u-DROP Documentation

Micro Droplet Rate/Region Ocular Processing

Overview –

* This program analyzes the speed and sizes of droplets and plugs of microfluidic chips from a video. The user inputs the general regions of droplet activity in the video and then gets a variety of outputs, including the average dimensions, areas, and speeds of each droplet for droplet fission videos, and the drop generation rate and average size of each droplet for drop generation videos.

Inputs –

* A video of either droplet fission or droplet generation
  + This video should have a high FPS (so drop speeds can be accurately measured). Having even lighting, well defined drops, and a high quality camera can also help your accuracies if you feel that the program is having problems.
* User Drawn Zones
  + Fission
    - General bounding box of Central Droplet
    - General bounding box of Top Droplet
    - General bounding box of Bottom Droplet
  + Generation
    - General bounding box of generated droplet
    - Top bound of known location
    - Bottom bound of known location
      * The “known” location is simply to convert from pixels to micro meters.
      * For instance, if you include a 100 square micrometer box in your experiment, select the top of the box and the bottom of the box. For the channel width, input 10 micrometers. The program calculates the difference in pixels of the two inputted lines and uses the value you gave for channel width to convert from pixels to micrometers
* Known FPS of your camera
  + To convert from drop speeds in units per frame to units per second
* Known channel size
  + For drop fission, this is the channel width (in micro meters) of your central chamber
  + For drop generation, this is the distance in micrometers between the two lines that you drew.

Outputs –

* Fission
  + 0sin.csv, 1sin.csv, and 2sin.csv for the central, top, and bottom droplets respectively
    - These files contain the frame followed by a 1 if edge noise was detected and a 0 otherwise.
    - This file is meant as a check for the researcher
      * If the period of the graph seems uneven (holes or extra peaks), check to see if there might have been a processing problem
  + central\_droplet.csv, top\_chamber.csv, bottom\_chamber.csv
    - These files contain the standard output in csv form.
    - They are structured as follows:
      * Area in pixels, area in micrometers, standard deviation of area in pixels, standard deviation of area in micrometers
      * Major axis size in pixels, major axis size in micrometers, major axis standard deviation in pixels, major axis standard deviation in micrometers
      * Minor axis size in pixels, minor axis size in micrometers, minor axis standard deviation in pixels, minor axis standard deviation in micrometers
      * Speed in pixels, speed in micrometers, speed standard deviation in pixels, speed standard deviation in micrometers
  + central\_dropletraw.csv, top\_chamberraw.csv, bottom\_chamberraw.csv
    - Contains the measurements for each individual droplet
    - The lines are as follows:
      * Droplet Sizes
      * Droplet Major Axes
      * Droplet Minor Axes
      * Droplet speeds
        + No speed entry for the last drop, because the video ends before the full cycle can be measured
  + raw0, raw1, and raw2 folders for the central chamber, top chamber, and bottom chamber respectively.
    - These folders contain png images of your processed droplet. You can use these to determine if there is too much noise or if droplets aren’t getting picked up.



* + cleaned0, cleaned1, and cleaned2 for the central chamber, the top chamber, and the bottom chamber respectively.
    - These folder contain jpg images of the droplets that the program has determined to be “full” droplets (i.e. not cut off by the edge of the frame). The area (calculated by the convex hull of the droplet) is the white zone and the bounding rectangle (used for the major axis and the minor axis measurements) is drawn in blue.



* Generation
  + sin.csv and sin\_smooth.csv files
    - Gives the frame number and the average pixel value under the bounding box for that frame.
    - The sin.csv file is the raw values obtained from the edge detected video. The sin\_smooth.csv file is the smoothed out wave data.
    - This file is mostly included as a check. Graph the values, and see if the resulting wave is messed up in anyway (peaks missing, or multiple peaks per period)
  + drop\_data.csv
    - Contains the standard output in csv form
    - It contains the following information (in order):
      * Average area of the droplets in pixels
      * Average area of the droplets in micrometers
      * Standard deviation of the droplets in pixels
      * Standard deviation of the droplets in micrometers
      * Drop Generation Rate
  + drop\_data\_raw.csv
    - A list of the areas of each droplet
  + raw folder
    - Contains png images of the edge detected droplet. Use this to see if the program is either outputting too much noise or if the program is missing parts of the droplet



* + cleaned folder
    - Contains the jpg images of the droplet frames whose average pixel value was determined to be a local max. These are the frames where the drop size is determined.
    - The convex hull of the drop is drawn in white (the area of the convex hull is taken as the area of the droplet). The bounding box is drawn in blue.



Trouble shooting

* Generation
  + The program failed!
    - Check the sin\_smooth graph. Look at the peaks then look at the raw folder images. Is there actually a droplet where the peak says there is one? If there is not, you’re video is probably going to fast, and the smoothing is breaking something. Try it again without smoothing. You can also try drawing the bounding box larger or