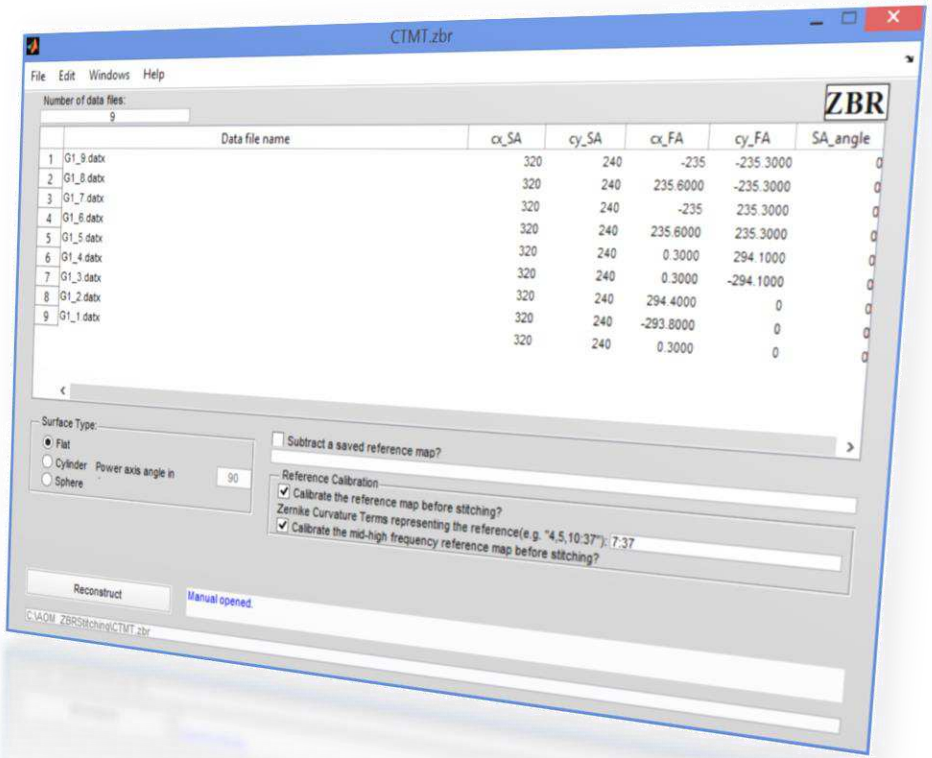
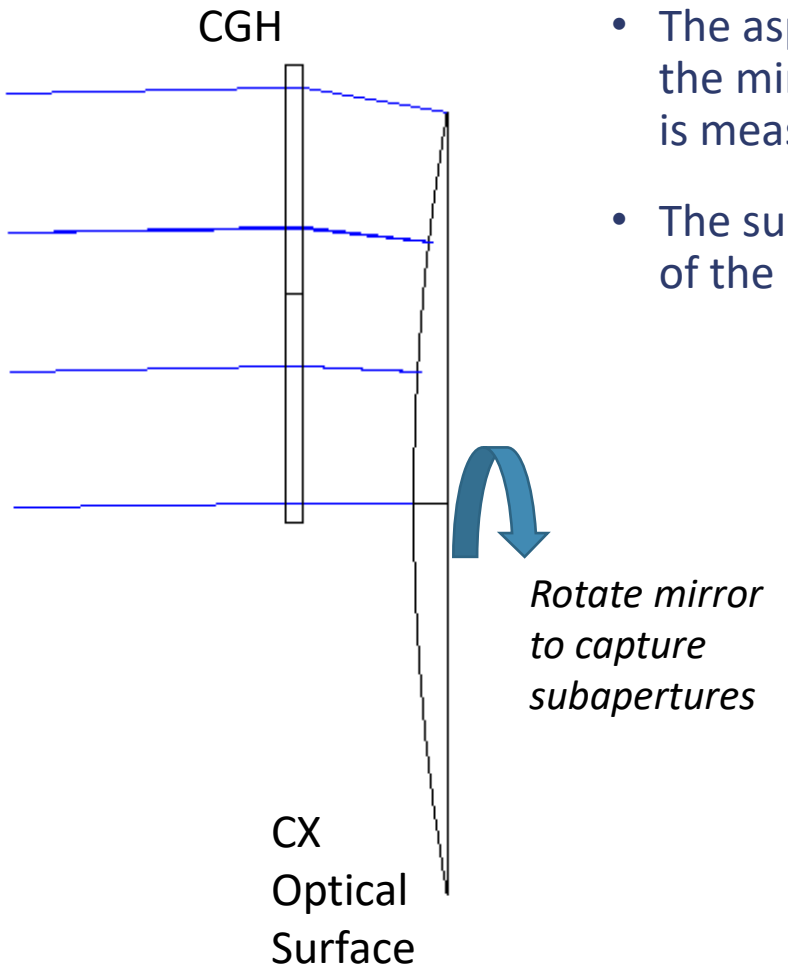
AOM ZBR Command Line User Manual v1.0

AOM Stitching Software ZBR

- ZBR stitches sub-aperture measurements enabling full surface map measurement of large optics
  - Stitching is necessary for large flats (larger than the available TF), large convex spheres and aspheres (larger than the beam size of a TS), long cylinders, etc.
  - ZBR takes sub-aperture measurement inputs in a variety of data formats, such as Zygo's datx and xyz, 4D's H5, ESDI's hdf, etc
  - To facilitate sub-aperture measurements that covers the entire surface, precision mechanics that allows rotation and/or translation of the surface is required
  - ZBR is available with a self-calibrating option, which removes systematic contributions of each subapertures, reducing error in the final stitched map

