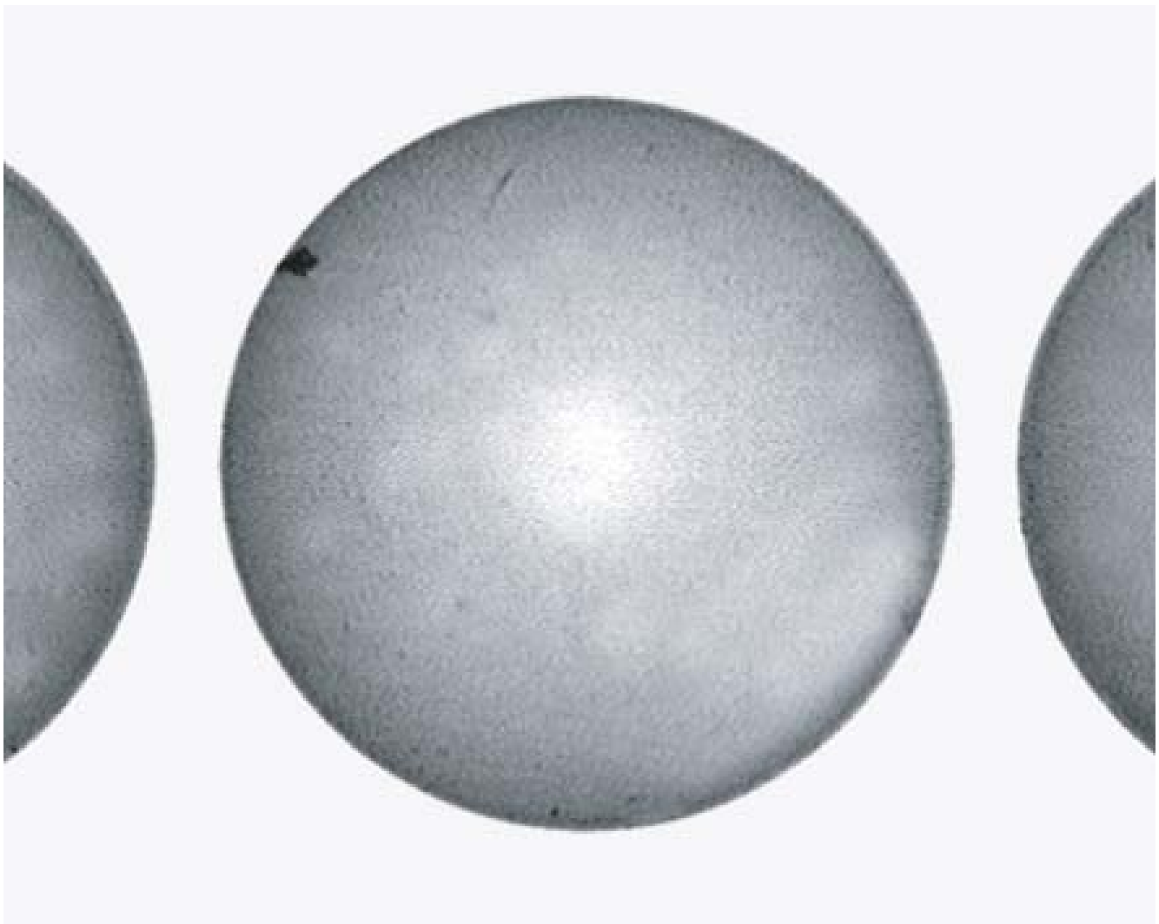
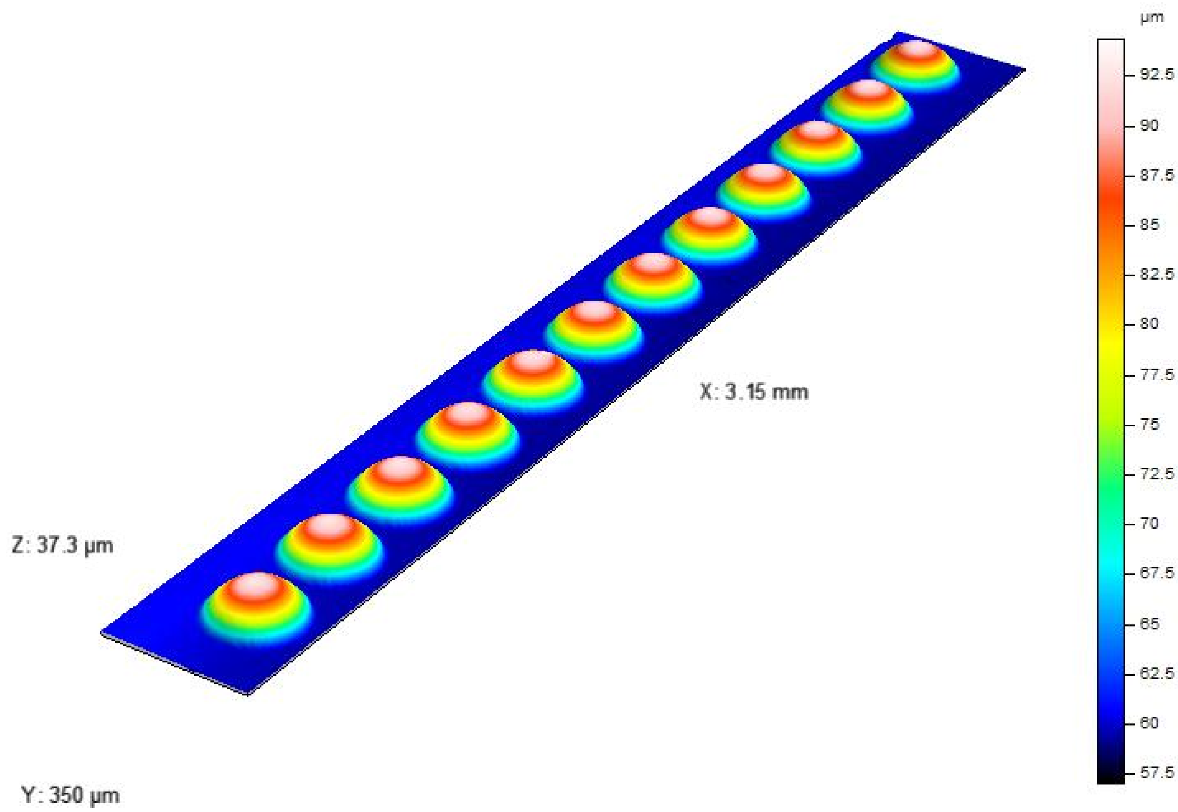
NANOVEA®
A Better Measure.

