SAPIENZA
UNIVERSITÀ DI ROMA

py2DIC
Instruction Manual

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1 Introduction

Py2DIC was developed at the Geodesy and Geomatics Division of DICEA of the University of Rome "La Sapienza". It is a free and open source software and it is based on the template matching method. The software returns the displacement and strain fields by comparing two or more images of a sample surface acquired at different stages of deformation. The software, completely written in Python, is provided with a Graphical User Interface (GUI), and it leverages the potentialities of OpenCV (Bradski and Kaehler, 2008). The source code is freely available at http://github.com/Geod-Geom/py2DIC. For more details about the implemented method and its applications, see the following scientific paper: Ravanelli, R., Nascetti, A., Di Rita, M., Belloni, V., Mattei, D., Nisticó, N., and Crespi, M.: A new Digital Image Correlation software for displacements field measurement in structural applications, The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, XLII-4/W2, 139-145, https://doi.org/10.5194/isprs-archives-XLII-4-W2-139-2017,2017.

2 User Guide

Py2DIC has been tested on Windows, Mac Os and Ubuntu. As for Windows and Mac Os, it is recommended the use of Anaconda.

2.1 Installation requirements

Install Anaconda and digit the following instructions in the command prompt in order to install the dependencies:

conda install -c conda-forge pyqt

conda install -c conda-forge opencv

conda install joblib

2.2 Py2DIC download

Before starting the image processing, open the above mentioned website http://github.com/Geod-Geom/py2DIC and download the software using the "Clone or download" button as shown in Fig. 1.

2.3 Parameter setting

Open the command prompt. Then, navigate to the directory

py2DIC-master/sources

and type

python DIC_UI.py

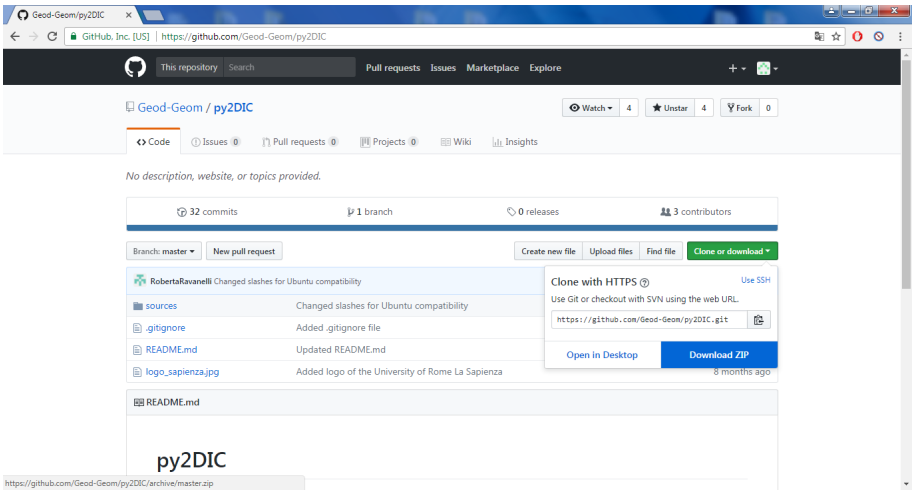


Figure 1: GitHub platform

in the command prompt in order to run py2DIC. First of all, the software allows to open an image as shown in Fig. 2.

