

First Pass at Outline Asphere Metrology standard  
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- Definition of aspheric surface
  - Need to tie to current standard definitions, which are messy
  - Can more free-form measurements be included?
- 1) Instruments to measure asphere surfaces, can be areal (2.5D) or profile (line traces)
  - a) Deformation Relative to nominal shape such as
    - i) With spherical (or plano) interferometer (mild asphere), relative to a sphere
    - ii) With stitching interferometer, where nominal shape is inputted into software, and measurement result is given as difference from nominal
    - iii) A CGH, where the measurement is done relative to the prescribed shape coded into the CGH
    - iv) These relative measurements may be
      - (1) Normal to nominal shape (as with an interferometer)
      - (2) In the z-direction (like a sag, but still relative to the nominal shape)
  - b) Absolute shape measured such as
    - i) CMM, etc.
    - ii) Profilometer
    - iii) Generally, these measurements are in sag, relative to some z-plane
  - c) Surface slope using deflectometry
    - i) Not sure if measurement is absolute or relative to the nominal shape (relative I think)
    - ii) Slope is generally converted to a height deformation

Measurement Results:

- 1) Irregularity
  - a) For spherical surfaces, irregularity is the difference between the measured shape and the best fit spherical shape, normal to the best fit sphere. For aspheres, this isn't going to be enough, but it should be an option.
  - b) At a basic level, the irregularity of an asphere could be the Form Error which includes all deviations from prescribed shape (i.e. any radius error would be included here), probably normal to the nominal shape. But, this may not be enough in manufacturing or determining if it will work in an optical system.
  - c) There needs to be some sort of mechanism for getting rid of low order form error (equivalent to removing the best fit radius of a spherical surface):
    - i) Possibility fitting the form error to a best fit shape.
      - (1) How to define the best fit
      - (2) what terms can vary, radius, conic, coefficients, etc.
      - (3) What method for a best fit? Least squares, etc.

- (4) Does this lead to permitting tolerances on these terms? (not really available in most software packages).
  - ii) Or subtracting out some prescribed shape, as desired: such as a radius error only, or a Zernike term?
- 2) Mid-Spatial frequencies are an issue for asphere manufacturing (sub-aperture polishing is typically used), We need to talk about how to measure:
- i) Slope
  - ii) PSD
  - iii) Zernike Residual
  - iv) Need to know what irregularity these terms are analyzed on (nominal shape removed? Best fit? Absolute surface)

Various Notes:

1. surface error is generally regarded as the difference between the nominal shape and the measured shape, but aspheric surfaces are generally described in terms of sag, an absolute shape. Need to have a standard make sense of that dichotomy.
2. Is it important to know the radius of an asphere? What is the radius of an asphere? Best fit (over what radius?), vertex? How is it measured?
3. Centration Errors also need to be considered, as it is a little bit different for aspheres than spherical surfaces
4. Believe that other measurements and specifications are the same as with spherical surfaces (scratch/dig).