DIMENSIONAL MEASUREMENT OF MICRO LENS ARRAY WITH 3D PROFILOMETRY



Prepared by
Benjamin Mell

6 Morgan, Ste156, Irvine CA 92618 · P: 949.461.9292 · F: 949.461.9232 · nanovea.com

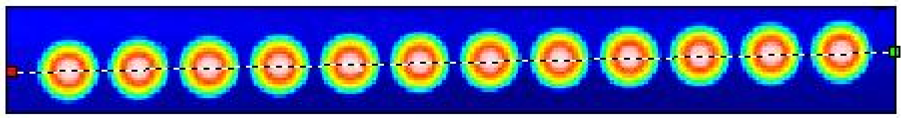


INTRO:

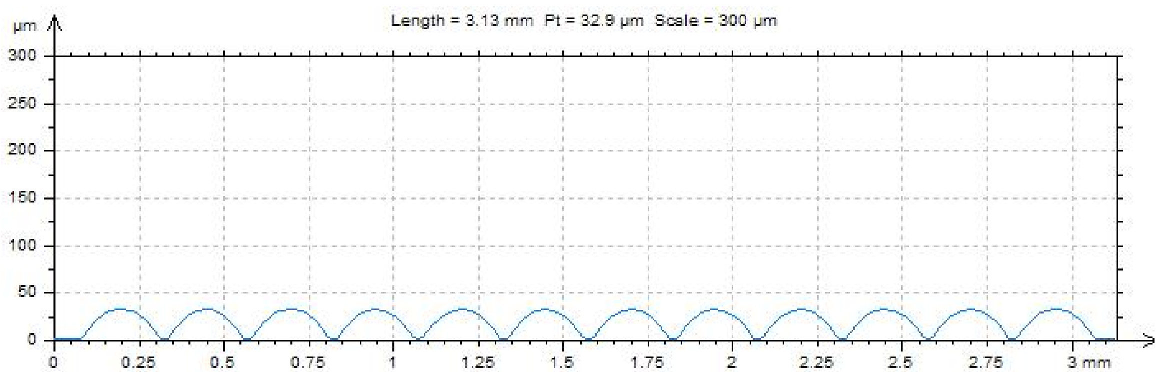
Micro lenses are small lenses that typically have diameters of less than one millimeter and can even have a diameter as small as 10 micrometers. A micro lens is characteristically composed of one plane surface and one spherical, convex surface that are used to refract light. In more complex designs, the micro lenses may have aspherical surfaces, while others may have multiple layers to accomplish their design goals.

