MicroFinish Topographer (MFT)

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Product Demonstration

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OPTICAL PERSPECTIVES

Overview

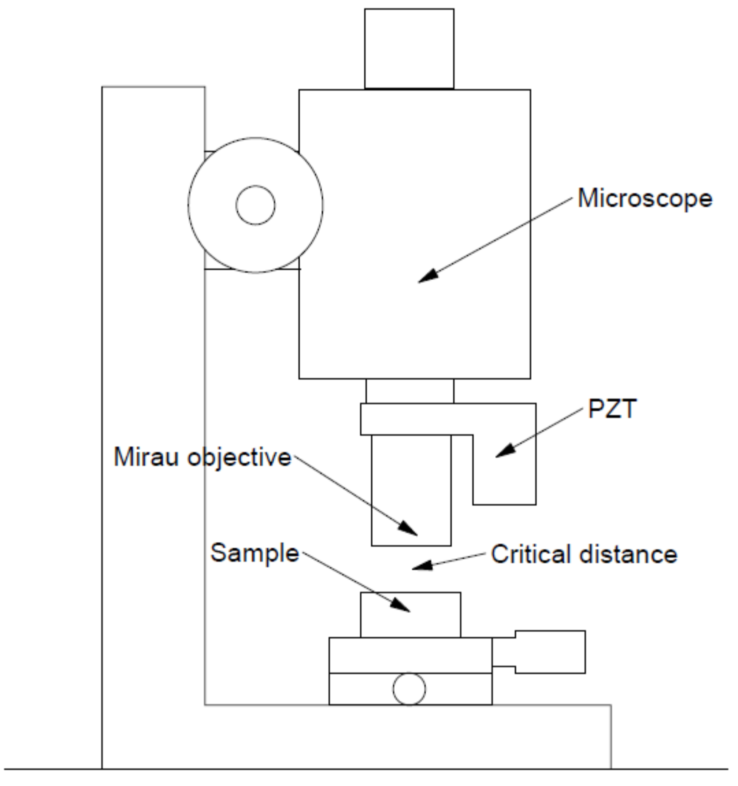
- Background/motivation
- Root of roughness measurement problem
- Solution to the problem; the MFT
- Advantages of the MFT
- MFT hardware solution
- Results/data
- Conclusion

OPTICAL PERSPECTIVES

Background/motivation

- Measuring surface roughness on large optics
- Currently done with replicas, but
  - Replicas require skill and time to make
  - Question of fidelity of replication
  - Residue is detrimental and difficult to remove
- Provoked thought about roughness measurement and instrument design for making measurements

