Introduction

Welcome to *TarMass*, the desktop application for automatic tardigrade biomass estimation.

TarMass combines the power of artificial neural networks and the capabilities of an annotation program to enable fast and accurate biomass calculation that are presented it in a from of *PDF* report.

System requirements

TarMass was tested on *Ubuntu 20.04.6 LTS*.

For GPU support, *CUDA 11.3.1* or later driver is required.

Installation instructions

- **Download executable**

  https://drive.google.com/drive/folders/1_X_-14Id1qeYmTvUEwmV5iJkc7EsCfS4?usp=sharing

- **Install from source**

  Clone repository:

  ```
  git clone git@github.com:TheGrycek/Tardigrada.git
  ```

  Build a docker container:

  - For GPU support:

    ```
    docker-compose build
    ```

  - For CPU only support

    ```
    docker-compose -f docker-compose-cpu.yml build
    ```

  To generate your own executable run:

  ```
  setup.py build
  ```

User interface overview

Graphical User Interface consists of two bookmarks.

- **Control**

  Allows user to run and stop animals detection, calculate biomass, generate *PDF* report, set algorithms and see execution logs.

- **Correction tool**

  Annotation tool, that enables correction of the inference results, addition of new instances and setting a scale value.

Pressing File on **Menu Bar** one can open new directory, change save directory and save current state.
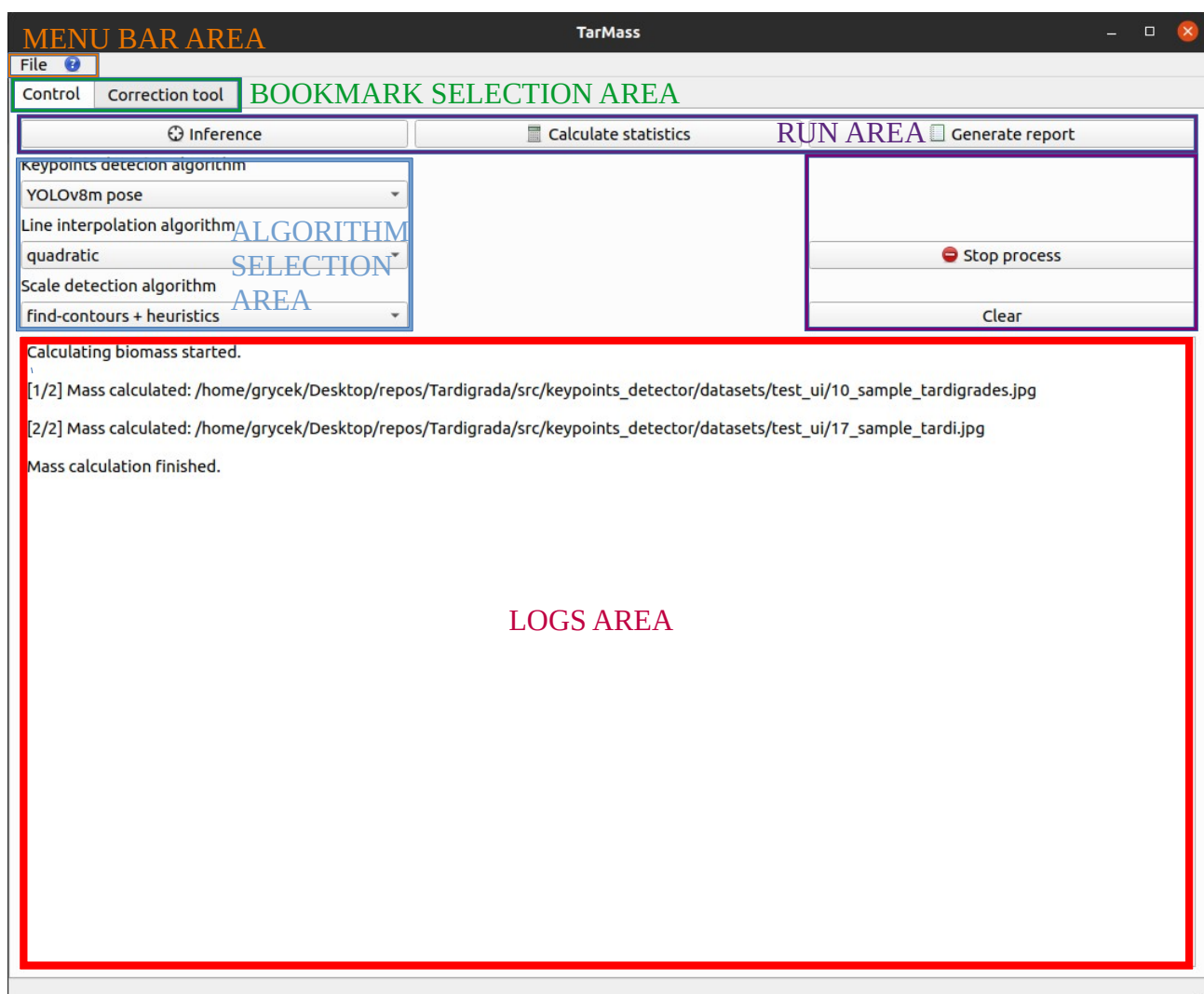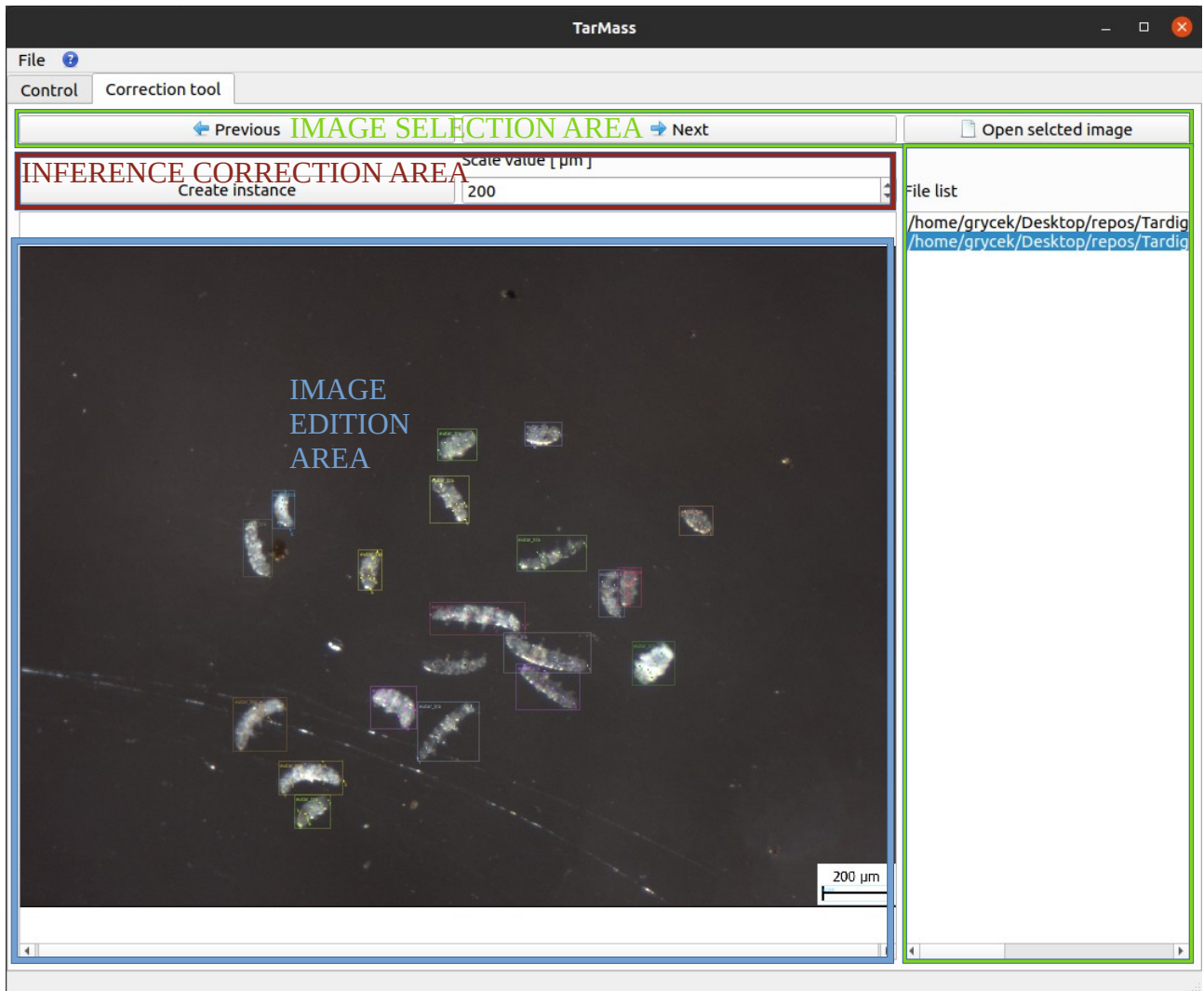
Usage

PDF report generation steps:

- in "*Menu Bar*" open "*File*" click "*Open Dir*" and select folder with your images

- in "*Menu Bar*" open "*File*", click "*Change Save Dir*" and select directory where all result files will be saved