Micro lens arrays are composed of several lenses that form either a one-dimensional or two-dimensional array on a supporting substrate. Micro lens arrays can couple to optical fibers and are used to collect and focus light.

In this application, the micro lens array is used for coupling to parallel transceivers for fiber optic transmission systems. In this case, the array couples lasers to fiber optics.

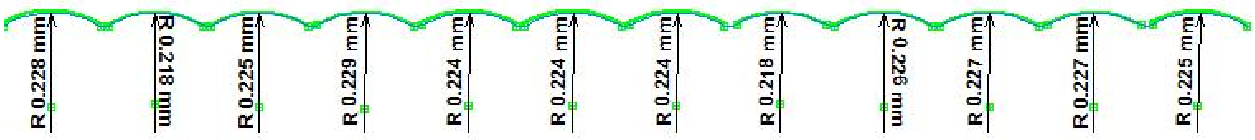


Extracted orofile

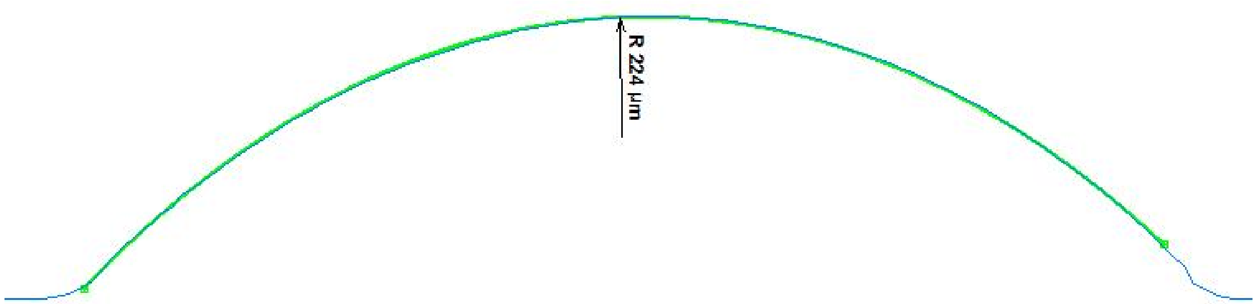


Height, shape, pitch and diameter are all important features to measure for the micro lens array. These values will be compared to the conceptual drawing to find out if the manufactured part meets the accepted tolerances for the application. In doing so, this quality control check will assist in preventing poor coupling and misalignment between the laser and fiber optic cable. The degree in which an aspheric lens deviates from a sphere can also be measured, or quantified, with this type of measurement.