Root of the problem



Design based on a classical microscope

Critical distance about 10 mm

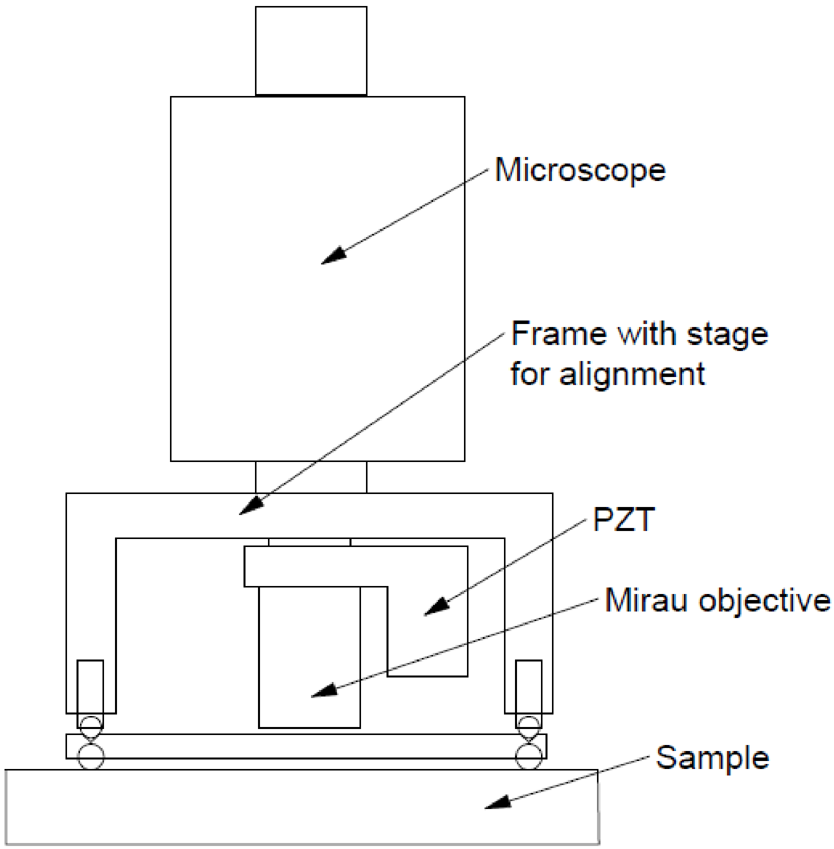
Need to maintain to nm level

“C” shaped mechanical path about 400 mm including 3 stages

Sample referenced off rear

OPTICAL PERSPECTIVES

Basic MFT design



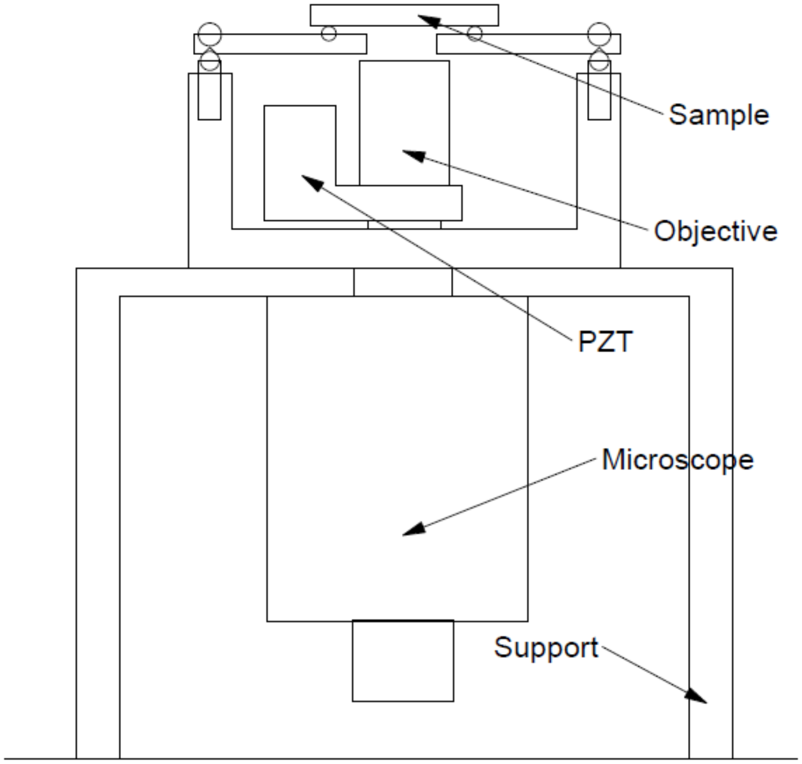
Short coupling between sample and objective

