Real-Time Measurement for an Internal Grinding System

Precision Machining Research Consortium

Industrial Advisory Board

Georgia Institute of Technology

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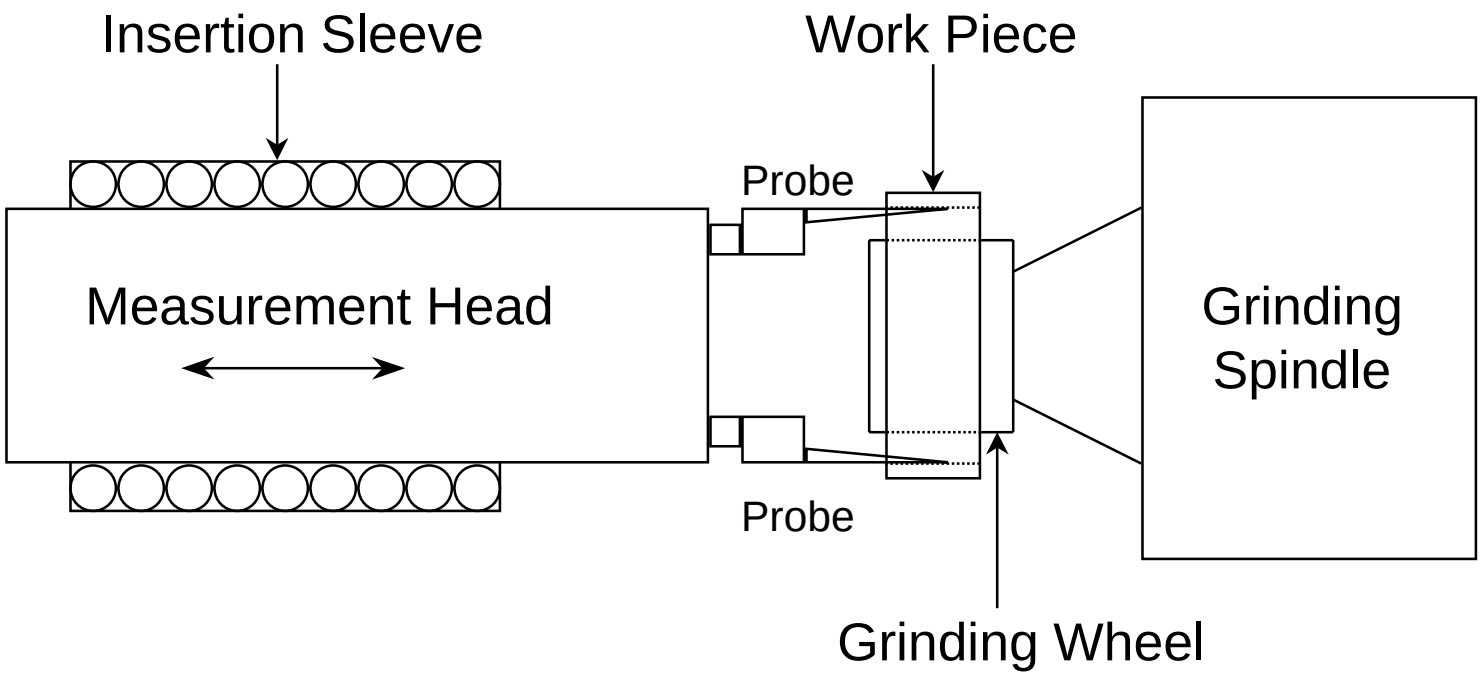
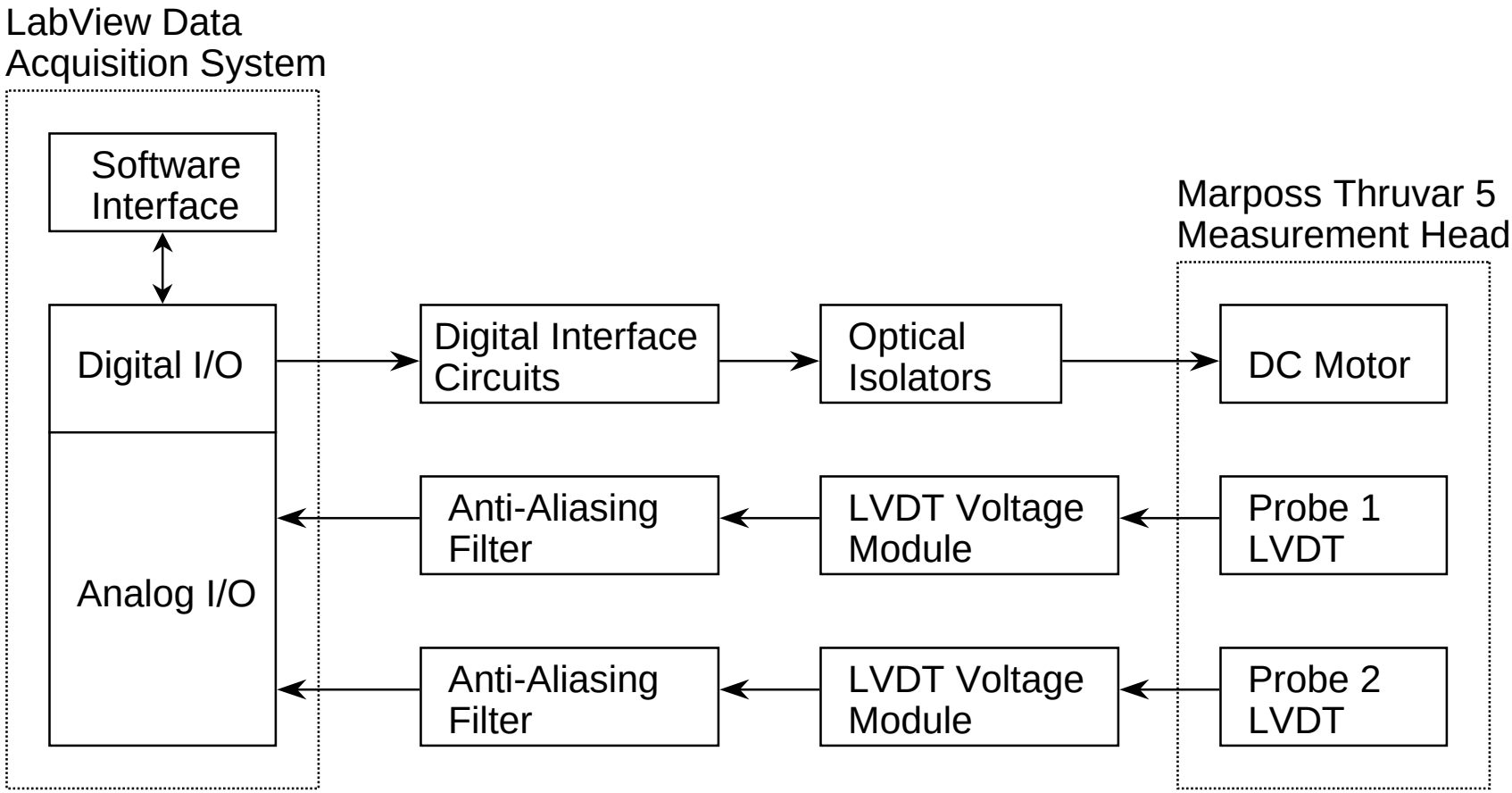
Measurement Head Background