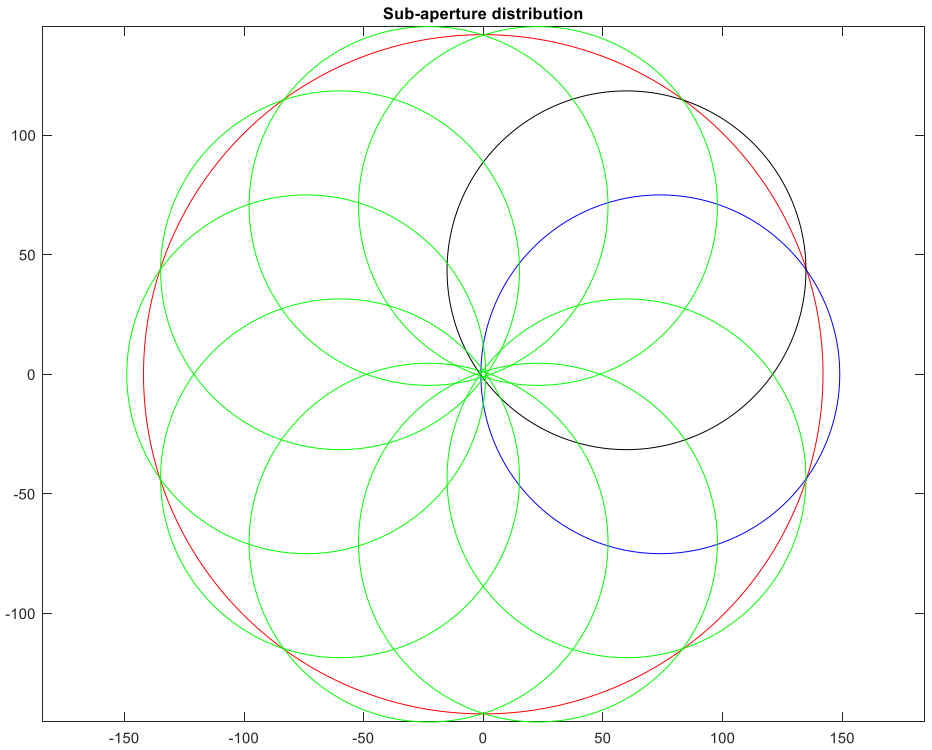


Sub-aperture measurements of a large convex optic with a CGH

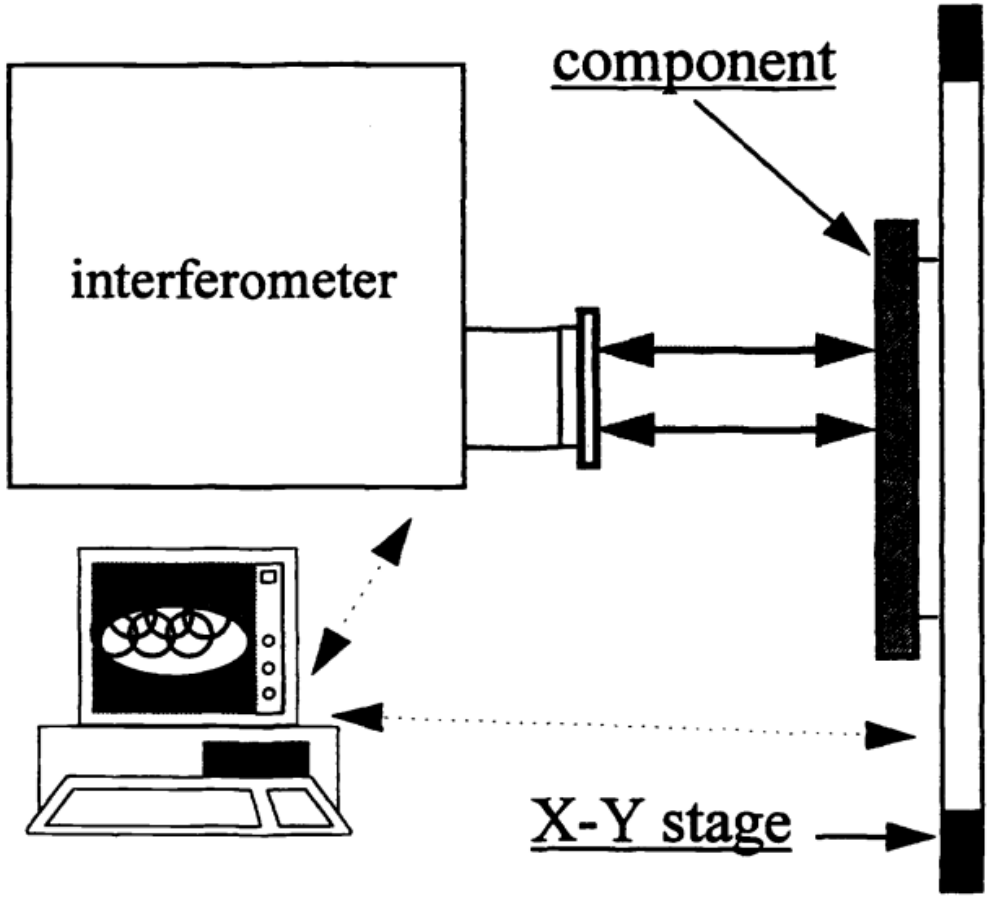


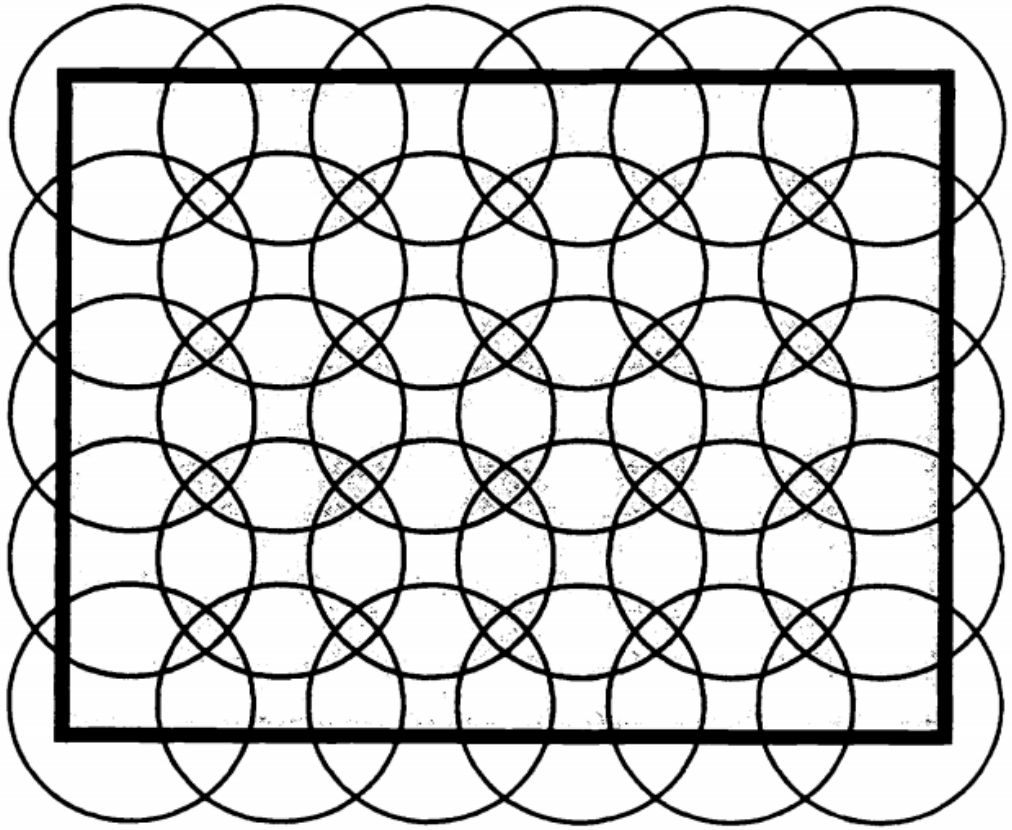
- A CGH is designed to test an off-axis portion of a large convex aspheric mirror
- The aspheric mirror can be rotated about its axis. Sub-aperture measurements of the mirror are taken at different clocking angles. Make sure every part of the mirror is measured at least once.
- The sub-aperture measurements are stitched with ZBR to get the full surface map of the mirror