Stages built into frame

Microscope referenced to front of sample

Microscopes moves with front of sample

MFT for small samples



Keep short coupling for small samples by inverting

Microscope references front surface

Similar samples require no adjustment between them

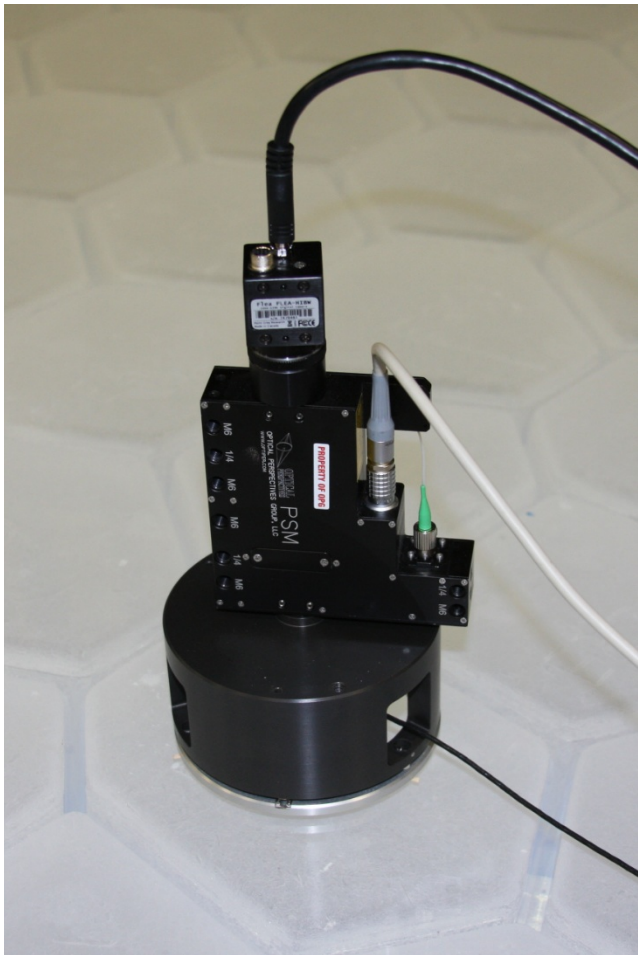
Sample moves with microscope

Advantages of the MFT

- Same instrument works for all sizes of samples
  - Quick change between configurations
- MFT is largely insensitive to vibration
- MFT is portable, can do on-machine metrology
- Front surface reference means minimum of adjustment
  - Allows for rapid sample change and measurement

OPTICAL PERSPECTIVES

Hardware – MicroFinish Topographer



MFT on a large mirror

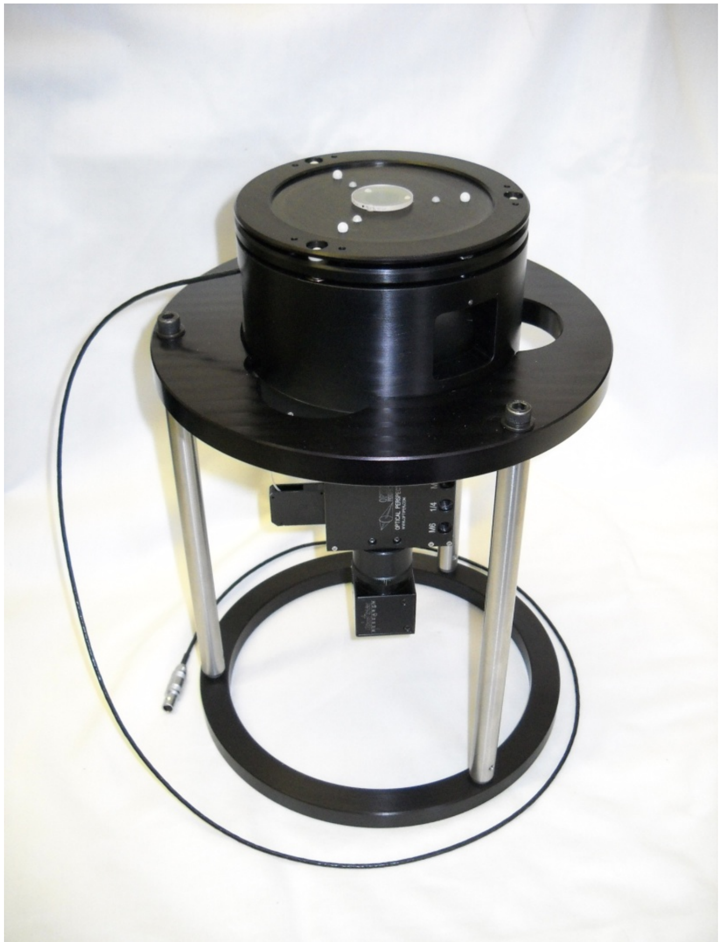
Uses the Point Source Microscope as the microscope