- Two diamond-tipped tactile probes
- Two LVDTs wired in series
- Small DC positioning motor

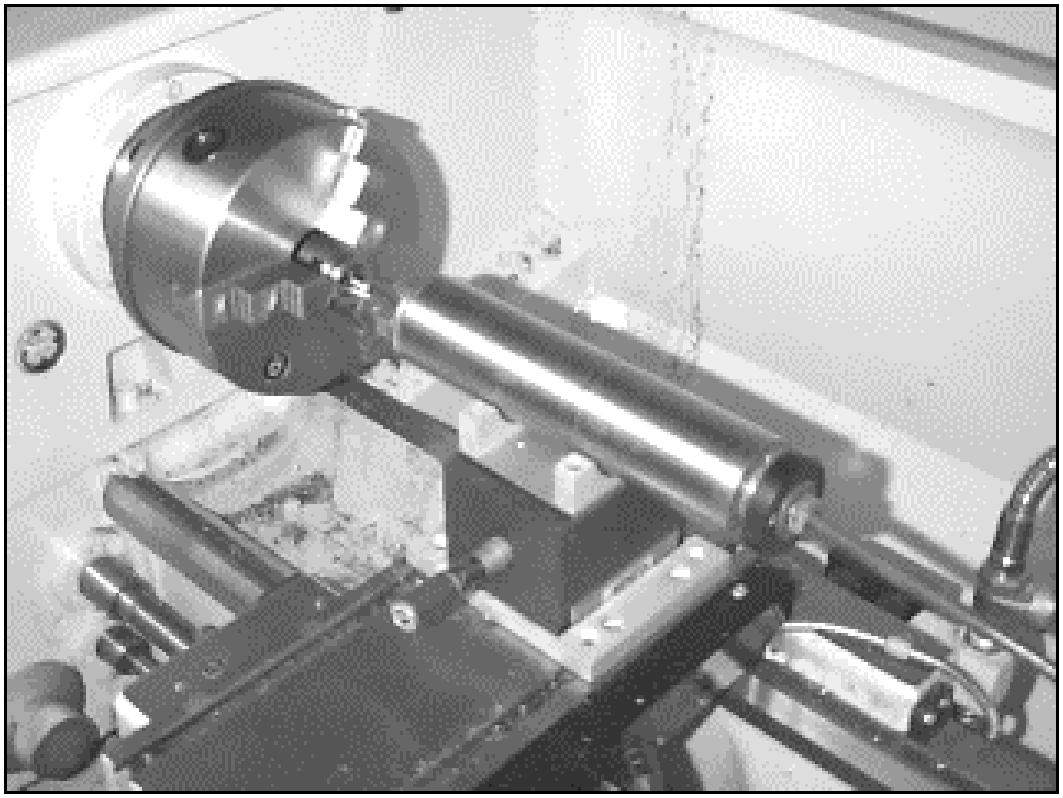


Experimental Setup Diagram



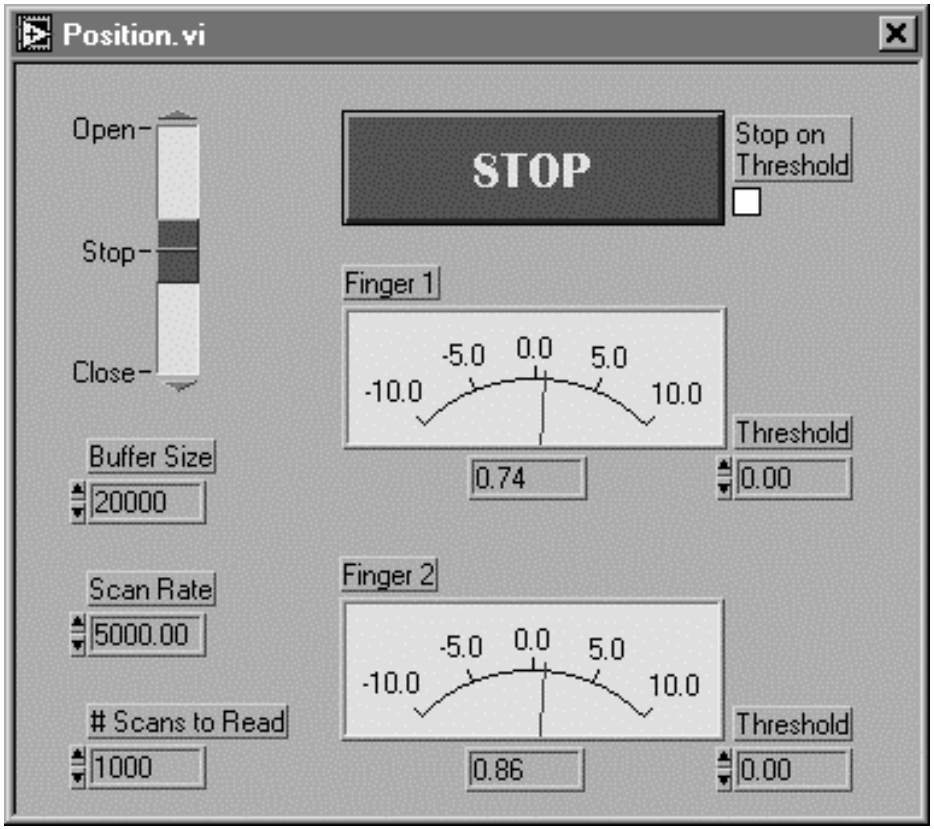
Work Piece Rotation

- Lathe simulated rotation at 519 RPM