- in "*Control*" bookmark select which algorithms will be used for

    - animal detection, classification and keypoints estimation

    - length keypoints spline fitting

    - scale detection

- click "*Inference*" button

- wait until an information confirming successful completion of the algorithm appears in the logs area– inside save directory single *json* file for every image file can be seen

- go to "**Correction tool**" bookmark and fix incorrectly annotated objects

- go back to "**Control**" bookmark and click "**Measure**" button

- wait until an information confirming successful completion of the algorithm appears in the logs area– inside save directory **results.csv** file with calculated lengths, widths and biomass for every classified animal appears

- click "**Generate report**" button

- wait until an information confirming successful completion of the algorithm appears in the logs area– inside save directory **report** folder is generated with the final results

- to stop any process press "**Stop process**" button

- to clear logs area press "**Clear**" button


Correction tool usage:

- select the image from the "**File list**" on the right

- press "**Open selected image**"- image should appear in the image edition area

- moving between the images is available, using "**Previous**" and "**Next**" buttons

- to move the bounding box or keypoint, left-press the mouse and drag

- to resize the bounding box double-left-click inside the area of the rectangle and move the mouse – only the right down vertex is movable

- to change the label of the instance double-click inside the label area until proper label appears

- to change the scale value click the up/down arrows or type the number in the "**Scale value [μm]**" box

- new object can be added by clicking "**Create instance**" button, selecting the proper class inside the "**Create instance**" window, and left-clicking on the image to place the first vertex of the rectangle, then moving the mouse to resize the rectangle and left-clicking second time to place the second vertex

- zooming in and out is possible using the **Ctrl+scroll** shortcut

- to save the changes one can use **Ctrl+s** shortcut or select **Menu bar > File > Save**

Glossary

Every detected object in the image is represented by the bounding box and the label.

Scale object has an extra attribute – *scale value* expressed in *µm*.

Tardigrade object has an extra 7 keypoints – 5 represents its length (numbered 1-5) and 2 width (numbered 6-7).
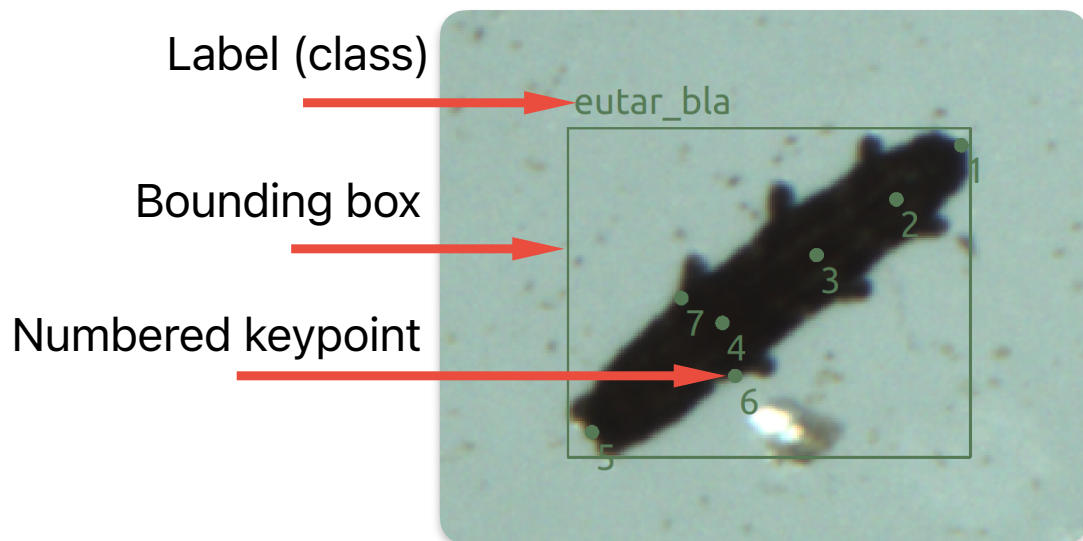
Annotation – label/bounding box/keypoint that describes an object detected by the neural network

Inference – the act of processing the image by the neural networks

Classification – the act of selecting the proper class for an object: *scale, eutardigrada black, eutardigrada translucent, heterotardigrada echiniscus*

Detection – the act of calculating the bounding box position

Bounding box – the rectangle, that represents the object position in the image

Keypoints – points that represents object body shape

Keypoints estimation – the act of calculating position of keypoints in the image

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Troubleshooting

If issue detected, please report it in the GitHub repository:
https://github.com/TheGrycek/Tardigrada/issues

Contact details

Feel free to help us develop the tool as a contributor at GitHub.

If you have further questions feel free to contact us at:
tarmass.software@gmail.com