Thickness Measurement and Surface Profiling Using Principles of Wavefront Sensing

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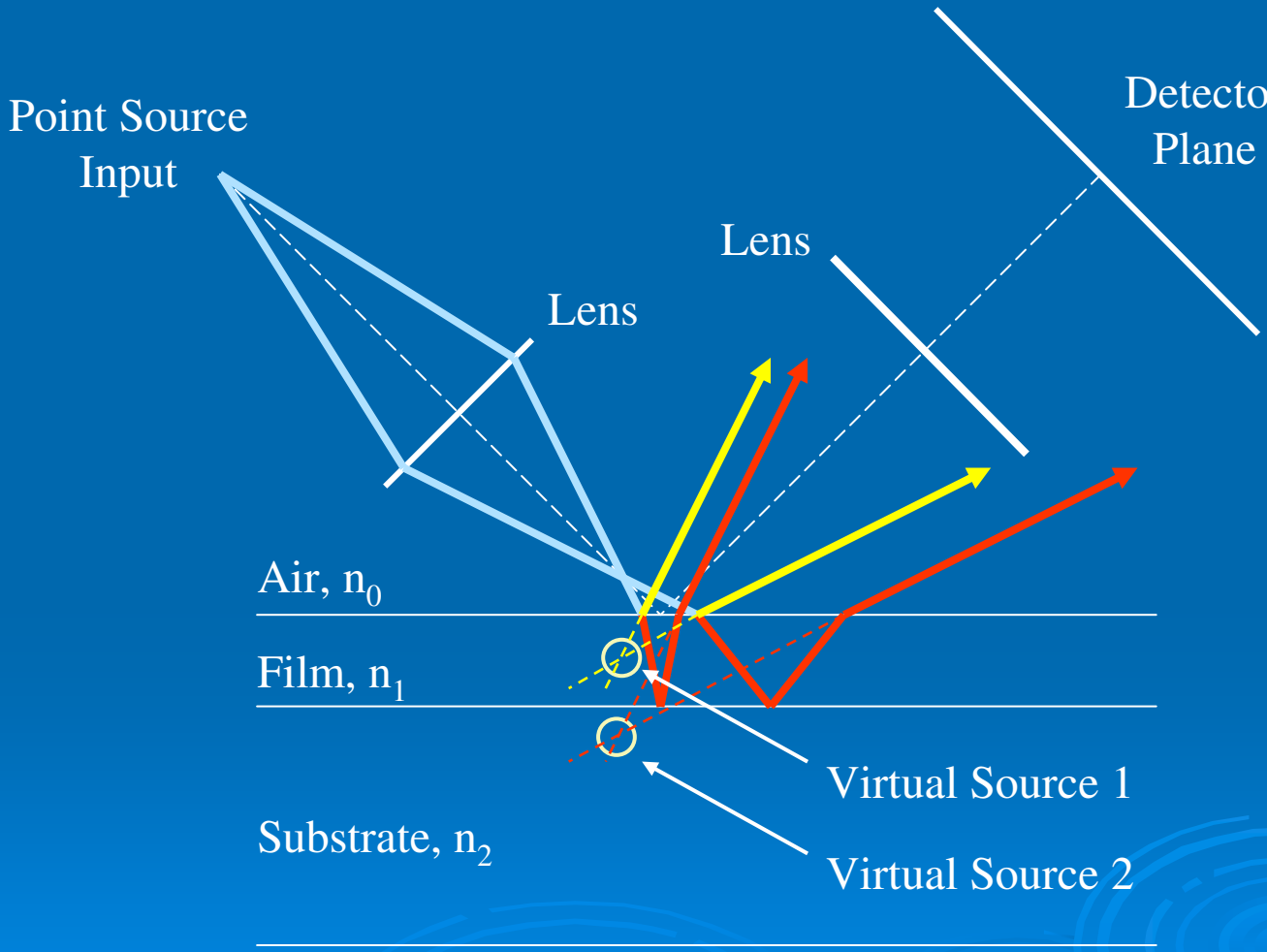
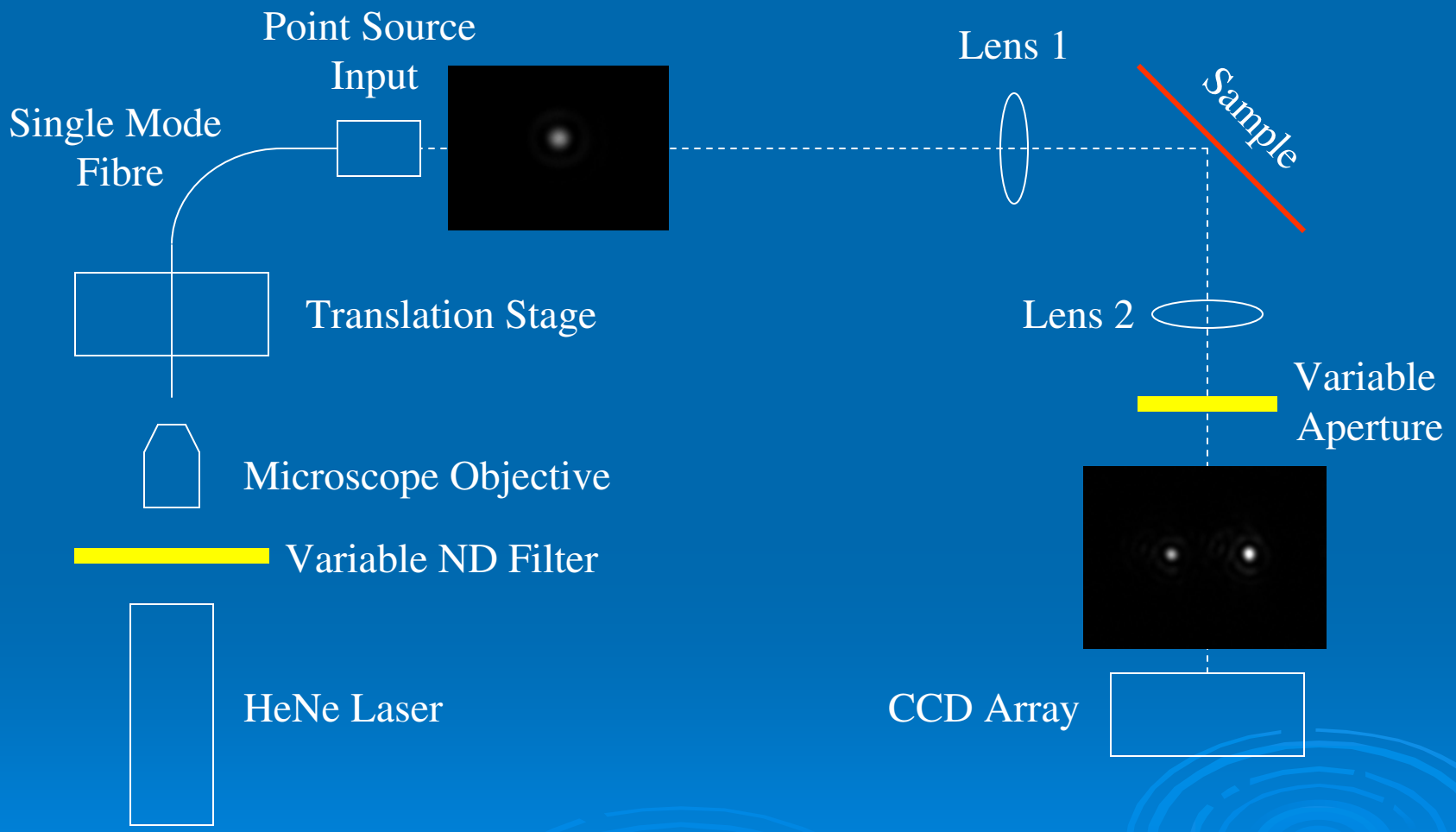
Overview Of Presentation.