- X, Y, and Z positioning capability



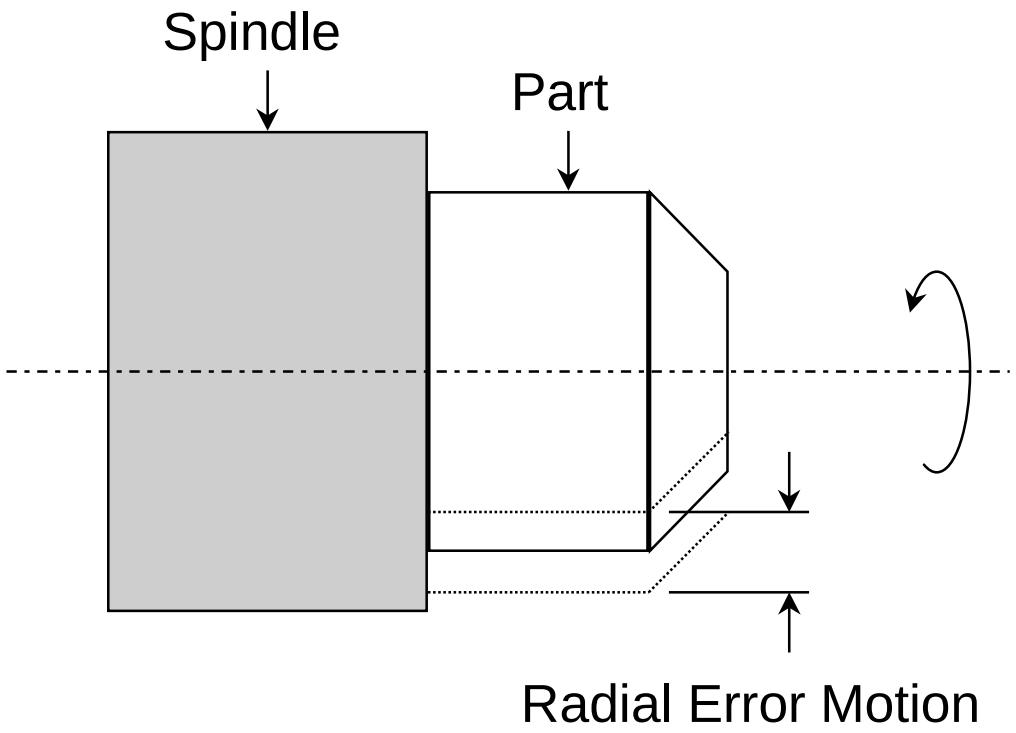
Data Acquisition System

- LabView virtual instrument software
- Real-time analysis
- Assumed maximum of 50 UPR
- Anti-Aliasing filters
- Two analog inputs
- Probe positioning