- The diagram on the left shows relations between the full mirror surface (red) and the sub-aperture measurements (blue, **black** and green)



Example setup for large flat measurements



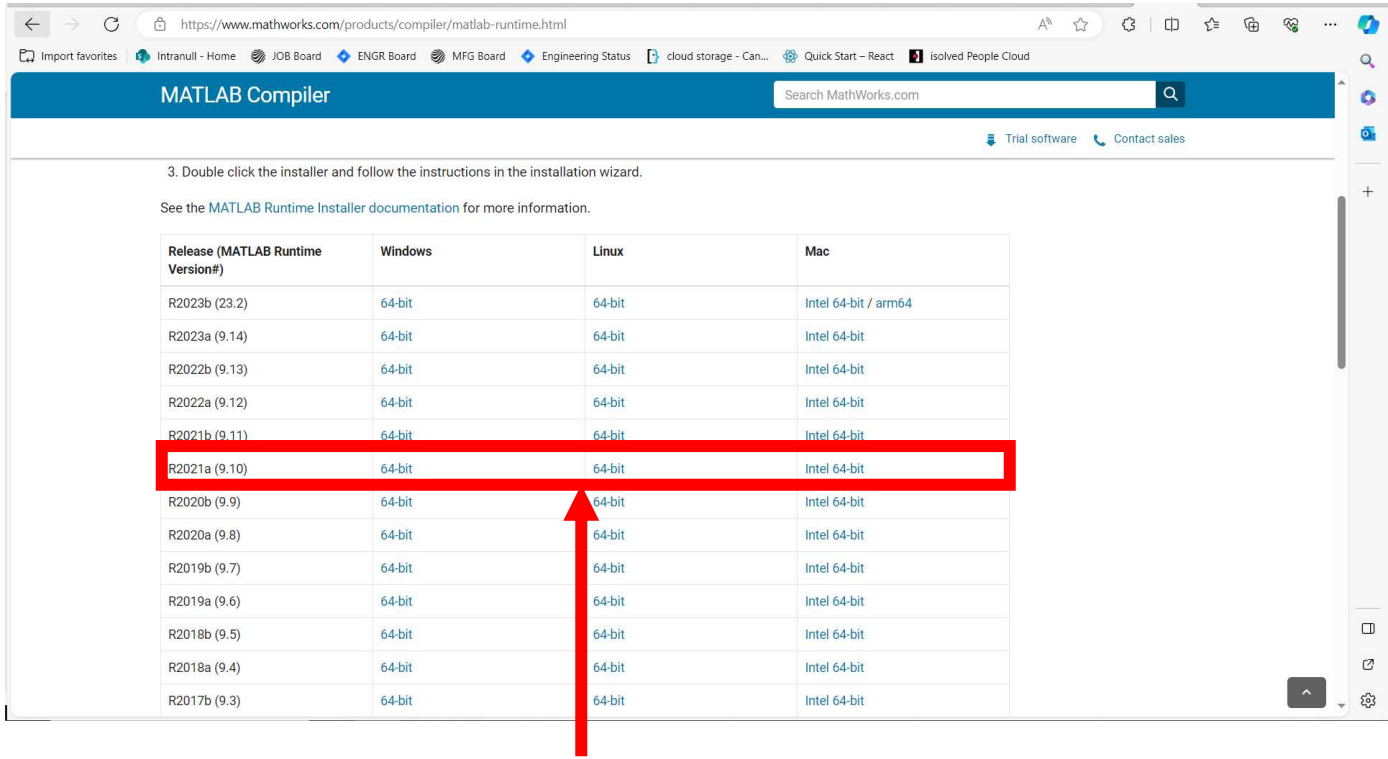


Sub-aperture distribution over the full surface

Software Requirements

The distortion correction tool requires Matlab 9.10 (R2021a) Runtime. This is a free runtime tool which can be downloaded from the MathWorks website here:

https://www.mathworks.com/products/compiler/mcr/index.html



Select the correct installer for your computer

Software Inputs and Outputs

Inputs

1. Measurement of your subapertures, in .xyz OR .datx format
2. ZBR (.zbr) file detailing your subapeture details
3. ZBR config file (.txt) detailing the stitching configuration data

Outputs

1. Undistorted measurement of your part, in .xyz or .datx format
2. Figures of the stitching performance, in .pdf format

Data Preparation

Data Preparation

1. **Create your ZBR file**
2. Create your ZBR Configuration file

A ZBR file defines the subapertures, surface, and more stitching details required by ZBR.

The full file format is a UTF-8 formatted text file saved with a .zbr extension. See the full file description to the right for how to write your own.

Line #	File Content		Remark
1	*Filename*.zbr		ZBR file name
2	*C:\Path\To\Measurements*		Path to your subaperture measurements
3	*Cylinder*		Type of surface. Enum of Cylinder | Flat | Sphere
4		90	If cylinder type, cylinder's power axis angle with respect to the +x axis of the stitched map
5	*2*		Number of sub-aperture data maps
6	*Test_x1_y1_.xyz*		No. 1 subaperture data file name
7		0	No. 1 SA map's reference pixel x coordinate (0 means the CENTER pixel's x coordinate). The lower left pixel is (1,1).
8		0	No. 1 SA map's reference pixel y coordinate (0 means the CENTER pixel's y coordinate). The lower left pixel is (1,1).
9		464.1	X coordinate of No. 1 SA map's reference pixel in the stitched map coordinate (round to integer in calculation)
10		926.9	Y coordinate of No. 1 SA map's reference pixel in the stitched map coordinate (round to integer in calculation)
11		0	Clocking angle of the SA map wrt to the +x of the stitched map in degrees (+ means clockwise)
12	*Test_x1_y1_.xyz*		No. 1 subaperture data file name
13		0	No. 1 SA map's reference pixel x coordinate (0 means the CENTER pixel's x coordinate). The lower left pixel is (1,1).
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16		926.9	Y coordinate of No. 1 SA map's reference pixel in the stitched map coordinate (round to integer in calculation)
17		0	Clocking angle of the SA map wrt to the +x of the stitched map in degrees (+ means clockwise)
18	*Test_ref.hdf*		Reference data file name (optional)