- Analysis of measurement and experimental set-up.
- Surface profiling on multiple samples.
- Film Modelling to investigate level of aberrations introduced by thin film structure.
- Future Work and sensor design.
- Conclusions.

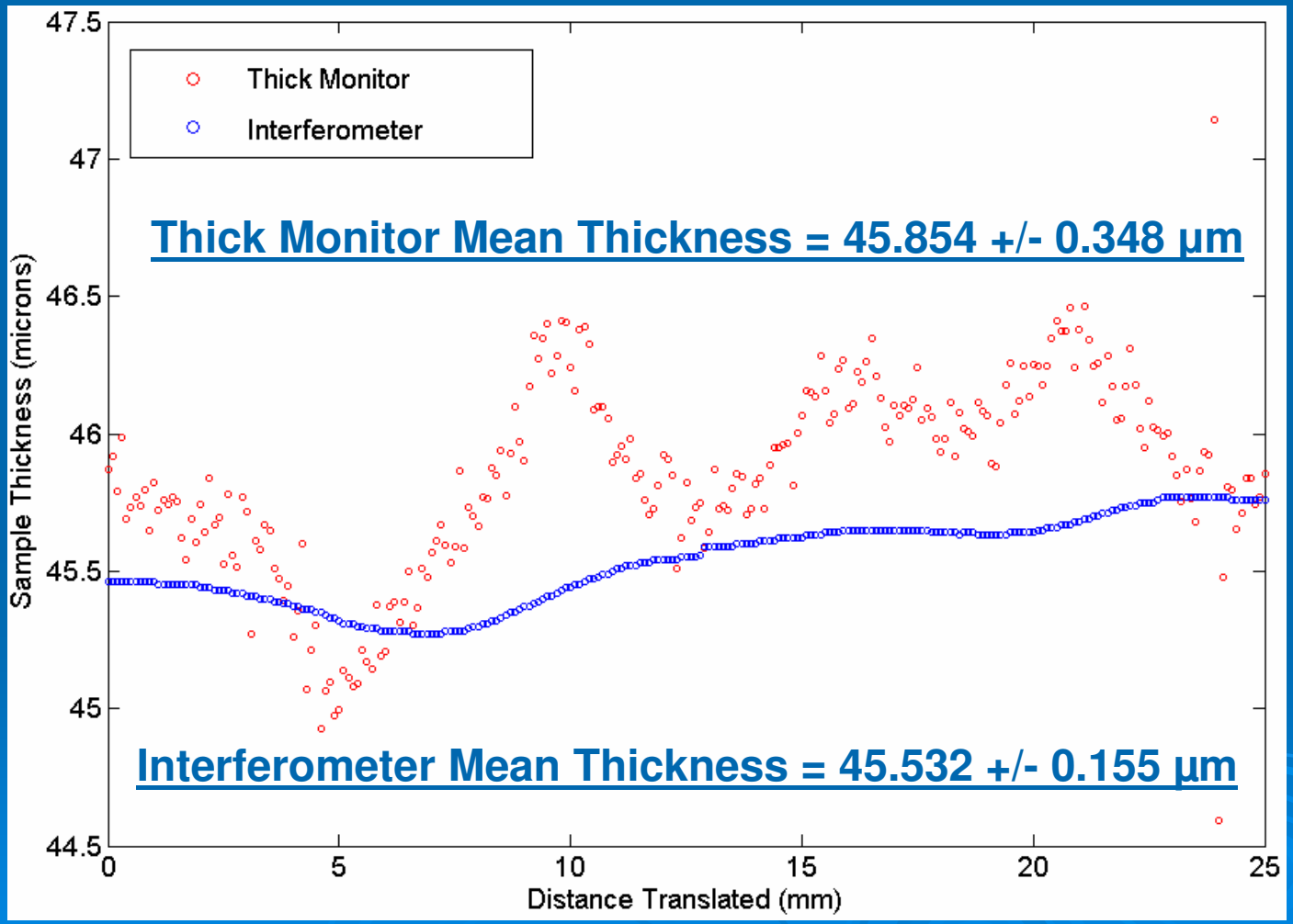
Analysis Of Measurement.