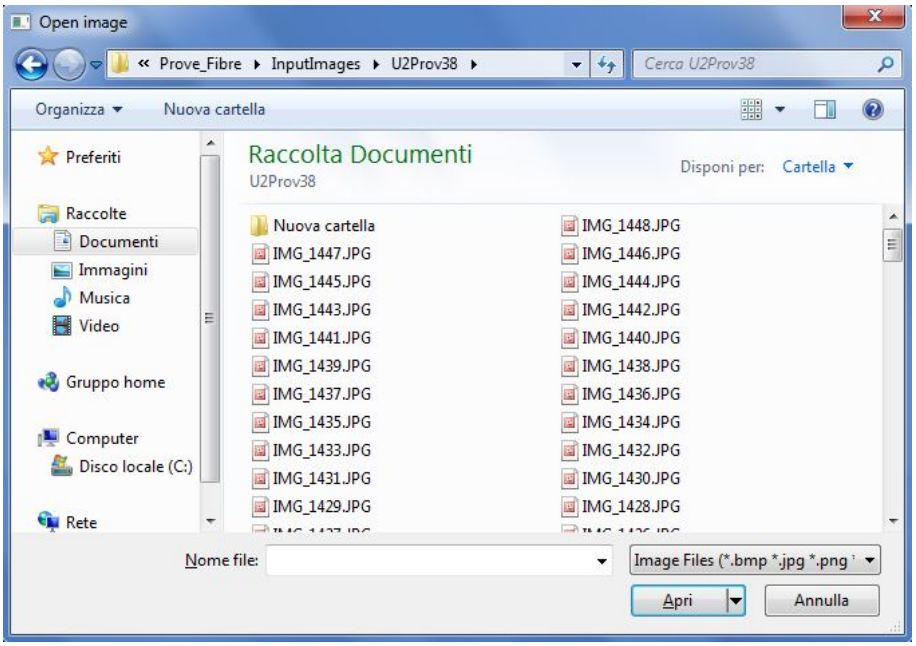


Figure 2: Graphical user interface developed to select the image

Once the image has been selected, the Graphical User Interface (GUI) opens on the desktop. The GUI has been developed using PyQt5 in order to select the Area of Interest (AOI) and set the parameters that the software requires as input. The GUI is shown in Fig. 3.