Data Preparation

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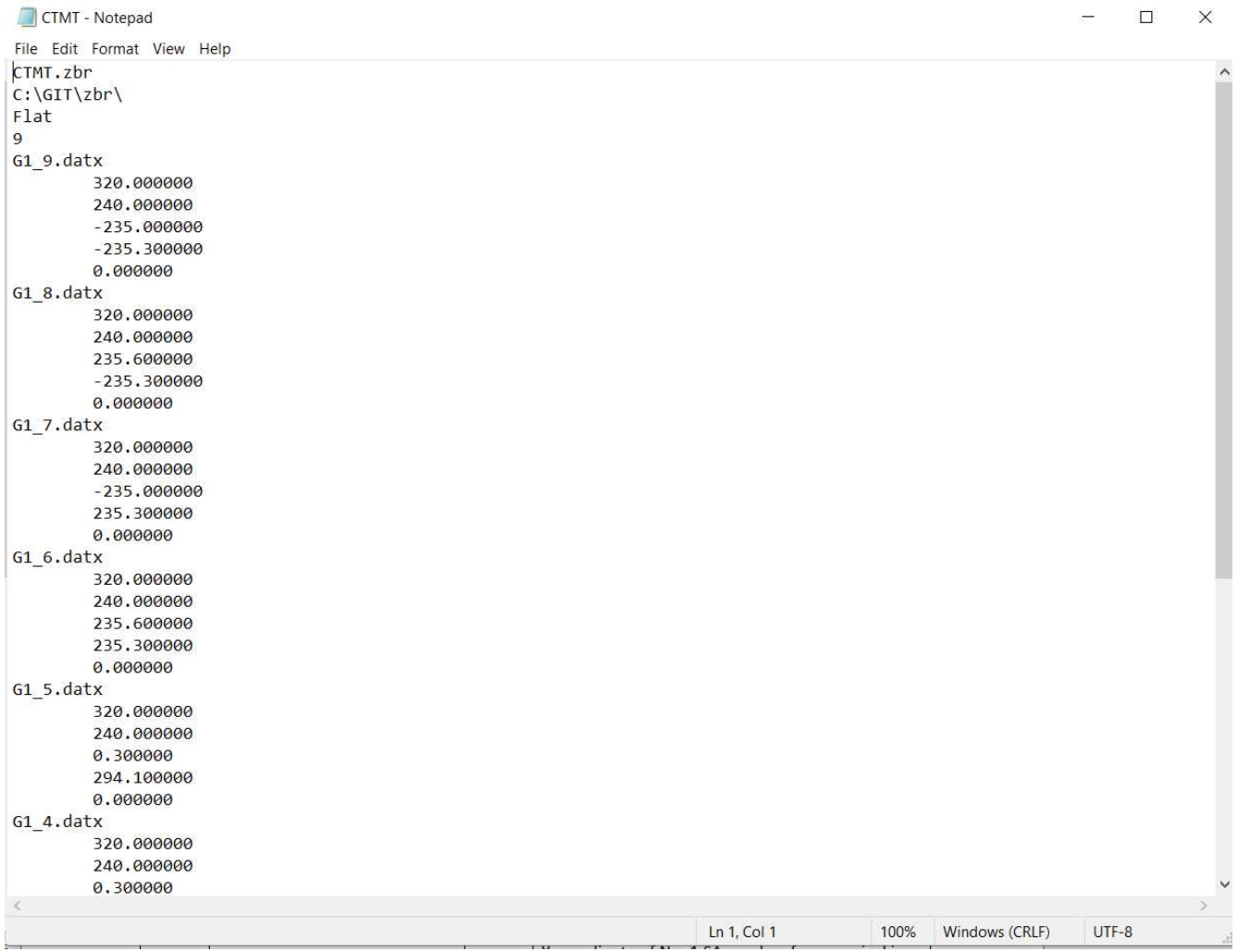
An example for a flat surface called CTMT.zbr is provided to you for your reference.



Data Preparation

1. Create your ZBR file

2. **Create your ZBR Configuration file**

A ZBR configuration file defines the location to save your stitched data and the self-calibration terms to use.

The full file format is a UTF-8 formatted text file saved with a .txt extension. See the full file description to the right for how to write your own.