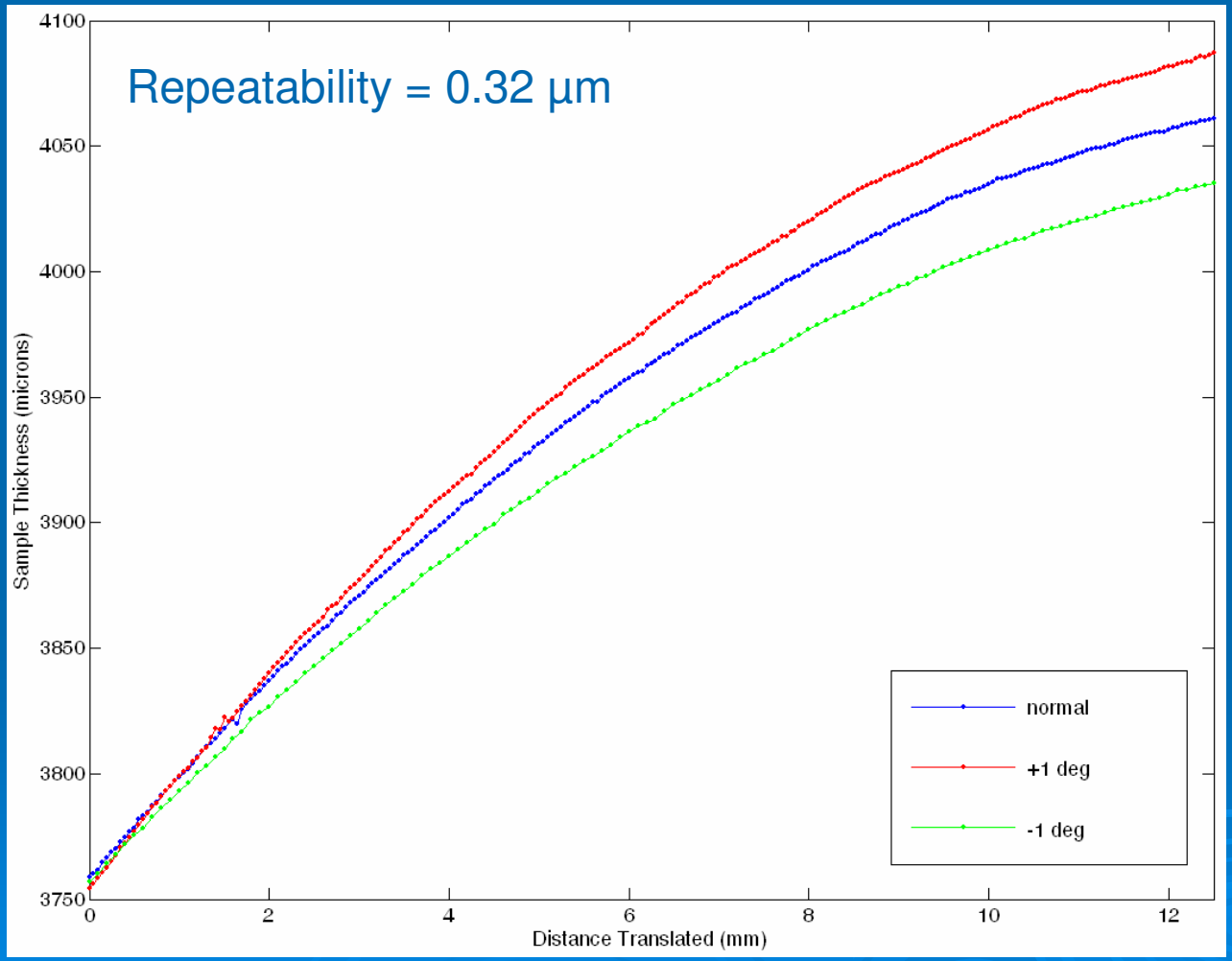
Experimental Set-up



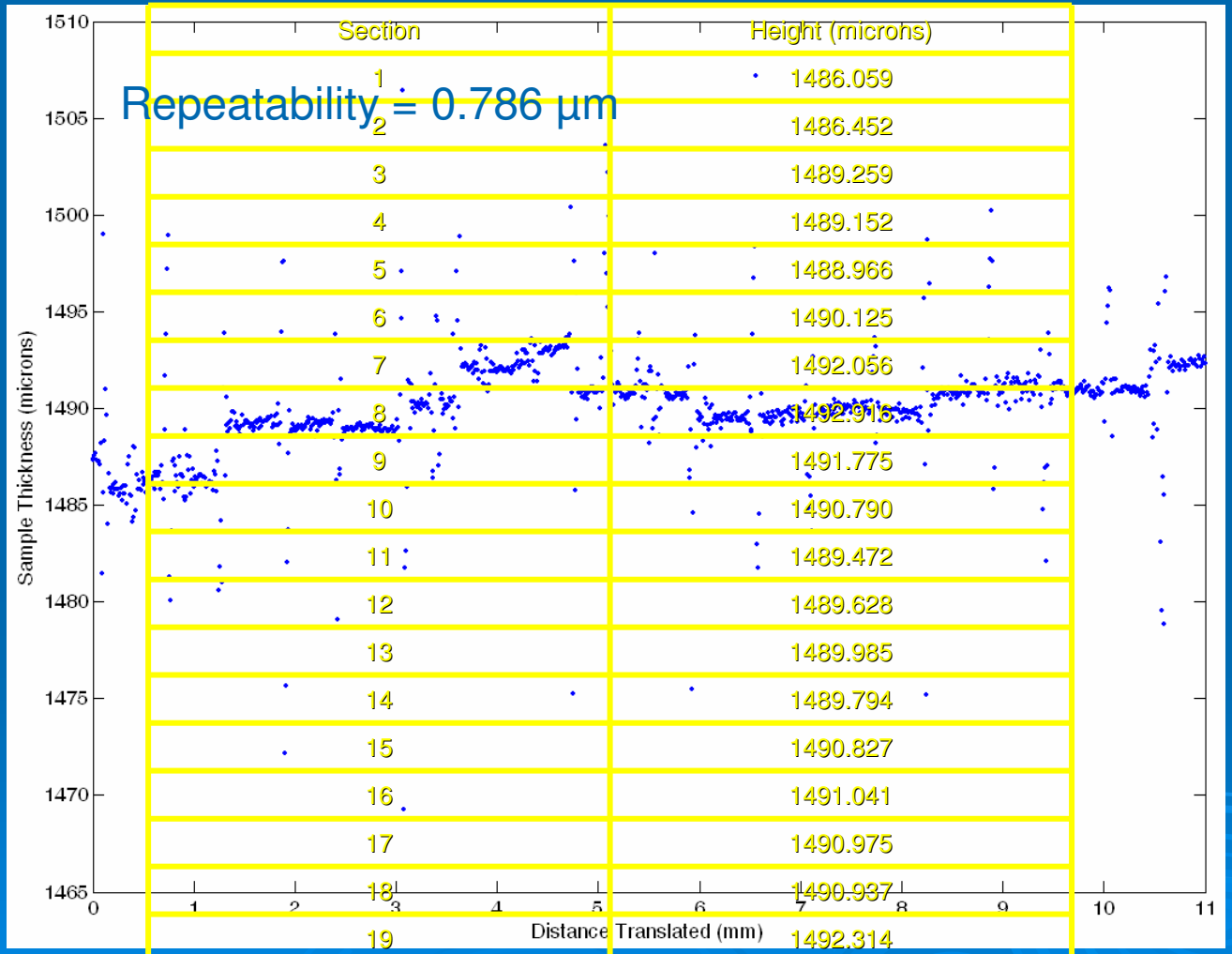
Surface Profiling – Wafer.



Surface Profiling – Cyl lens.



Surface Profiling – Filter.



