

How to Focus an Interferometer

Tools Needed

- ▶ Interferometer
- ▶ Part under test

Introduction

Focus is often seen as a secondary procedure in the setup of an interferometer test. With today's diffraction limited imaging systems focus is now critically important to gaining maximum image resolution and even obtaining the correct form measurement. The described focusing procedure applies to all measurements, figure 1 shows a typical setup, in this case the measurement of a flat.

In Brief

Properly focusing an interferometer is important to achieve accurate results. This is even more true today with high-resolution systems.

This application note guides you through a deterministic method to assure you have the best focus possible.

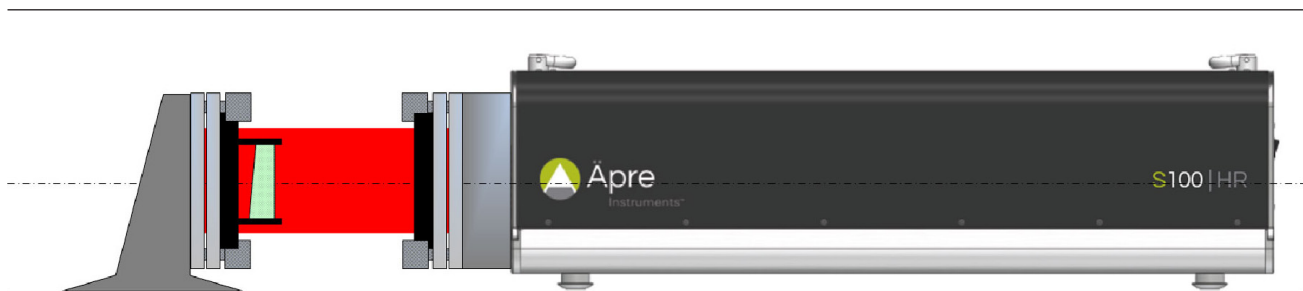


Figure 1: Typical Setup, here measuring a flat

Test Part Focus

An out-of-focus interferometer will exhibit edge diffraction that measures as a error on the part edge shape or form, see figures 2a and 2b. The more out of focus the larger the edge zone peak-to-valley error will be produced and the deeper into the part the error will appear. Another way to say this is the higher and wider the error zone will be.

Rough Focus

The higher the interferometer image resolution the more important is image focus and the more sensitive the focus. Low resolution interferometers, such as continuous zoom systems, can have a "soft focus", yet the diffraction effects at the edges still degrade the measurement. Historically interferometers are focused visually, this is not recommended for high resolution modern interferometers, visual focus is considered rough focus.

1. Observe the live fringe monitor
2. Zoom in on the part edge with the highest image zoom possible
 - a. REVEAL: Place the mouse cursor in the live image on the region to be zoomed on, roll the mouse wheel forward to zoom in, and back to zoom out.
3. Adjust the focus control in and out to find the direction of improving focus
4. Focus until no improvement is found, continue until the image starts to defocus.
5. Return to the position half way between these two positions where focus seems to degrade.
6. Rough focus is complete

Fine Focus

1. Take a measurement and observe the results at the edge.
2. An out-of-focus image will measure a turned up and then down edge as shown in figure 2b.
3. Jog the focus by the smallest quantity
 - a. REVEAL: The focus has a + and - 0.1mm focus jog button (the number refers to the focus stage motion amount)
4. Measure again. If the measurement result is worse click the jog in the opposite direction
5. Continue in the improving direction until the measured result degrades and click back to the best result
6. Focus is at the best possible position, see figures 3a and 3b.

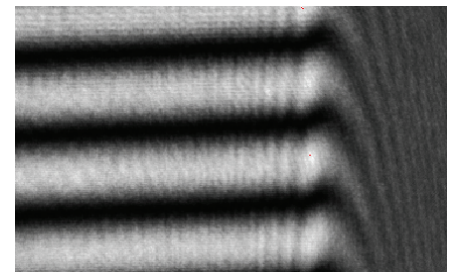


Figure 2a: Out-of-Focus Fringes

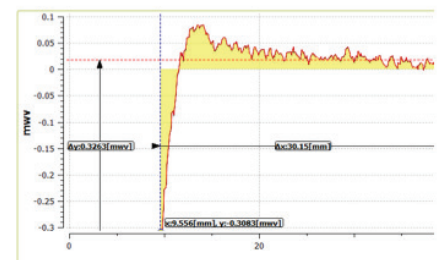
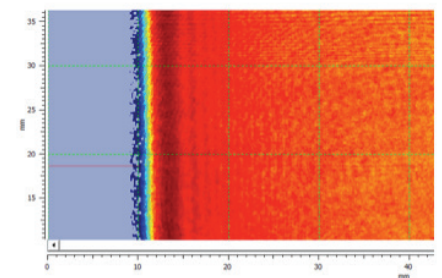


Figure 2b: Measurement of Out-of-Focus Fringes

Remove Residual Edge Errors with Erosion Filter

One error correction method is to erode the edge pixels to remove residual edge errors due to imperfect focus (found in REVEAL, open the universal tool bar > open the side bar to the far left of the opened window > filters > erosion or “trim” in other software packages). The physical size of the out of focus diffraction zone is the same for any out-of-focus interferometer no-matter the camera resolution. So more pixels will require trimming for higher resolution cameras to erode the same focus induced edge error.

Note regarding Small Parts

Since the size of the out-of-focus error region is the same for small parts the clear aperture is easily affected. Therefore for parts with less clear aperture the margin at the edge, and particularly for small parts, best focus is even more important to achieve.

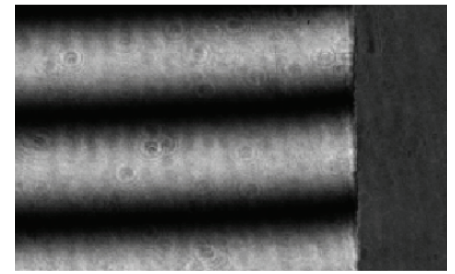


Figure 3a: Focused Fringes

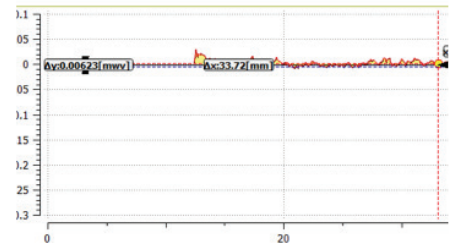
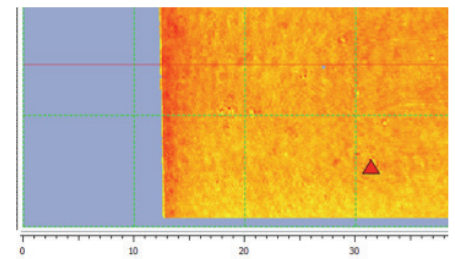


Figure 3b: Correctly Focused Result



For more information
contact us at:
Apres Instruments, Inc.
Tucson, AZ
sales@apre-inst.com
apre-inst.com