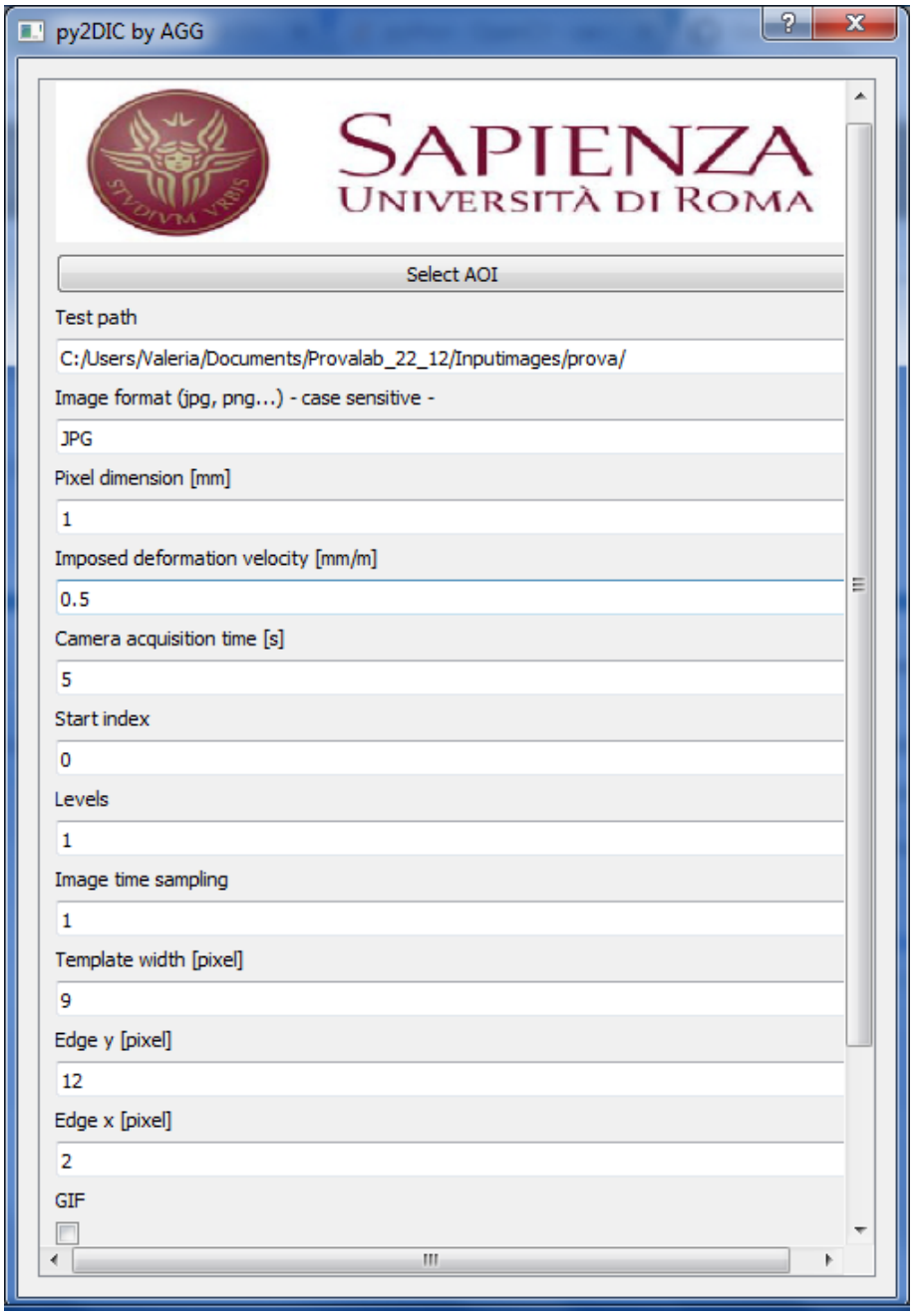


Figure 3: Grafical user interface

In order to select the AOI, click on the corresponding button and draw a yellow rectangle on the image by means of mouse click events to indicate the outline of the selection (indicate the upper left corner and the bottom right corner). The procedure is shown in Fig. 4 and Fig. 5. It is worth noticing that if the AOI is not defined, the images are entirely processed.