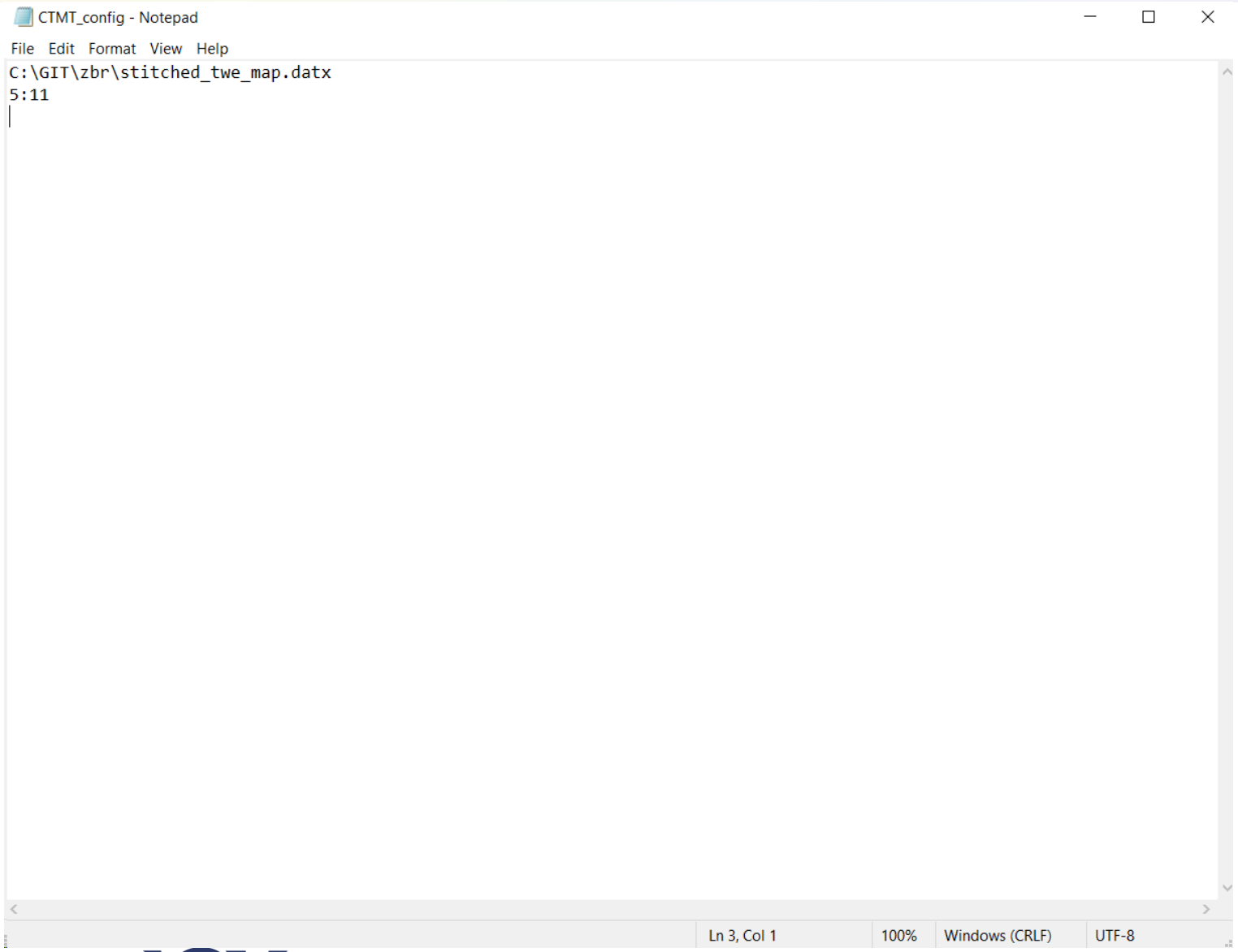
Line #	File Content	Remark
1	*C:\Path\To\Save\To.datx*	Save file path for where to save your stitched map to. Must have matching extension to input data (.xyz or .datx depending on your input subaperture maps)
2	*5,7:21*	Zernike terms to use in self-calibration. Can format as comma separated or with a colon to be inclusive of numbers. NOTE: NEVER include terms 1,2,3,4 for fitting! These are degenerate modes and cannot be fit. If fewer than 2 rotations are available in the subaperture measurements, you cannot fit astigmatism (Zernike terms 5 and 6).

Data Preparation

1. Create your ZBR file
2. **Create your ZBR Configuration file**

A ZBR configuration file defines the location to save your stitched data and the self-calibration terms to use.

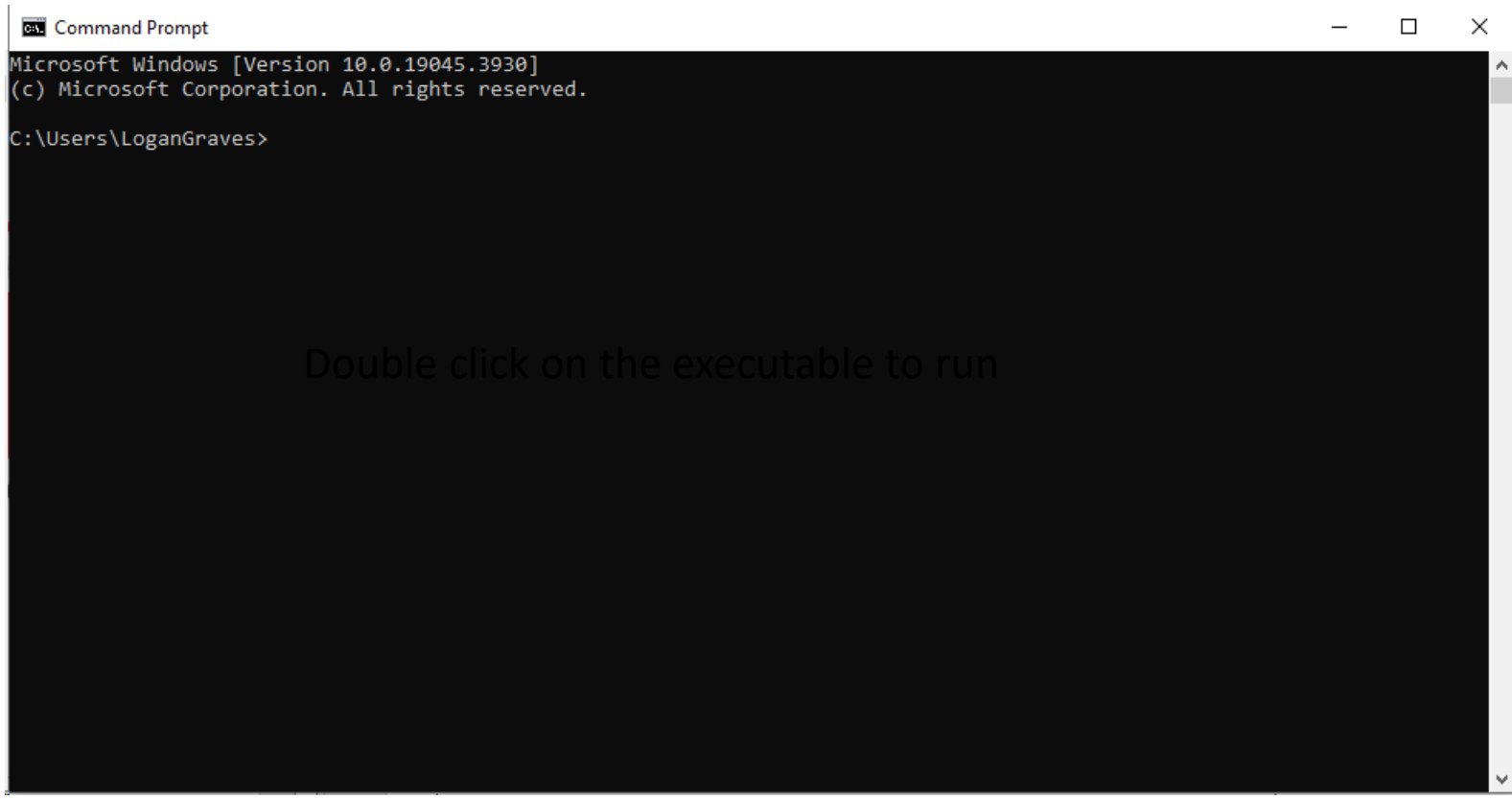
An example for a surface, which fits Zernike terms 5:11 for self-calibration, called CTMT_config.txt is provided to you for your reference.