Uses 4D 4Sight software for phase stepping or ramping data reduction

3 nylon balls sit directly on mirror surface

OPTICAL PERSPECTIVES

MicroFinish Topographer - Inverted



25 mm sample for measurement

Three adjustments align for tip/tilt and focus

Front surface reference means rapid sample measurement

Little or no adjustment needed sample to sample

Pat. Pending on design

OPTICAL PERSPECTIVES

Results of measurement

Use 4D 4Sight software

Aver. of 10 measurements

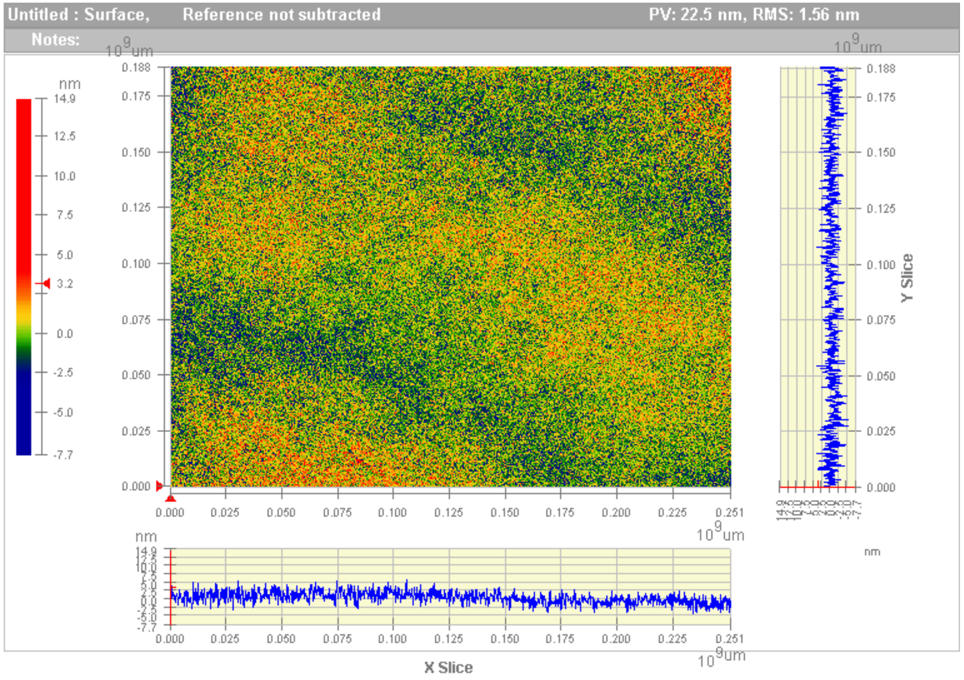
Pitch polished plano

Inverted configuration

No vibration isolation

No filtering

PV = 22.5 nm, rms = 1.56 nm



Good repeatability

10 single measurements

Same sample

Same conditions

Pv and rms in nm

Valid data every point

Right, Average – individual

St. Dev. PV = 3.5 nm

St. Dev. Rms = .067 nm

Meas.	Pv	rms	Valid pts	diff Pv	diff rms
1	63.20	4.78	all	56.70	4.51
2	51.40	4.70	all	49.80	4.44
3	63.10	4.66	all	51.00	4.38
4	58.50	4.58	all	53.20	4.31
5	57.40	4.64	all	58.10	4.36
6	51.50	4.68	all	51.50	4.39
7	50.70	4.68	all	47.60	4.32
8	50.00	4.63	all	50.40	4.35
9	61.70	4.63	all	51.60	4.34
10	55.30	4.52	all	56.90	4.28
Average	22.9	1.57	average	52.68	4.368
			St. dev.	3.469	0.067

PV & rms from sets of 10 meas. 22.41 and 1.59 nm

OPTICAL PERSPECTIVES

Good data consistency

Average of 10 single meas.