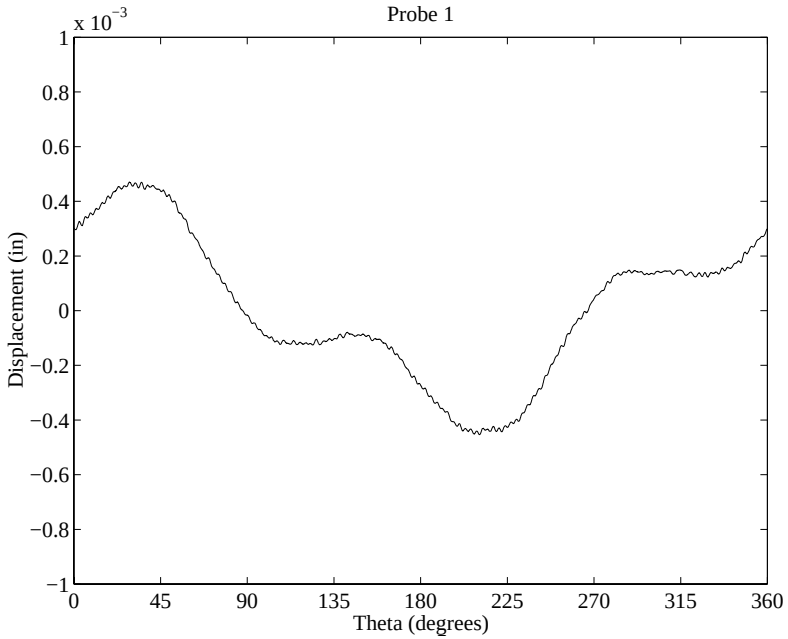
Spindle Error

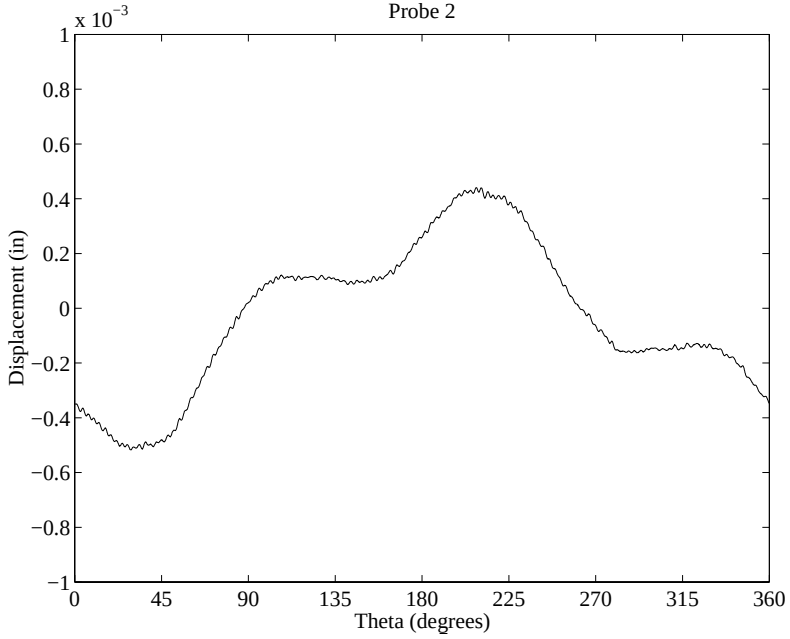
- Low frequency undulations distort results
- Evaluated with Donaldson Reversal Technique



Spindle Error

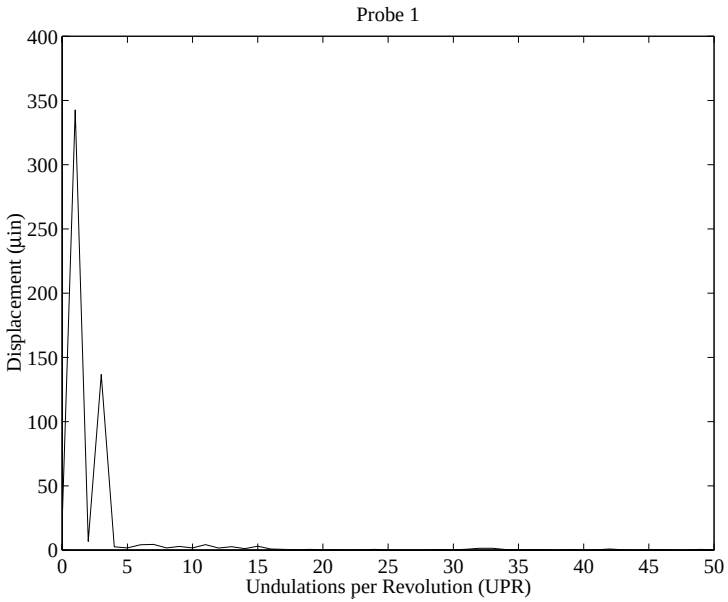
- Significant low frequency error motion
- Two signals 180° out-of-phase