Running ZBR from Command Line

Running the ZBR

1. **Starting ZBR**
    1. **Open command prompt (or create bash file)**
    2. Run ZBR command with ZBR and config file args passed in.
2. Viewing status and log file
3. Viewing results
4. Running in GUI mode



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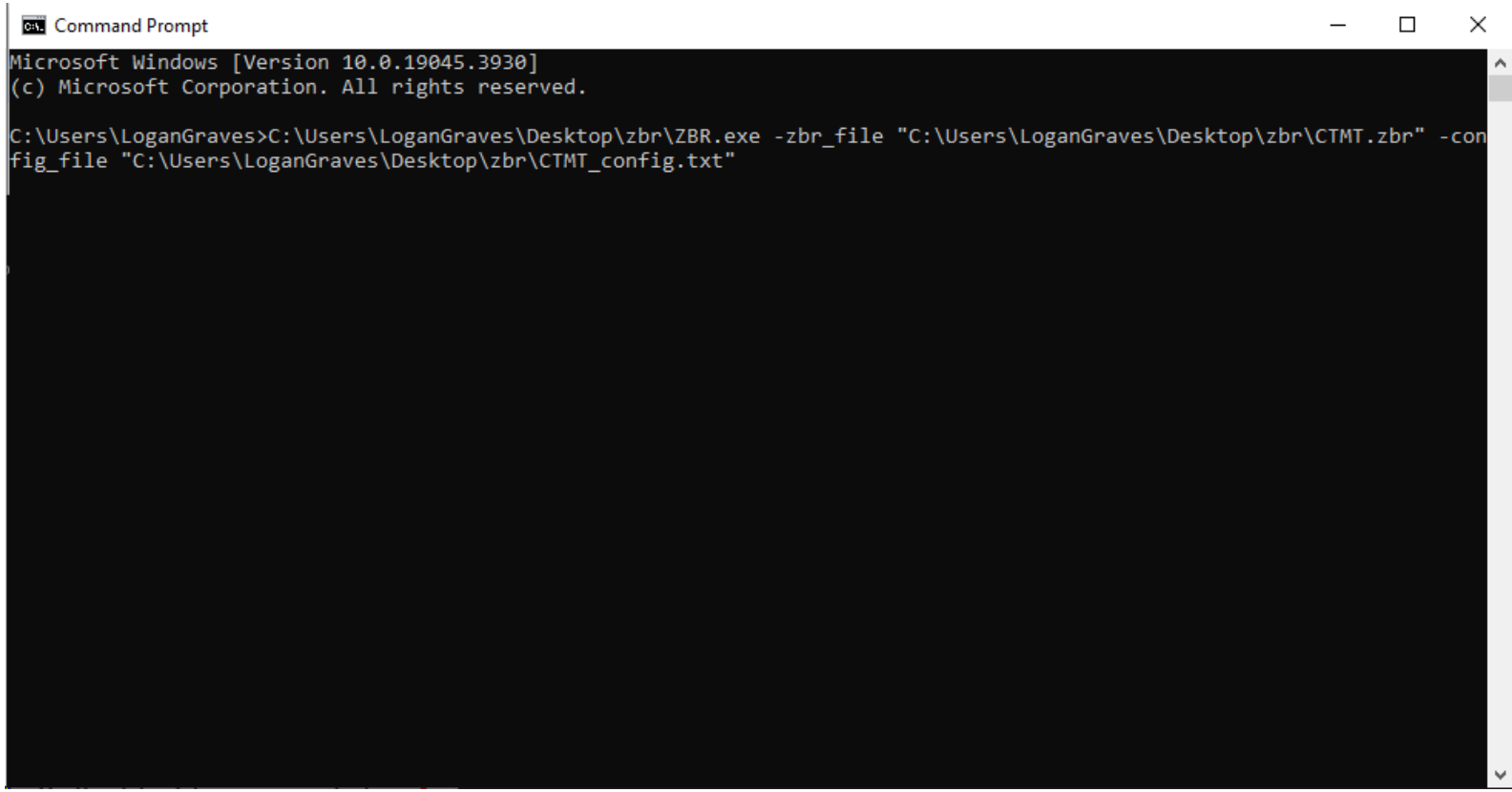

ZBR command input:

ZBR.exe –zbr_file “full_zbt_ file_name.zbr” –config_file “full_config_file_name.txt”

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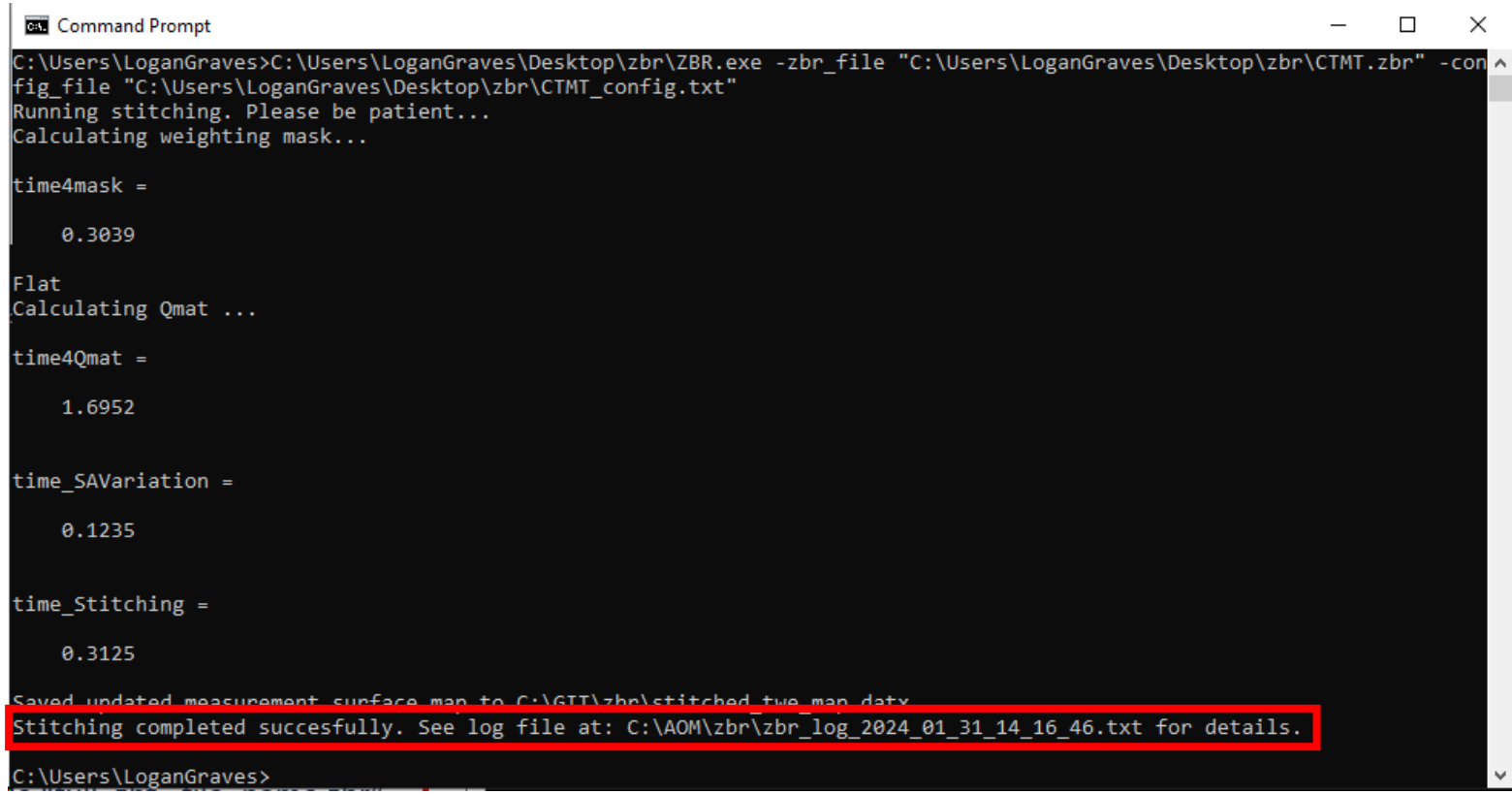