PV = 22.9, rms = 1.57

Expect noise reduction

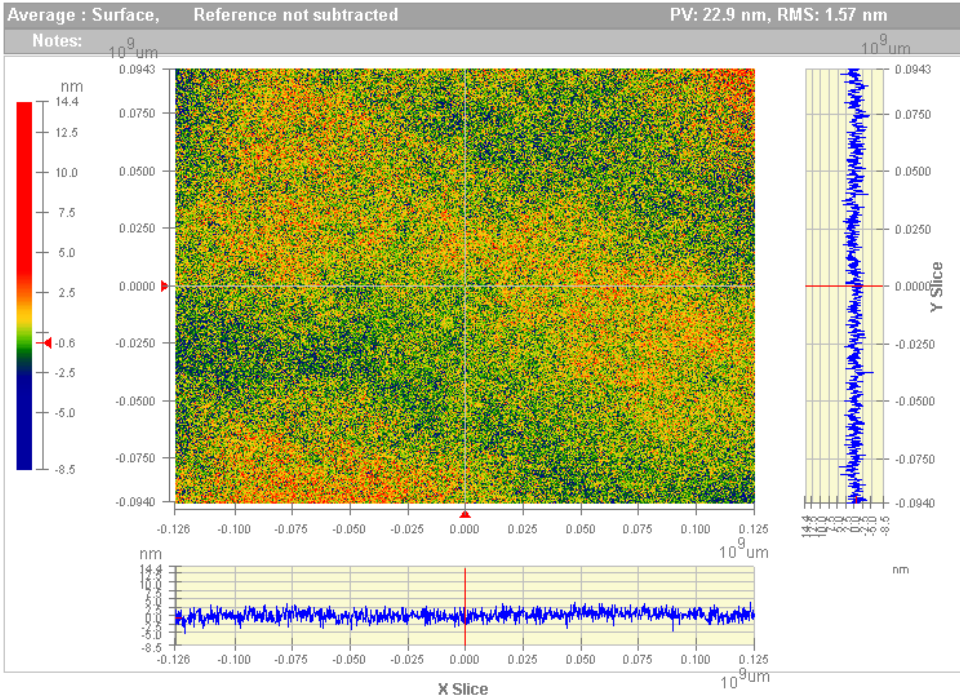
Sqrt(10 - 1) = 3

Aver. indiv PV = 56.28

56.28/3 = 18.8

Aver. Indiv. rms = 4.65

4.65/3 = 1.55



Height Calibration

Measure surface of known radius, for example, R = 291 mm

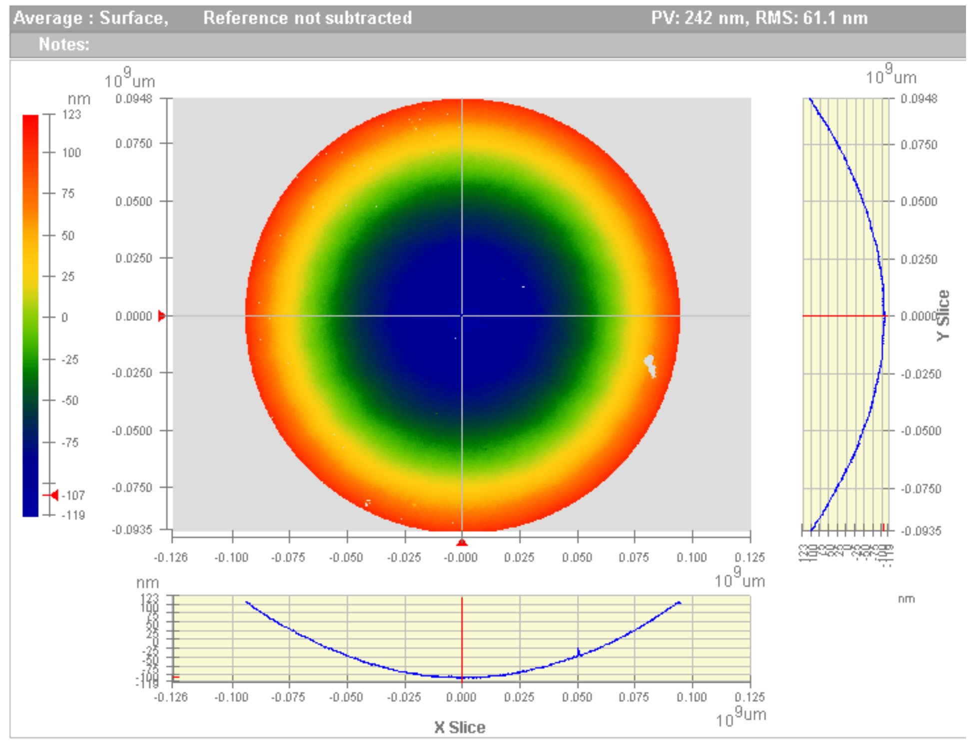
Calculate sag over width of sample viewed, y = 711 µm