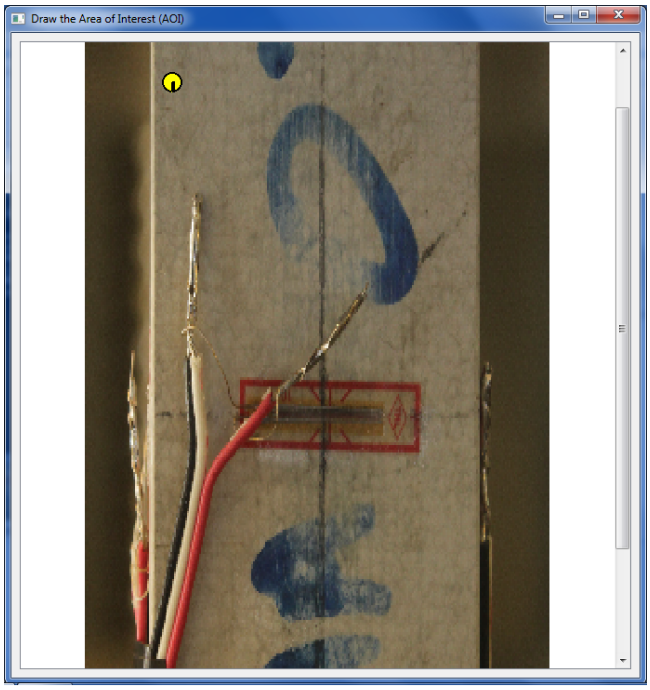


Figure 4: Selection of the AOI

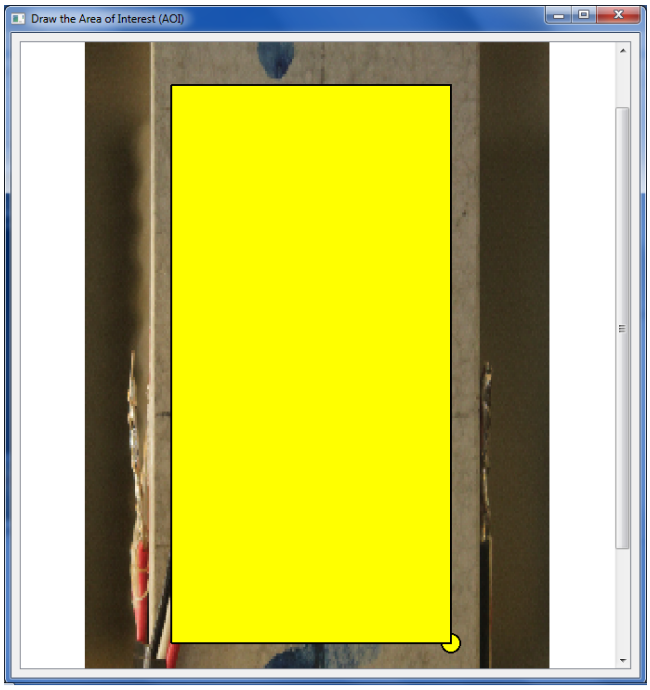


Figure 5: Selection of the AOI

Once the AOI is selected, the following parameters must be set:

- **Test path**: the path in which the images are saved. It is not necessary to set this parameter because it is automatically defined when the first image is selected.
- **Image format**: jpg, png, tif and so on. It is worth noting that it is case sensitive.
- **Pixel dimension**: the pixel dimension used for the pixel-to unit length conversion. The pixel is considered square and constant throughout the image.
- **Imposed deformation velocity**: the velocity imposed during the tensile test to deform the specimen.
- **Camera acquisition time**: the acquisition time between two consecutive images.
- **Start index**: the parameter used to select the first image that is to say the reference image.
- **Levels**: the number of images used to compute displacement.
- **Image time sampling**: the image time sampling used to select some images and reduce computational time.
- **Template width**: the template dimension used to perform DIC. It is considered square and constant and it must be defined carefully; if the template is too small the noise increases whereas if it is too big there is a risk of losing displacements.
- **Edge x**: the edge of the search window in the x direction.
- **Edge y**: the edge of the search window in the y direction.
- **GIF**: the animated GIF creation. Selecting this option by a check mark, the animated GIFs of the output images are created in the GIF folder.

Finally, press the Run button to start processing the images.

During the processing, the command prompt shows some informations about the analysed images, the camera resolution and the expected displacement if the imposed deformation velocity and the camera acquisition time are available. The command prompt is shown in Fig. 6.

2.4 Py2DIC outcomes

Py2DIC computes displacements (u, v) and strains $(\frac{\partial u}{\partial x}, \frac{\partial v}{\partial y})$ by comparing two or more images of the sample acquired at different stages of deformation. The software allows to perform the analysis in several steps: the results are the accumulated displacements and strains for each step of calculation and they are reported into text files for each pair of processed images. The text file are automatically saved in the "OutputPlots" folder. The first file contains different columns of data: the x and y coordinates of the grid point, the displacements