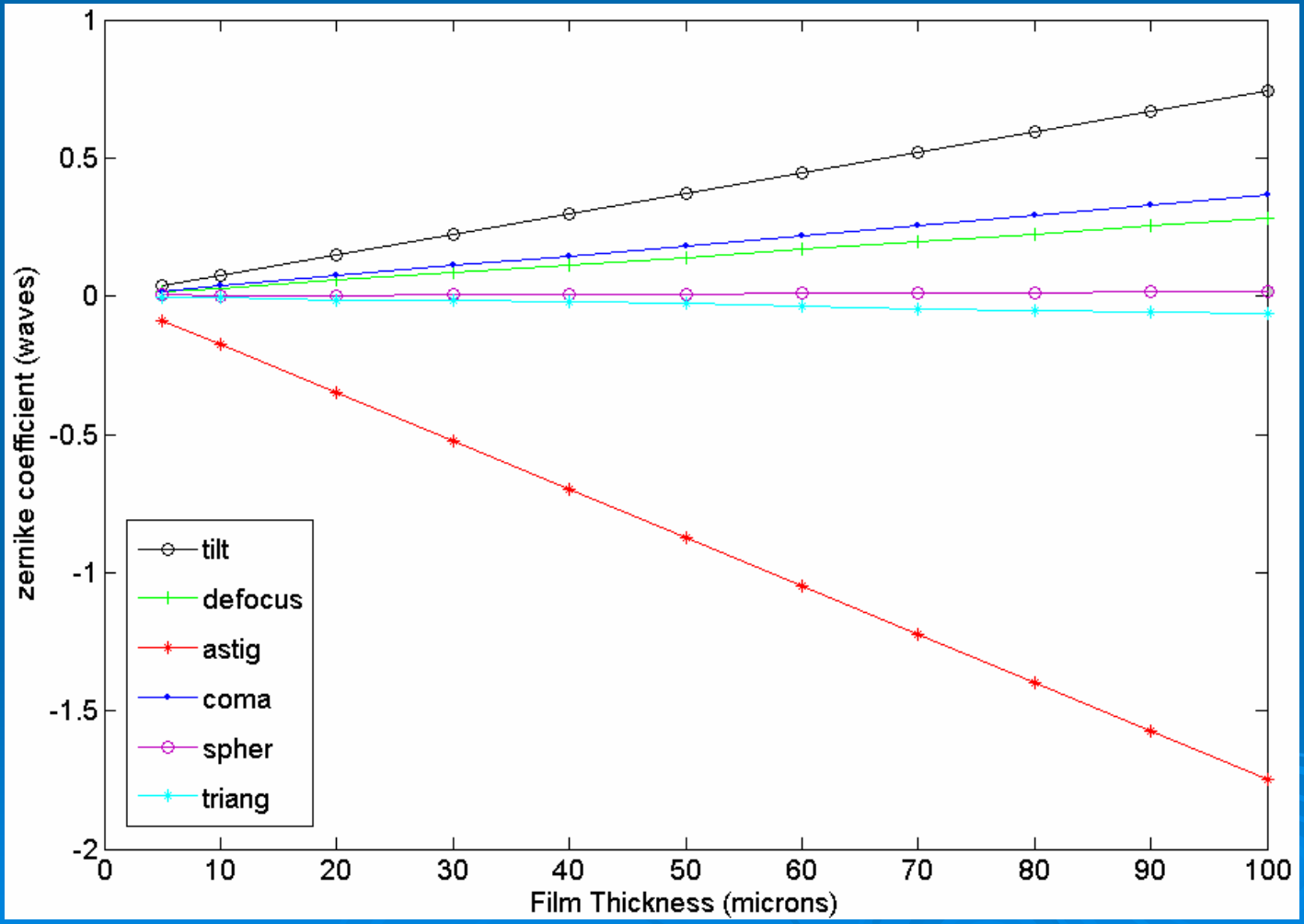
Repeatability = 0.786 µm

Section	Height (microns)
1	1486.059
2	1486.452
3	1489.259
4	1489.152
5	1488.966
6	1490.125
7	1492.056
8	1492.915
9	1491.775
10	1490.790
11	1489.472
12	1489.628
13	1489.985
14	1489.794
15	1490.827
16	1491.041
17	1490.975
18	1490.937
19	1492.314