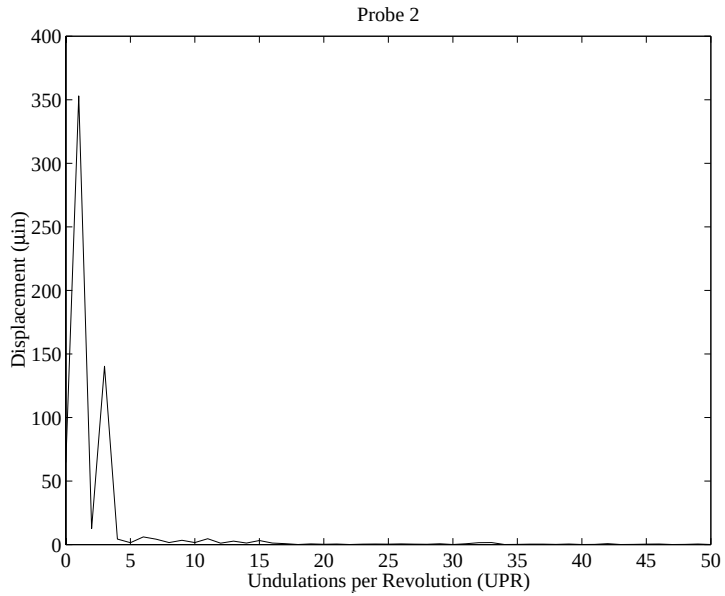




Spindle Errors

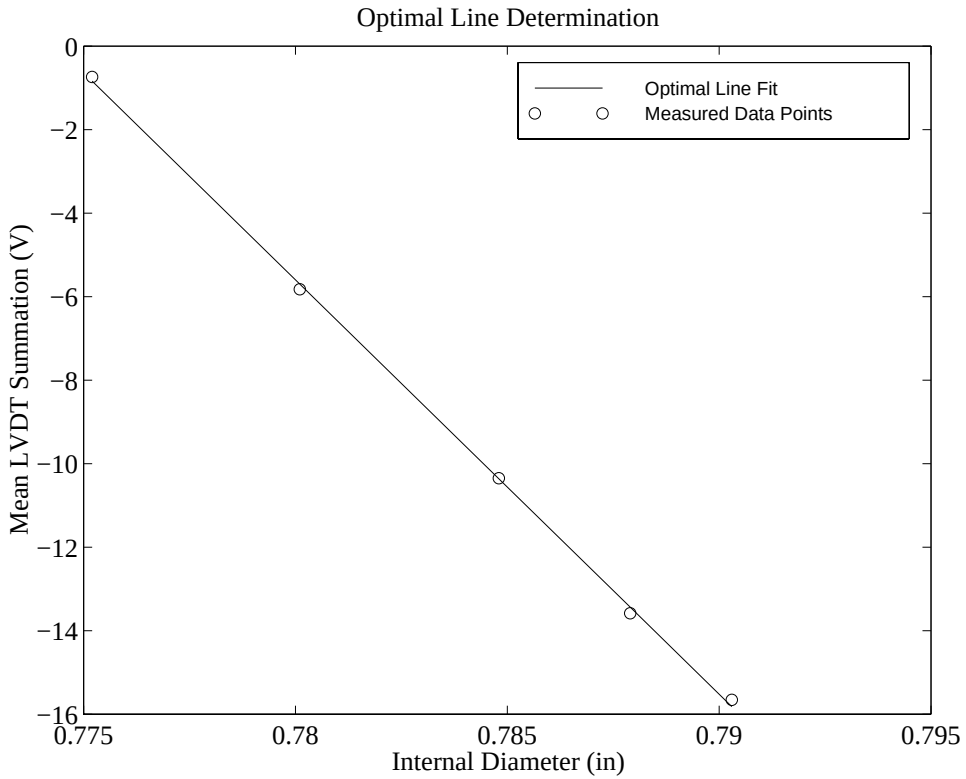
- Frequency analysis
- Low frequency 1 and 3 UPR error motion





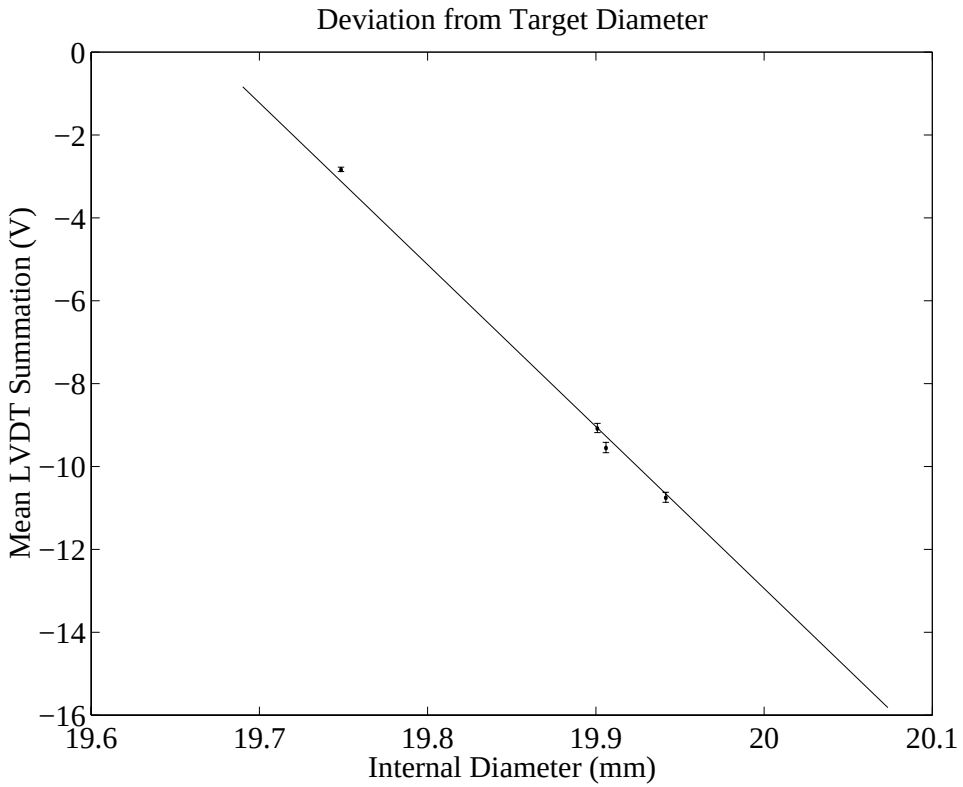
Deviation from Target Diameter

- Minimized measurement normal deviations
- Diameters of master parts verified on CMM



