

PyPAIS

Python Phase Analyzer based on Image Segmentation

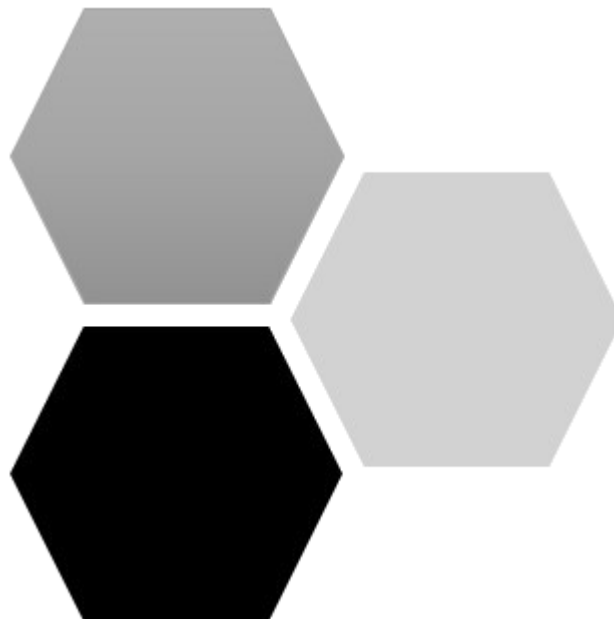
Instruction Manual

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Introduction

PyPAIS was developed in Python 3 as an open-source tool for assessment of bitumen coverage on aggregate. The program offers a graphical user interface (GUI). The image segmentation process consists of three basic steps: intensity thresholding, texture roughness thresholding, and smoothing. The local entropy calculation for texture roughness assessment overcomes inconveniences with the similarity of aggregates and bitumen regarding color, or reflections on the glossy bitumen surface. The thresholding upper and lower bounds, as well as the standard deviation of the Gaussian kernel, can be easily adjusted using GUI controls. Moreover, the implementation of algorithms for blob analysis allows for studying the size distribution of individual phases, which significantly extends the potential use of the software in other fields.

1. Program Structure

The program initiates after running the main.py script, located in the root program folder (Figure 1). Exported data (images, excel spreadsheets) can be found in the “export”, while folders “__pycache__” and “_aux” store auxiliary files and do not need to be accessed by the user. The “input” folder consists the images to be analyzed (these can be stored in subfolders).

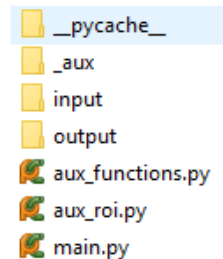


Figure 1: Structure of the program folders and files.

The program can be run via main.py from a command prompt (Windows) / terminal (Mac, Linux) by calling python, see Figure 2. In order to run it successfully, a few packages (besides [Python 3.5+](#) must be installed. These include **os**, **time**, **tkinter**, **PIL**, **matplotlib**, **skimage**, **copy**, **subprocess**, **numpy**, **cv2**, and **sys**. The information on how to install packages on your computer can be found, e.g., [here](#).

```
ca. Command Prompt
Microsoft Windows [Version 10.0.16299.98]
(c) 2017 Microsoft Corporation. All rights reserved.

C:\Users\Venca>cd C:\PyPAIS

C:\PyPAIS>python main.py
```

Figure 2: Structure of the program folders and files.

2. Program workflow

The program workflow is very intuitive and the user can adjust all parameters using GUI controls (see Figure 2). After running the main.py file the user must load an image and consequently is asked about a name of the project – this project name is used for naming subfolders and files when exporting images / data.

All the parameters, such as intensity/entropy thresholding bounds or smoothing, can be adjusted using sliders or edit boxes (entry widgets) – however, after entering a value **THE ENTER KEY MUST BE PRESSED**, otherwise the entered value has no effect. The user can switch the view using the radio buttons located under the image. The smoothing actually adjusts the standard deviation of the Gaussian kernel.

The region of interest can be set manually (which can take a while, before the user is prompted), if a simple polygon suffices, or loaded in the form of a black-and-white image. ROI selection by hand is done in a pop-up figure window (see Figure 4) and after selecting the polygon vertices the polygon is closed by a double mouse-click.

The scaling does not have to be set if the information about the size distribution is not required.

“Export” menu item contains commands for data exporting. The statistical data are exported to ASCII text files for further analysis, e.g., using spreadsheets.