RADIUS

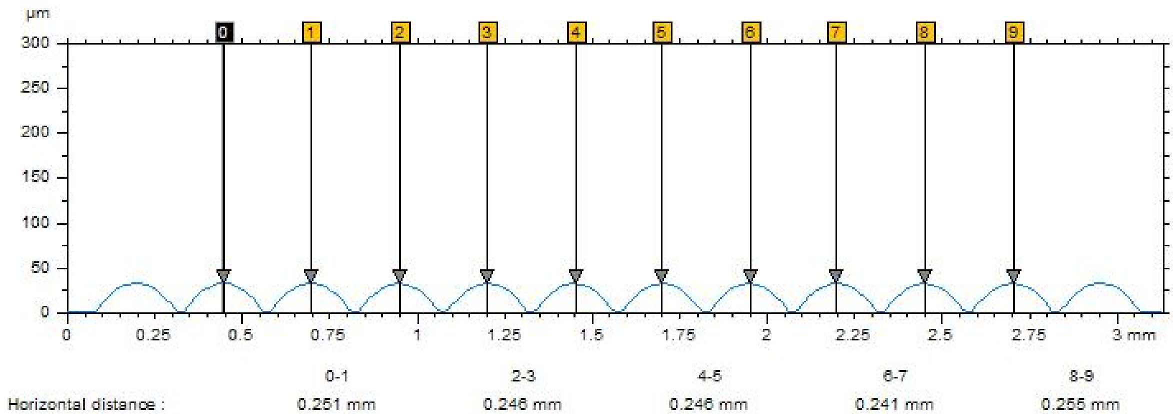


Average = 0.22458mm **Standard Deviation = 0.00348mm**

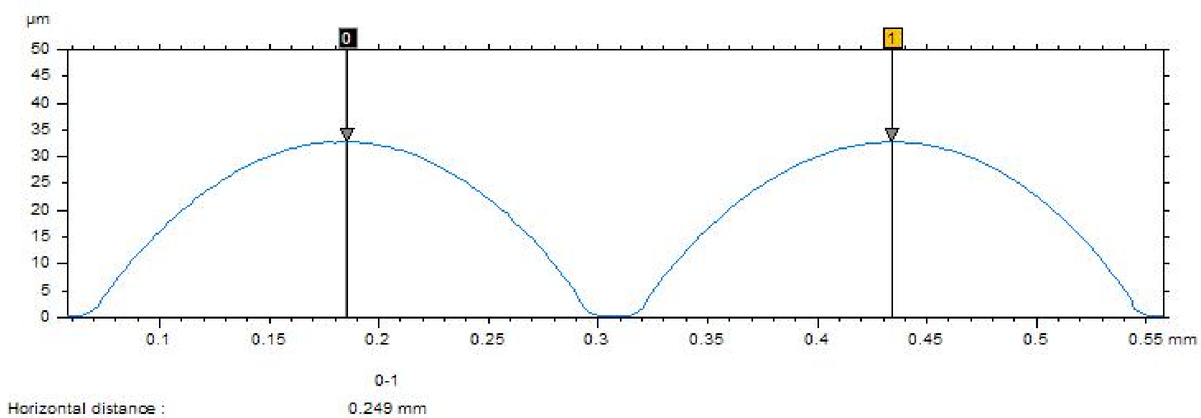


Nanovea profilometry instruments were used to measure this sample because of their ability to accurately capture data points on a small convex surface without dropping or interpolating data points along the way. Nanovea profilometry instruments were also used because of their ability to capture the complete micro lens array in a single measurement, without the need to stitch images. The technique used by Nanovea optical sensors for non-contact profiling systems allows for these intricate measurements. The optical sensors combine principles of chromatic aberration and axial chromatism.

PITCH



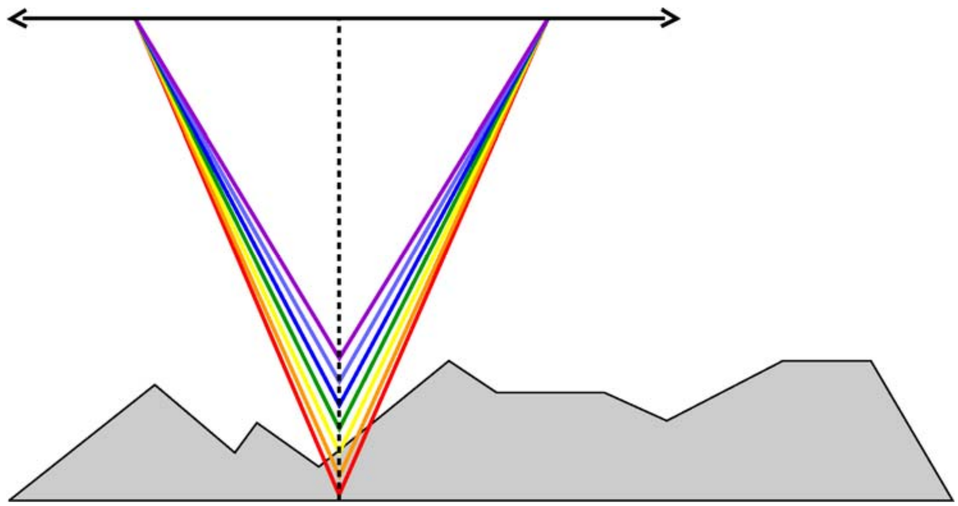
Average = 0.2478mm **Standard Deviation = 0.00536**



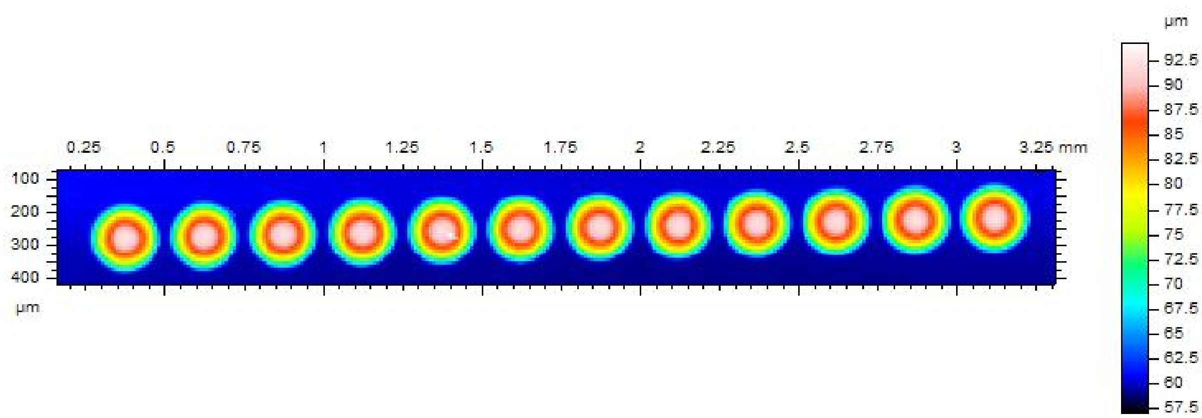
MEASUREMENT PRINCIPLE:

The axial chromatism technique uses a white light source, where light passes through an objective lens with a high degree of chromatic aberration. The refractive index of the objective lens will vary in relation to the wavelength of the light. In effect, each separate wavelength of the incident white light will re-focus at a different distance from the lens (different height). When the measured sample is within the range of possible heights, a single monochromatic point will be focalized to form the image. Due to the confocal configuration

of the system, only the focused wavelength will pass through the spatial filter with high efficiency, thus causing all other wavelengths to be out of focus.

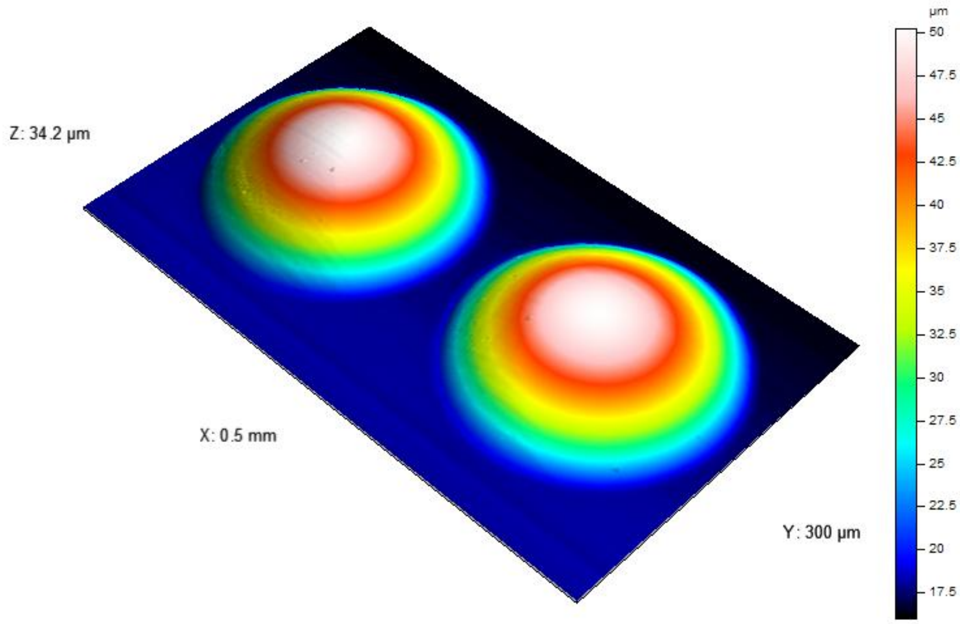


The spectral analysis is done using a diffraction grating. This technique deviates each wavelength at a different position, intercepting a line of CCD, which in turn indicates the position of the maximum intensity and allows direct correspondence to the Z height position.



MEASUREMENTS TIPS:

The use of a low measurement frequency (speed) is required in order to not drop data points. The frequency of 30 Hz was used in this measurement; however, 100 Hz may also be an acceptable measurement rate. The 300 Hz and 1000 Hz frequencies will not be able to be used for this type of complex measurement.



CONCLUSION:

The Optical Pen used for this measurement was the 130 µm Pen. This pen/sensor can measure up to 130 µm of vertical height change (depth of field). An area of 3.5mm x 0.5 mm was measured with 10 µm step sizes (lateral resolution). The time to complete the measurement was approximately 12 minutes. Increasing the step sizes would decrease this measurement duration. This area was then zoomed (cropped) to an area of 3.15 mm x 0.35 mm.

In conclusion, either the Nanovea ST400 or PS50 can be used to quickly and accurately measure micro lens arrays without dropping data points and interpolating them. Also, due to the measurement technique of the ST400 and PS50, no stitching of images is required to measure a large area of micro lenses.