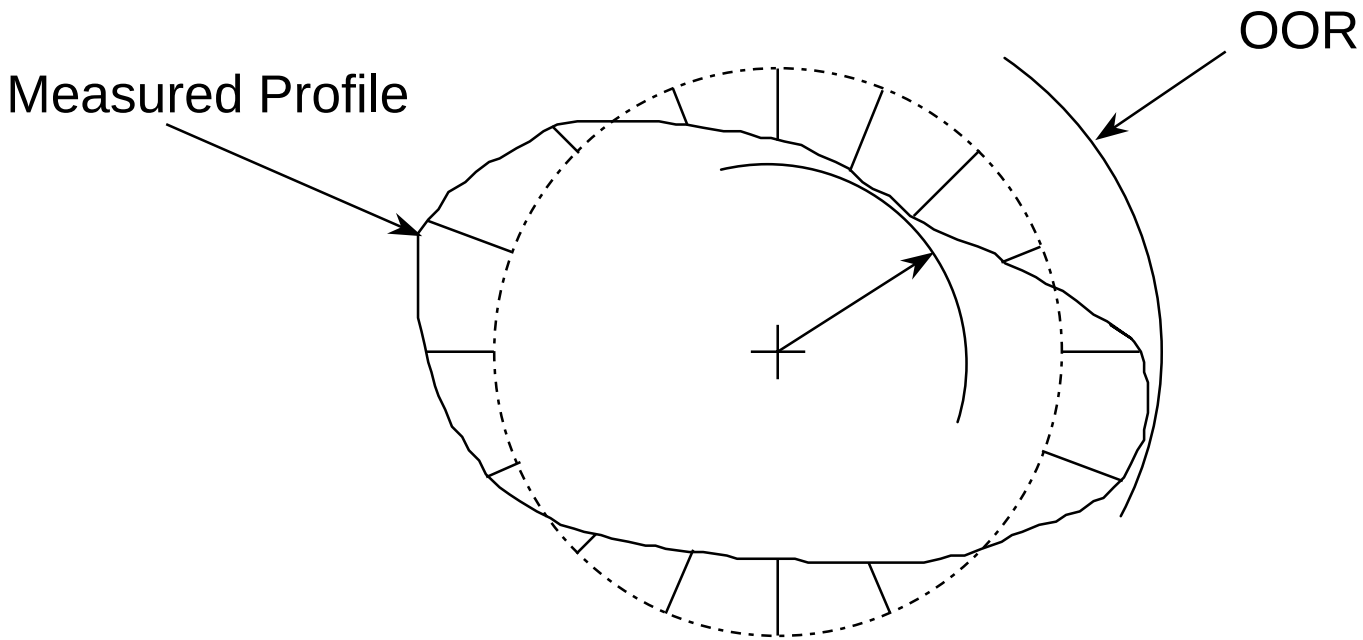
Deviation from Target Diameter

- Diameter measurement with line definition
- Small statistical variation



Out-of-Roundness

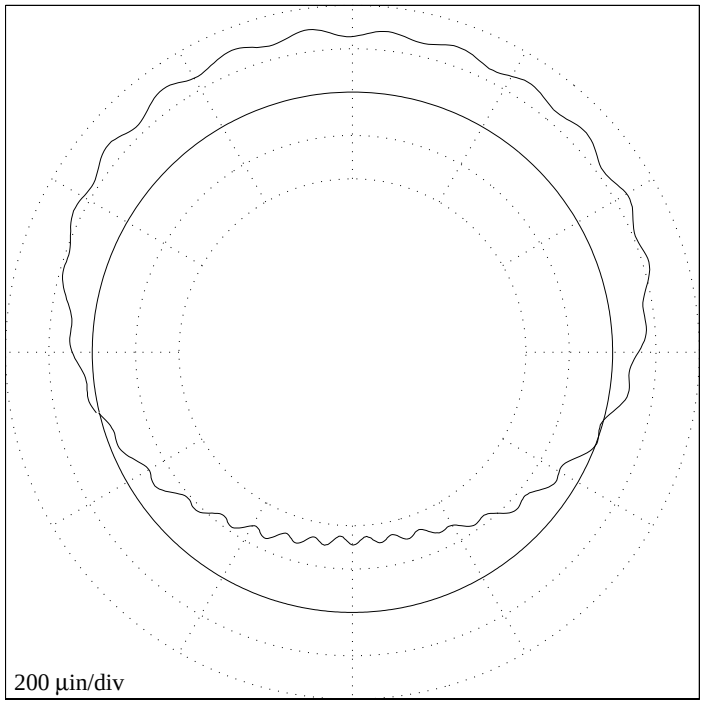
- Visualization of surface profile
- Least Squares Circle method



Out-of-Roundness Visualization

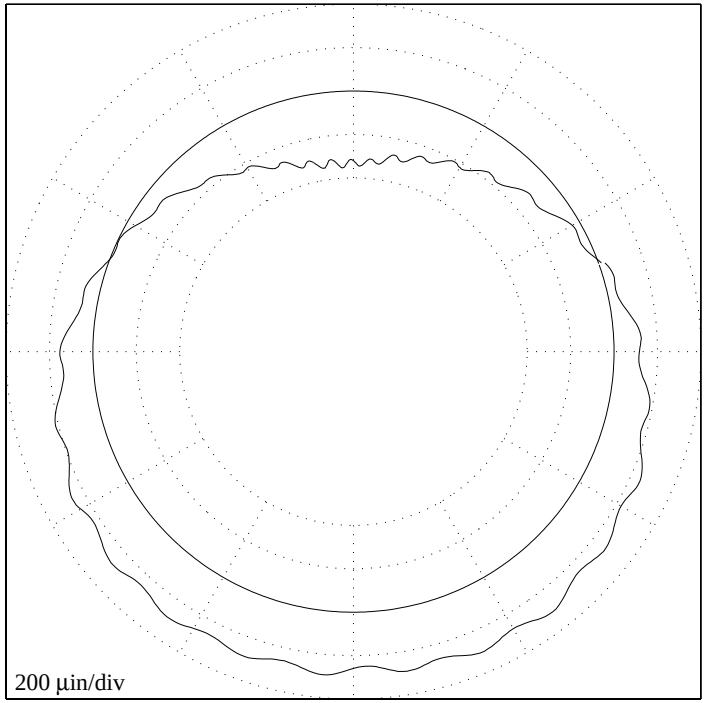
- Low and high frequency undulations
- Lower frequencies distort higher frequencies