Sag = y^2 / 8*R = 217 nm nm

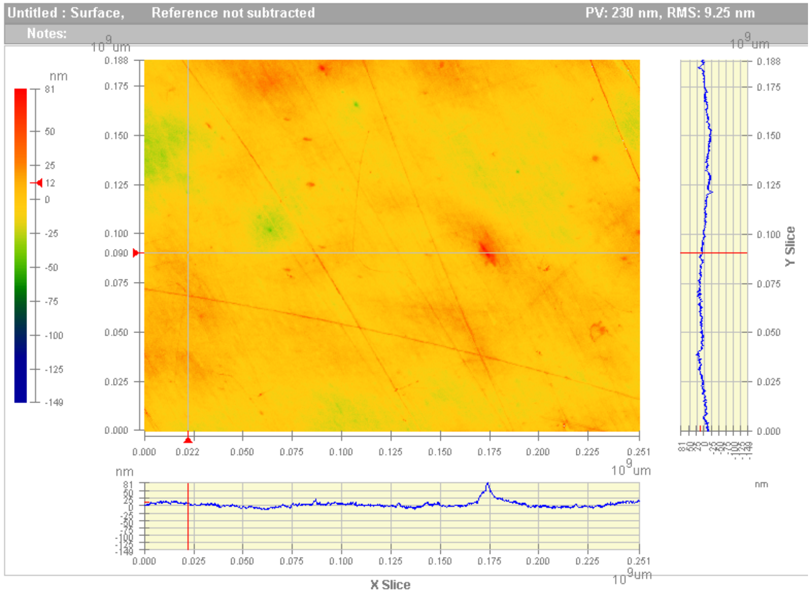
Average of 10 yields 212.5 nm

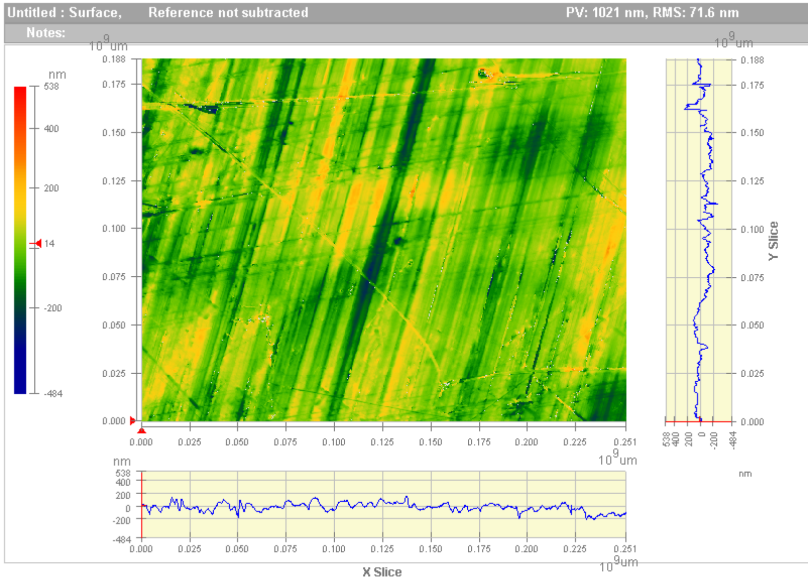
Std dev. of sag = 0.08 nm

Based on 99% of all points



Other surfaces measured





Molded plastic
230 nm P-V, 9.25 nm rms

Machined aluminum
1021 nm P-V, 71.6 nm rms

OPTICAL PERSPECTIVES

Wrap-up

- Designed a micro roughness tester for any size sample
- Repeatable without vibration isolation
- Uses well vetted software
- Rapidly tests multiple samples of same geometry
- Designed for easy portability including a laptop
- Can be adapted to cylindrical surfaces with new interface

OPTICAL PERSPECTIVES

Come see us

For further info stop by at Booth 205

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