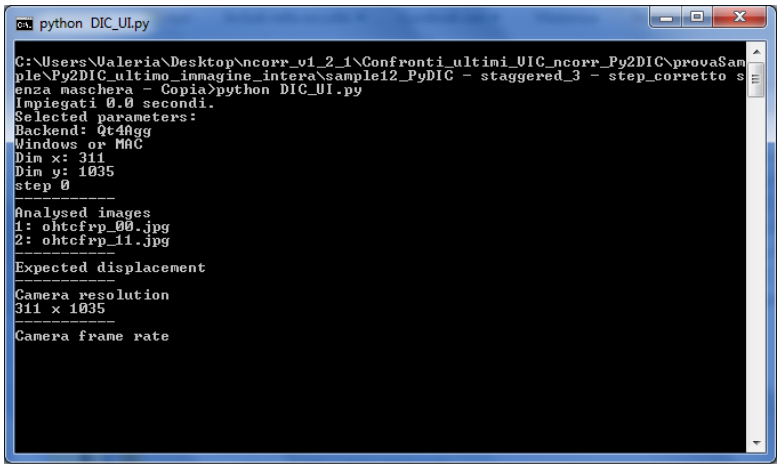
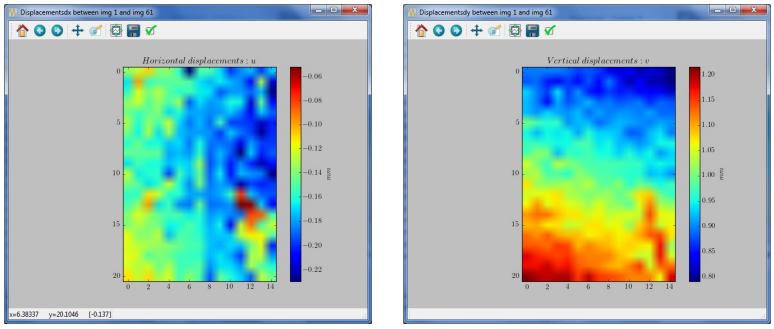


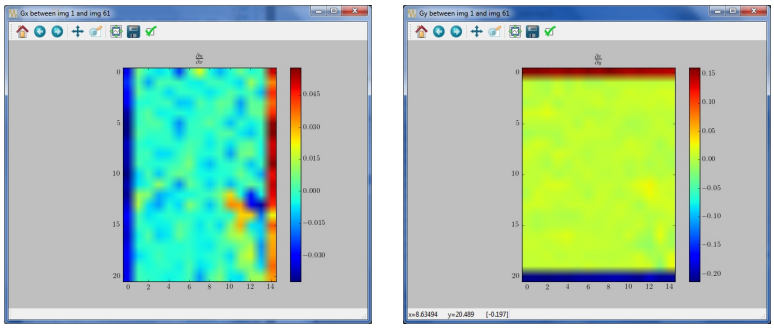
Figure 6: Command prompt

along the x and y direction, the length of the displacement vector and the correlation coefficient for each point of the grid. The other files show the values of displacements and strains along the grid. Furthermore, the displacement and strain maps, the displacement quiver plot and the displacement plot related to the central section of the sample are shown at the end of the process and saved in the "OutputPlots" folder. The output plots are shown in Fig. 7a, Fig. 7b, Fig. 8a, Fig. 8b, Fig. 9a, Fig. 9b.



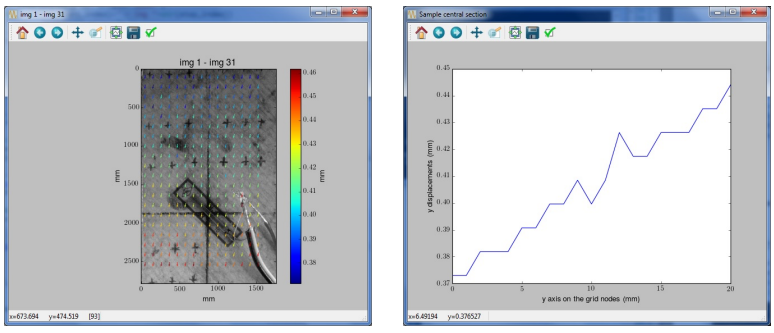
(a) (b)

Figure 7: (a) The horizontal and (b) vertical displacements.



(a) (b)

Figure 8: (a) The horizontal and (b) vertical strains.



(a) (b)

Figure 9: (a) Quiver plot of the computed displacements and (b) displacement plot of the sample central section.