User Manual:
Endoscope Geometric Distortion evaluation software

Tool Reference

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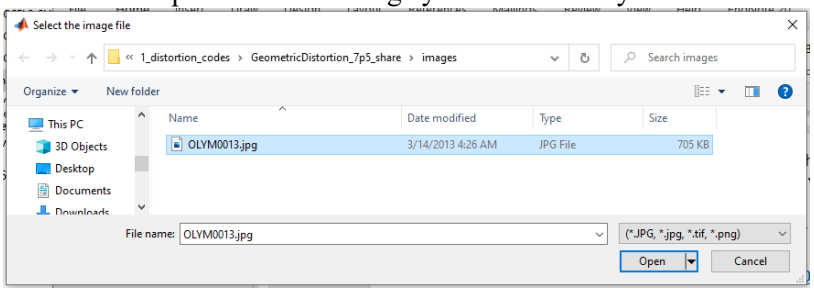
This manual provides instructions for utilizing the software designed to assess endoscope geometric distortion. MatLab (https://www.mathworks.com/products/matlab.html) is required to run this software. The software includes the following parts:

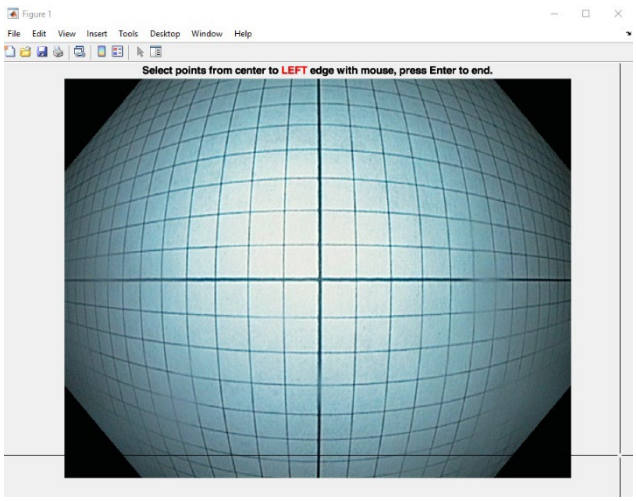
- A main program named "distortion_polyfit_correct_7p5.m".
- A folder named "private". Several subroutines are saved in this folder and the main program will call them during running. *If you run the software on a Mac computer, this folder might not be recognized. In that case, you can move the subroutines to the same folder as the main program.*
- A folder named "images". Images in this folder will be inputs to the software. A sample image named "OLYM0013.jpg" is in the folder for testing the software. This software can analyze images in jpg, tif, and png formats. You can put the target images taken by your own endoscopes into this folder as inputs. Please refer to our paper for taking target images. [1]
- A folder named "outputs". An output file will be generated in this folder after each run. The file contains the values of all the variables for the analyzed endoscope image. To understand the algorithm and the meaning of these variables, please refer to our paper [1].

You can follow the following steps to run the software:

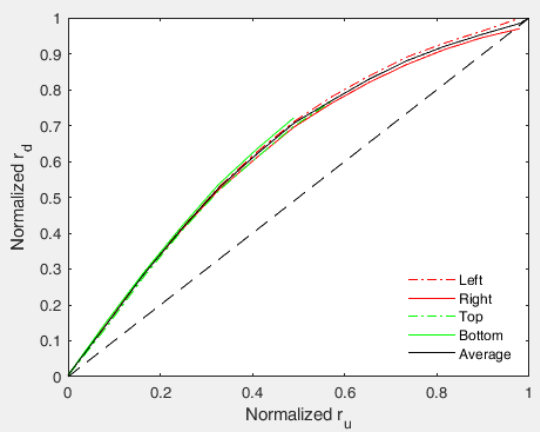
- Follow our paper [1] to take target images and put the images in the "images" folder.
- Install Matlab on your computer.
- Download the zip file named "GeometricDistortion_7p5_share_2.zip" from GitHub and unzip it.
- Double click the main program named "distortion_polyfit_correct_7p5.m" to open it in MatLab.
- Click the "Run" button  to run the software.
- The "images" folder will open. Select an image you want to analyze and click the "Open" button.

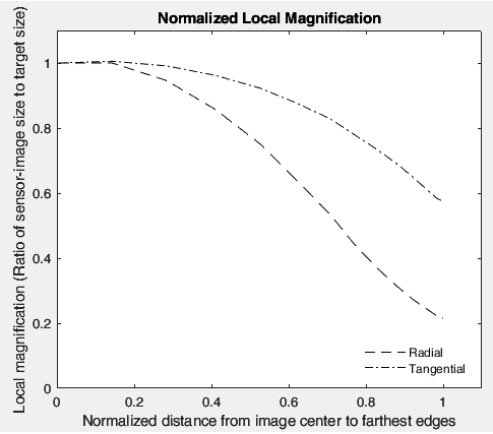


- A figure window will open. Follow the instruction on the top of the window to select cross points on the horizontal and vertical lines that across the image center as follows.
    - Starting at the center, click the left mouse button once at each intersection until the leftmost intersection is selected. Then press the Enter key on the keyboard to end the selection.
    - Repeat similar procedure from the center to right, from the center to top and from the center to bottom.



- The software will generate the following outputs.
  - A "*.mat" file in the "outputs" folder. Double click the output file to open it with MatLab to check the values of all the variables from the image analysis. The file name is a string started with the name of the analyzed image followed by date, month, year, and time when the file was generated.
  - Two images in two MatLab image windows as follows. The left image shows the relation between distorted radius (r_d) and undistorted radius (r_u) in four directions: center to left, center to right, center to top and center to bottom. The average of these four directions is also displayed. The right image shows the local magnification curves in the radial and tangential directions. The values for these curves (**r_d** and **MLR_N** for the radial direction; **r_d** and **MLT_N** for the tangential direction) can be found in the "*.mat" output file in the "outputs" folder.





Reference:

[1] Q. Wang, W.-C. Cheng, N. Suresh, and H. Hua, "Development of the local magnification method for quantitative evaluation of endoscope geometric distortion," Journal of biomedical optics 21, 056003 (2016). doi: https://doi.org/10.1117/1.JBO.21.5.056003

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