The final output of the command window will let you know if the stitching was successful, and, will inform you of the log file location, which details all of the runtime events for ZBR. This can be helpful for debugging as well. The log file is always written to "C:\AOM\zbr_log_YYYY_MM_DD_HH_MM_SS" where 'YYYY_MM_DD_HH_MM_SS' is the time of running in year, month, day, hour, minute, second format.

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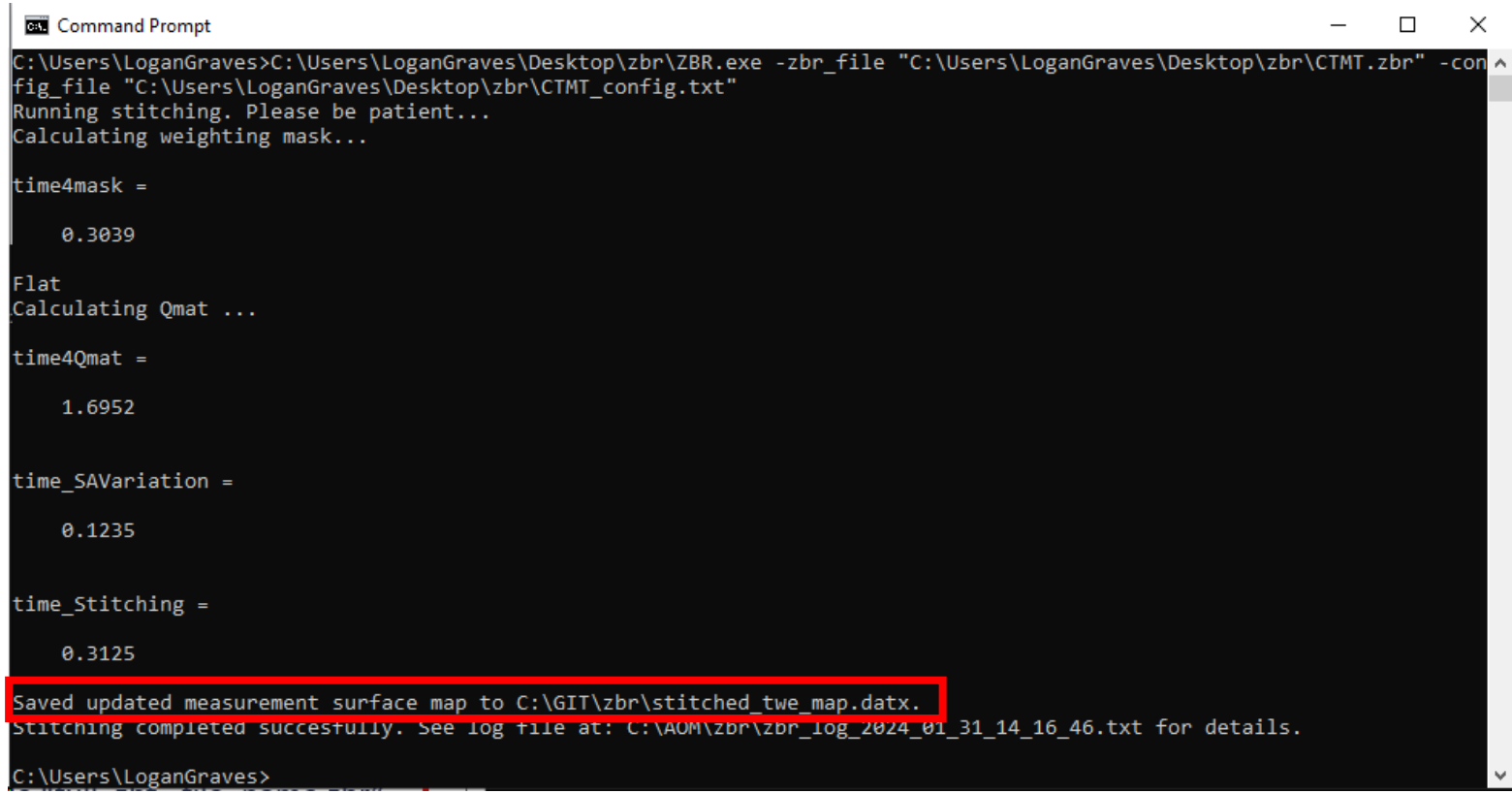
ZBR will let you know where your saved stitched map is. This save location was defined in your config file. The stitched map and the figures detailing the stitching performance are located here.