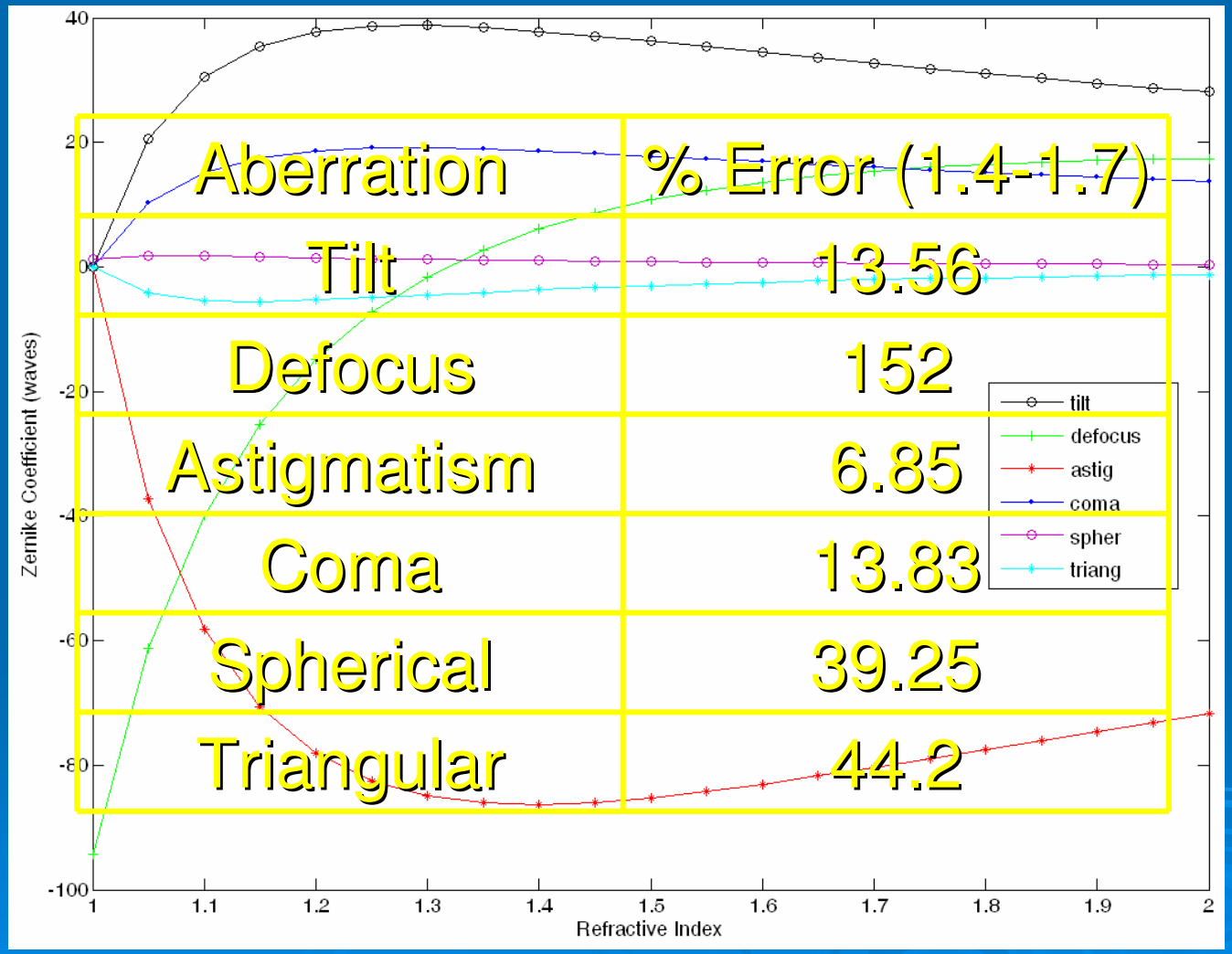
System Modelling

- System modelled using Optalix ray tracing software from Optenso.
- Model gives information on aberrations introduced by the film structure.
- Used to evaluate how aberrations change with thickness and refractive index.
- Use model information to optimise DOE design for Generalised Phase Diversity wavefront sensor.

Thickness Variation.