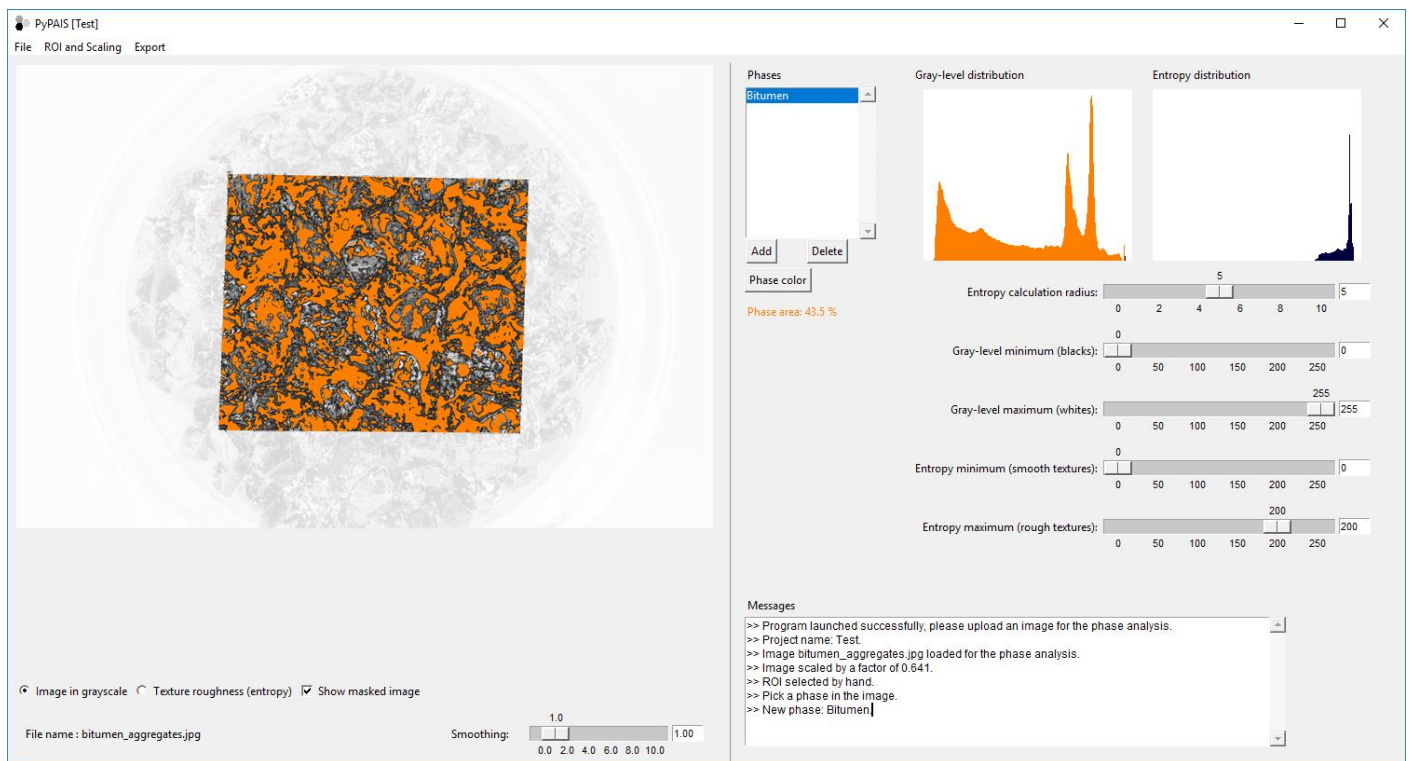


Figure 3: PyPAIS GUI.

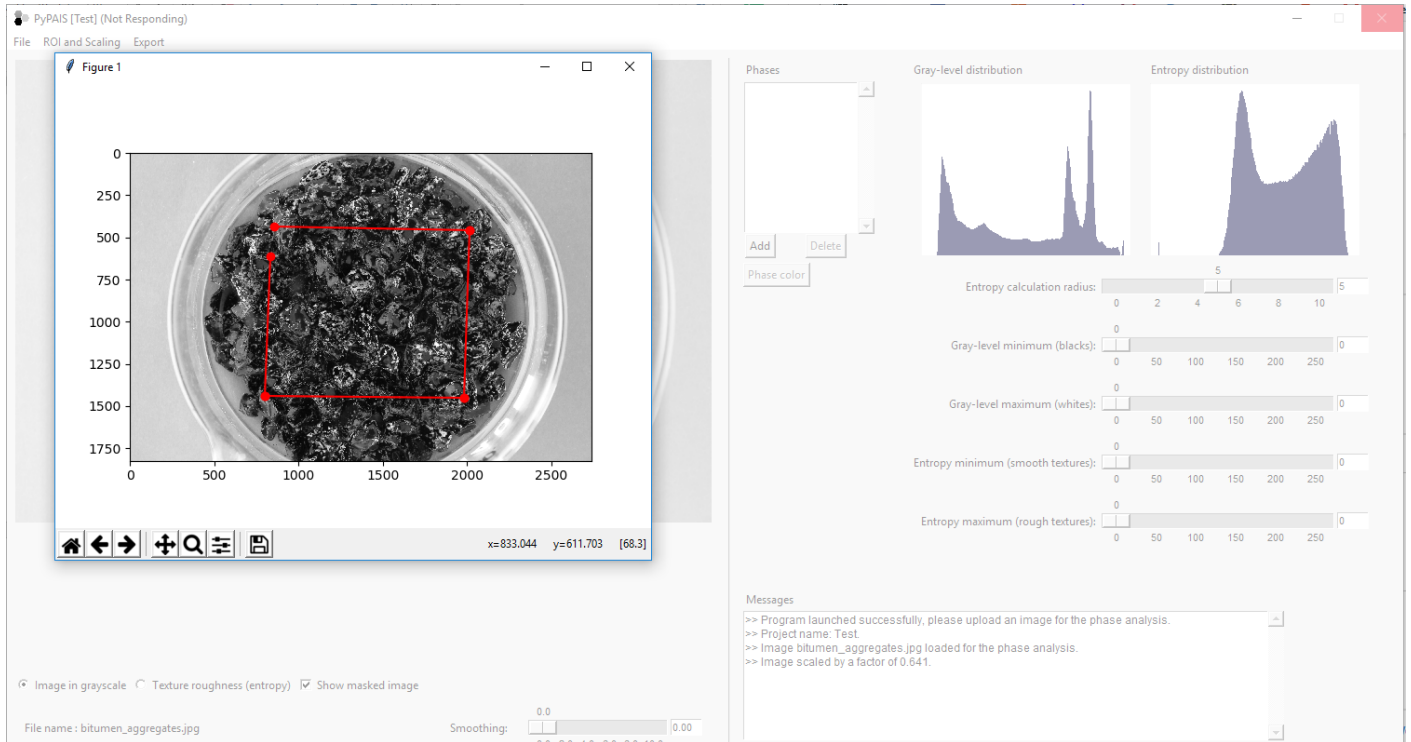


Figure 4: Manual ROI selection.

Acknowledgement

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