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BubCNN Transfer Learning Module

Manual

Release 1.0

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1. Load image or video

After the app was started, a dialog box opens where an image, multiple images or videos can be selected. Note that loading a video file can take a while.

2. Crop Image

Press 'Crop Image'. Mark the area you want to crop. Right clicking opens the dialogue box seen in Figure 1. Press 'Crop Image' to finish cropping. Press 'return' to go back to the main window.

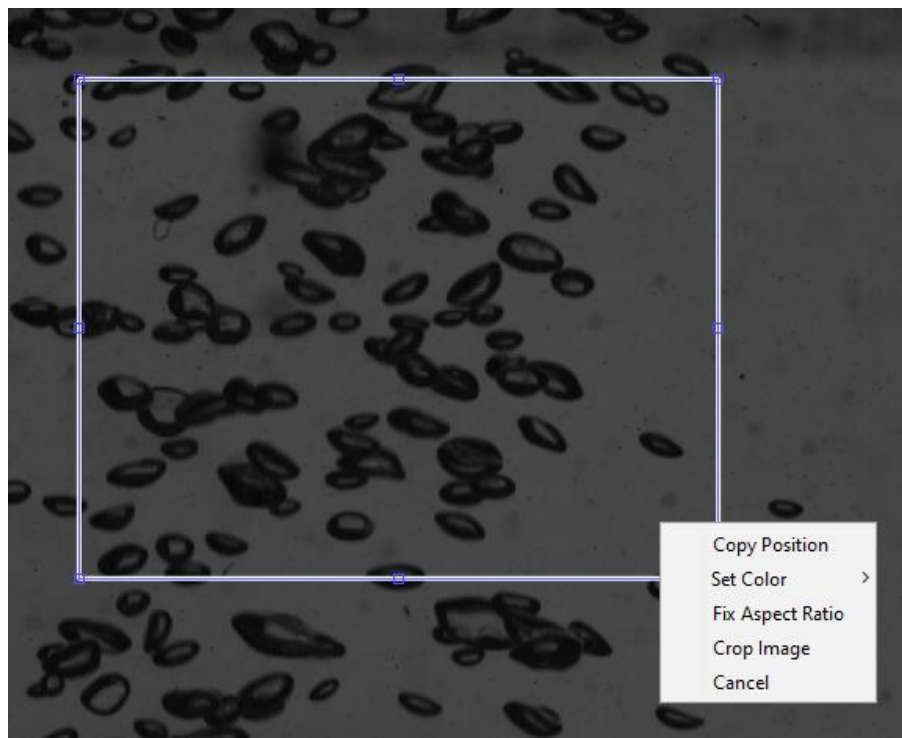


Figure 1: Crop Image

3. Use Pre-labeling

Manually marking all bubbles can be quite time consuming (and annoying). The BubCNN Transfer module provides two processes to pre-label images. Both techniques can be used for the same image. However, some bubbles might be marked twice.

a) Traditional image processing

Pre-labeling with a parameter-free traditional image processing that employs the following stages:

- Median Filter to reduce image noise
- Gradient detector with sober filter
- k-means segmentation of the gradients
- Class assignment to background or bubble outline
- Ellipse fitting for bubble outlines

b) BubCNN

For pre-labeling with a previous version of BubCNN, a trained Faster RCNN module has to be chosen first. After that, select a trained shape regression CNN. Note that the procedure might take a while.

4. Select Bubbles

With 'select bubbles', ellipses can be adjusted, wrong positives can be removed and missing ellipses can be created.

Remove ellipses:

- Click on the bubble you want to remove.
- Press 'backspace'. The program will search for the bubble which's center is closest to the last clicked location and remove it.

Create new ellipses:

- Click on a location you want to create a new bubble.
- An ellipse is created centered at the marked position. The semi-axes have the lengths defined on the main window.

Adjust ellipses:

- To shift an ellipse, move the mouse pointer inside the ellipse until you see the cross shown in Figure 2 (a). Press the left mouse button and drag the ellipse to the new position.
- To change the ellipse axis, move the mouse pointer to the ellipse control points until the you see the arrows seen in Figure 2 (b). Press the left mouse button and change the axis length to its new value.
- To rotate the ellipse, move the mouse pointer near the ellipse control points until you see the circle seen in Figure 2 (c). Press the left mouse button and change the rotation angle to its new value.

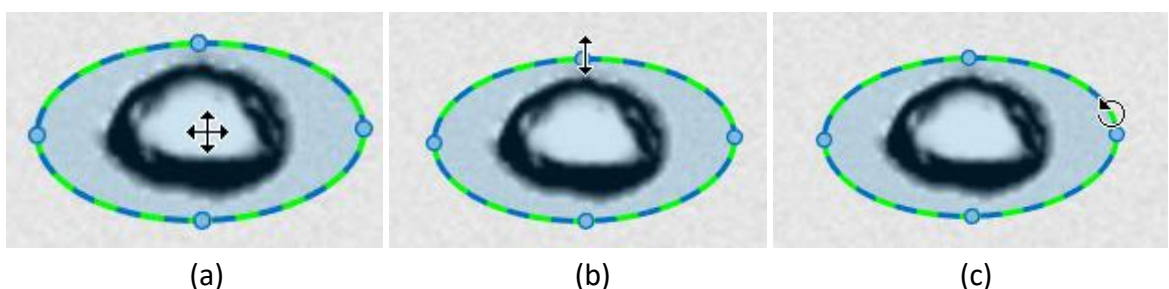


Figure 2: Adjustment of ellipses by shifting (a), axis manipulation (b) or rotation (c)

5. Save Lines/Points

6. Load Lines/Points

7. Create Training Data Sets

A data set to train a Faster RCNN module will be created by using all images on which bubbles were marked. Bounding boxes are created around the bubbles, based on the created ellipses. For each valid image, 25 augmented versions will be created by random cropping. The images will be saved and the bubbles location will be stored in a table.

For each marked ellipse, 100 data samples will be created by randomly creating image patches which contain the bubble. The samples will be automatically assigned to the training or the validation data set, based on random numbers.

Both training data sets will be saved in separate .mat files.

Please help improving future versions of BubCNN by sending these files and the images created to the author (haas@iob.rwth-aachen.de). All received data sets will be merged and used to train more general version of BubCNN.

8. Transfer Learning

Clicking on 'Transfer Learning' starts the learning process. Chose an existing version of the shape regression CNN as basis. First a customized version of this module will be trained. Subsequently it will be used as the basis for the Faster RCNN detector. Note that training will take about one hour on a GPU and much longer on a CPU. The program will automatically be executed on a GPU if available.