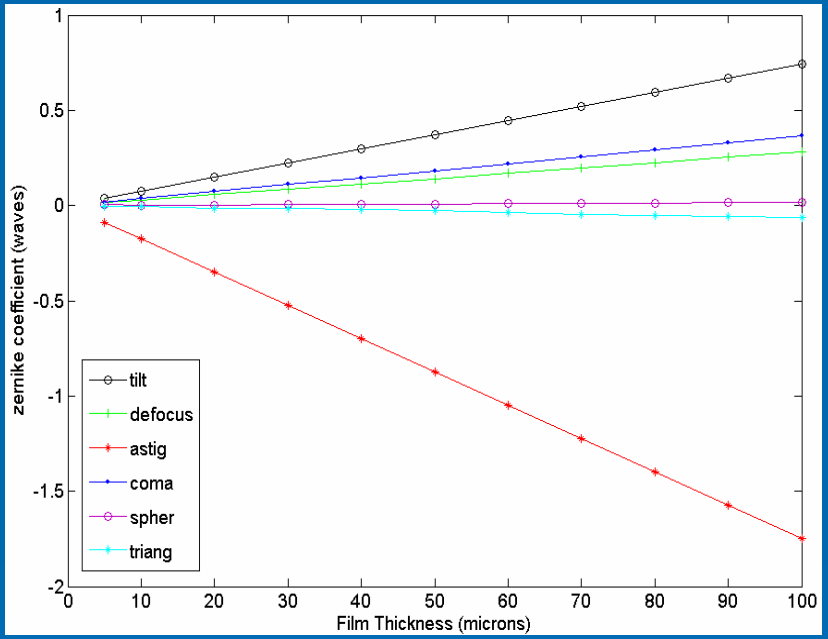


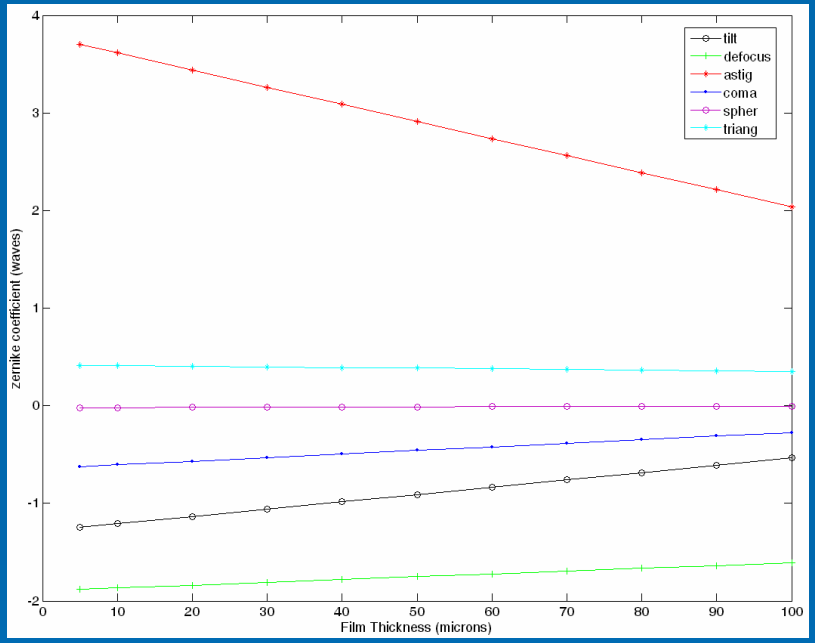
Refractive Index.



Aberration	% Error (1.4-1.7)
Tilt	13.56
Defocus	152
Astigmatism	6.85
Coma	13.83
Spherical	39.25
Triangular	44.2

Influence Of Surface Tilt.





- Tilt affects relative measures of aberrations introduced.
- Use of these results allow measure of thickness with surface profile.

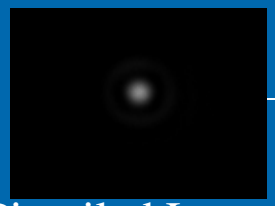
Example of Tilt.

Original Measurement.

Sample Rotated by 90.

Measure from opposite side.

Future Sensor Design.

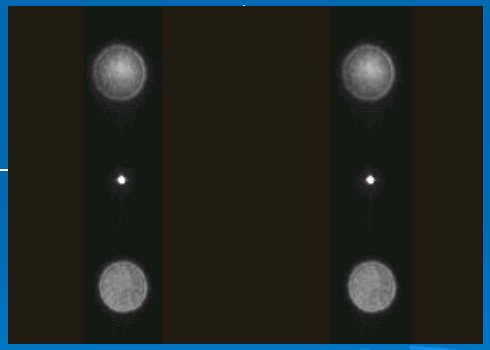


Pigtailed Laser Diode

Point Source Input

Sample

DOE



Control Signal Output

On Board Programmable Electronics

- Small compact sensor design
- Can be mounted on industrial scanner

Future Work.

- Comprehensive study using model to evaluate influence of surface deformations.
- Practical implementation of DOE for wavefront sensing.
- Check correlation between theoretical and experimental results for thickness measurements.
- Surface form measurements.
- Industrialisation of sensor for in-line measurements.

Conclusions.

- Simple thickness monitor can accurately measure from mm to microns in single instrument.
- Thickness monitor used to carry out surface profiling measurements on number of sample types with some success.
- Film structures affect reflected wavefront shape, info can be used to gain measure of thickness plus surface profile simultaneously.
- Thin film structure introduces tilt, defocus, astigmatism, coma, spherical and triangular aberrations.

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