Probe 1



No Filter

Probe 2

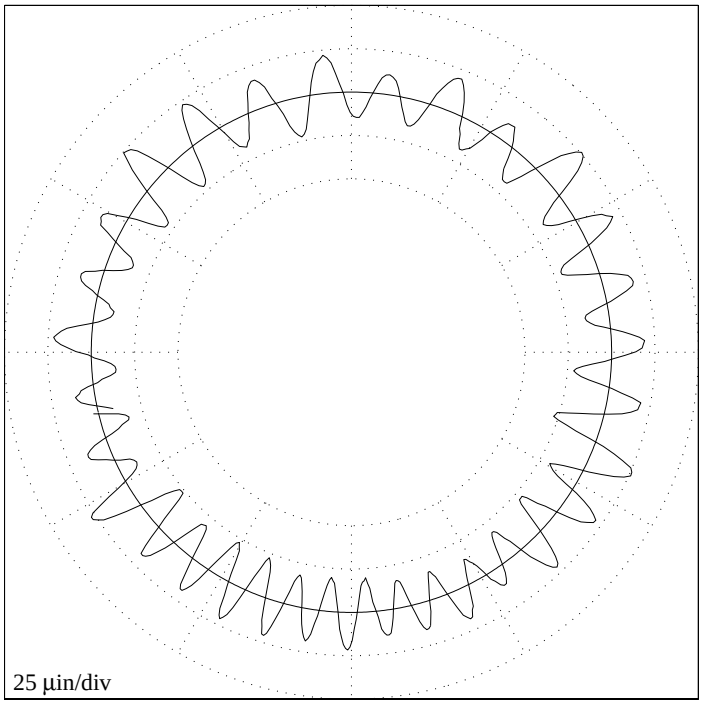


No Filter

Out-of-Roundness Visualization

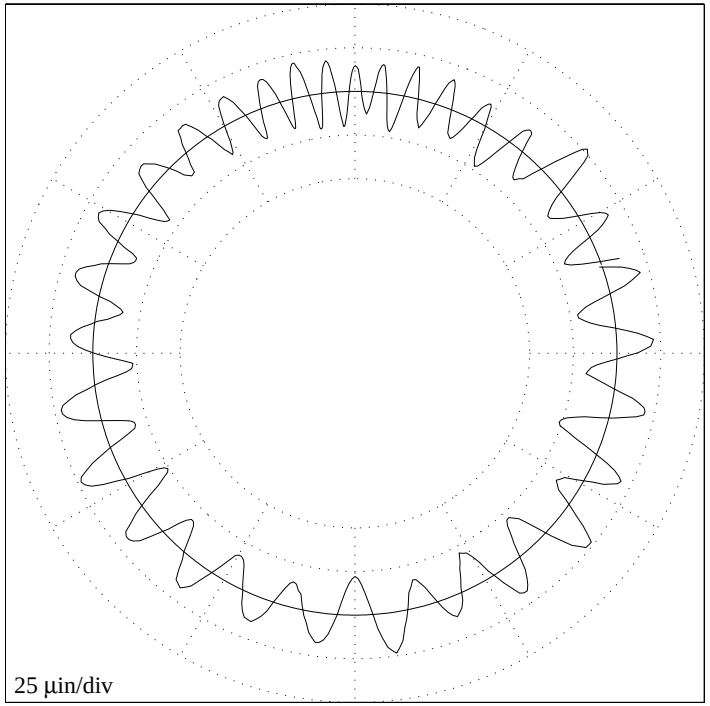
- Minimized distortion of high frequency information

