that during the experiments!)
- Show what happens is Rz is not estimated (for instance supposed equaled to zero =¿ increased coupling)

3.1 HAC Plant

- Compute transfer function from u to dL (with IFF applied)

3.2 Effect of Payload mass

- Show effect of payload mass + rotation

3.3 Controller design

- Show robustness with Loci

3.4 Sensitivity to disturbances

- Compute transfer functions from spindle vertical error to sample vertical error with HAC-IFF Compare without the NASS, and with just IFF
- Same for horizontal
- Maybe noise budgeting, but may be complex in MIMO…

3.5 Tomography experiment

- With HAC-IFF, perform tomography experiment, and compare with open-loop
- Take into account disturbances, metrology sensor noise. Maybe say here that we don't take in account other noise sources as they will be optimized latter (detail design phase)
- Tomography + lateral scans (same as what was done in open loop here)
- Validation of concept

4 Conclusion