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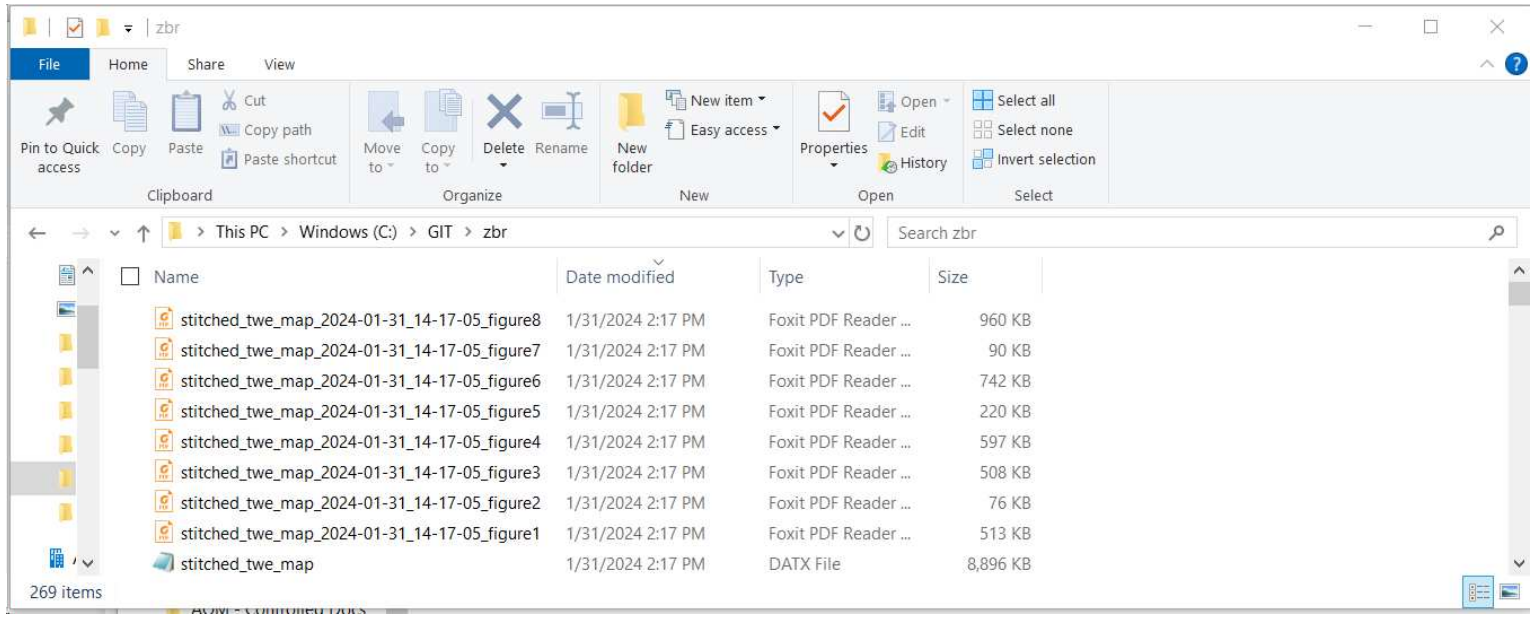

Navigate to your save folder to find the stitching results and stitched map. **You can load your .xyz or .datx stitched map in Zygo Mx software for further analysis.** You can open the pdfs to view details of the stitching.

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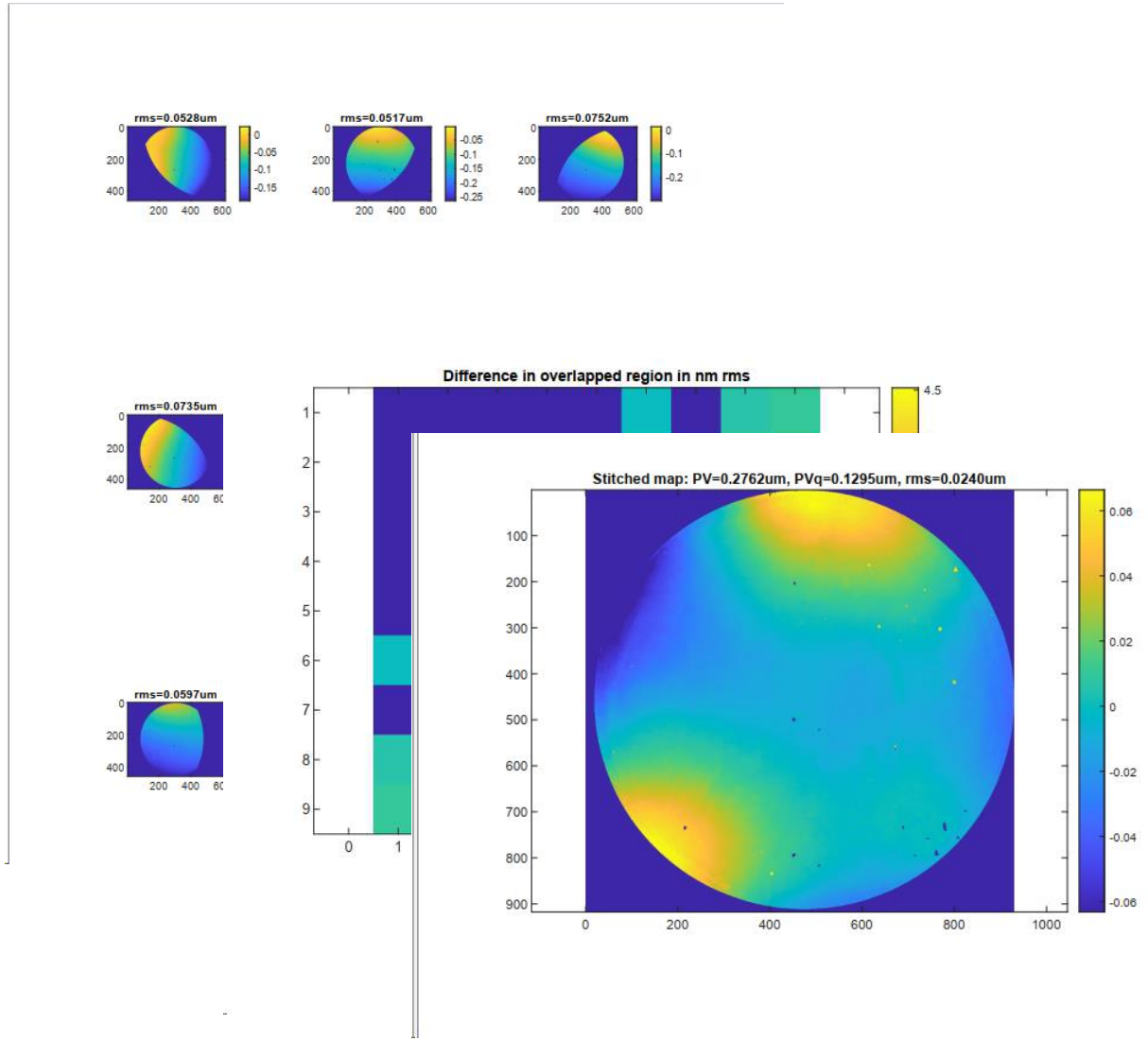

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You can also run ZBR in GUI mode, which launches the traditional ZBR user interface. To do so, run ZBR.exe with no arguments passed in.

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