Probe 1



10 UPR Filter

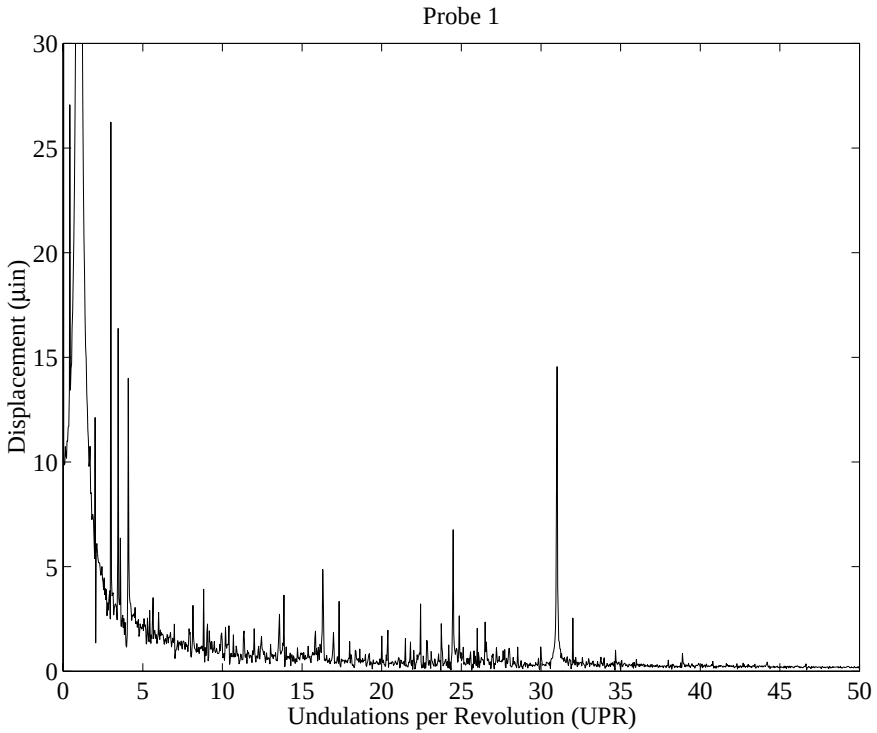
Probe 2

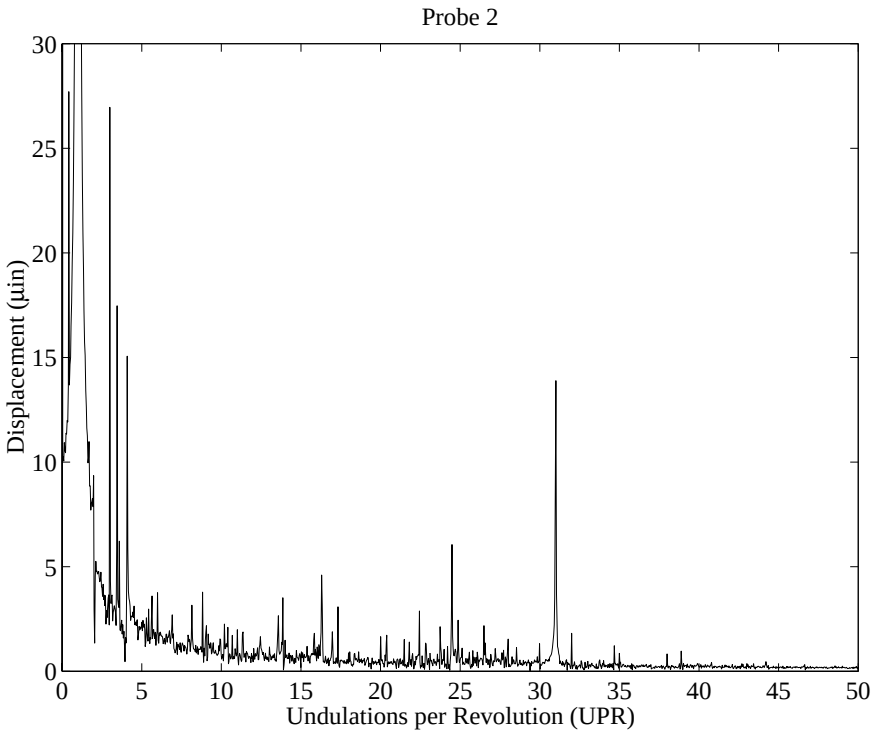


10 UPR Filter

Surface Profile Waviness Analysis

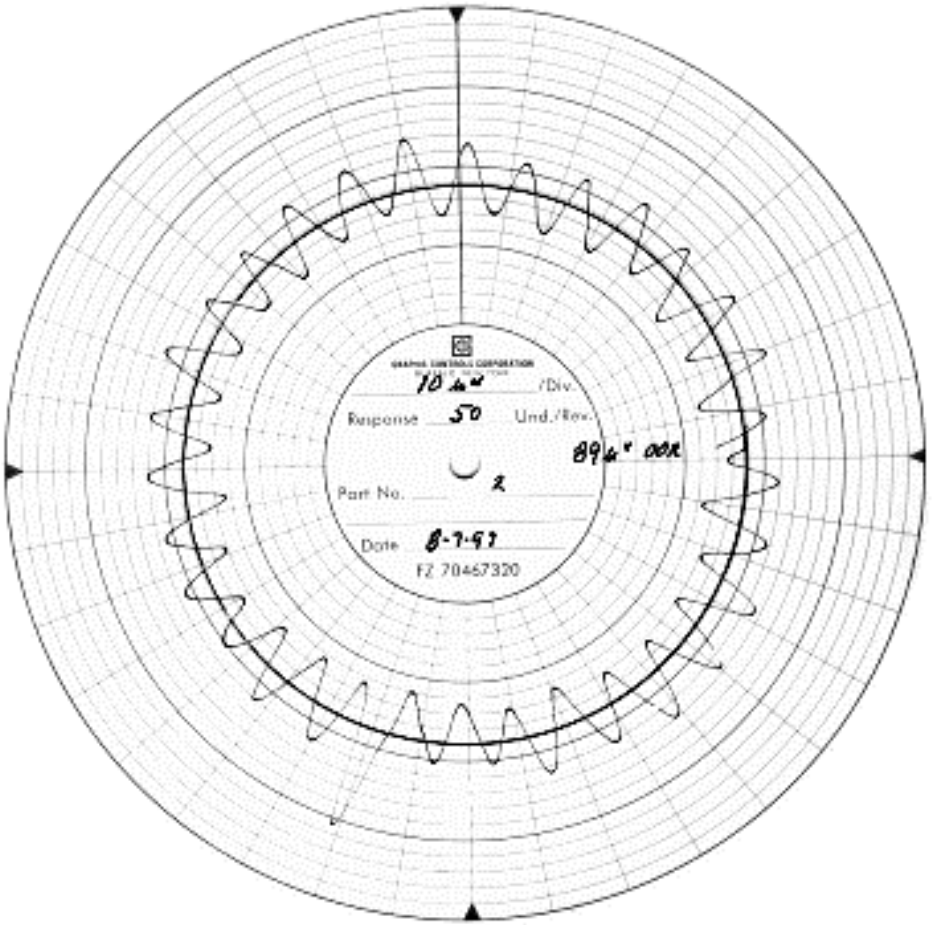
- Large low frequency spindle error
- Peak visible at 31 UPR





Surface Profile Verification

- Verification on Pneumo-Centric 5500



Future Work

- Minimize radial deviations of spindle
- Implement interface to machine controller
- Determine frequency response of gauge
- Develop portable experimental setup