Geometric orifice area (GOA) analysis,

Matlab user protocol

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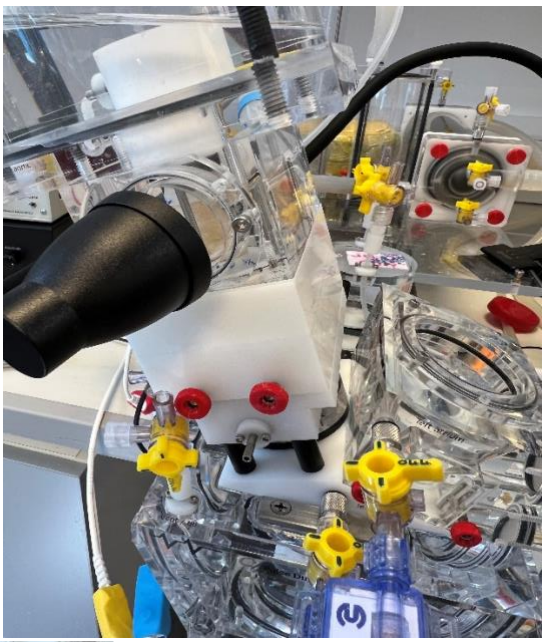
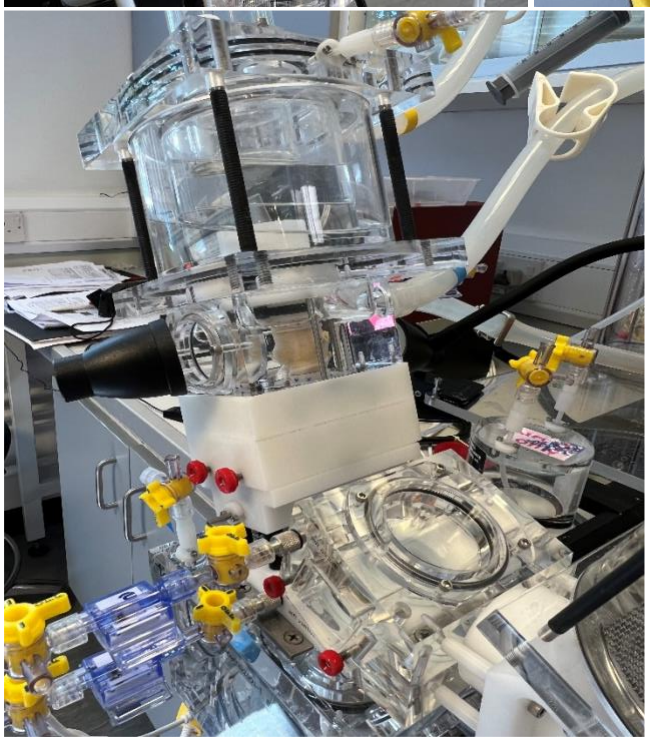
Image acquisition

Camera and light settings for GOA video

- Adjust the lights clamped onto the Vivitro by placing it on each side of aortic chamber (refer to the image below).





- Set the camera to HFR mode, HFR aperture at 480FPS or 960FPS with record setting at 24P 50M, priority setting on quality priority and record timing at end trigger.
- Place the camera on top of aortic view tube like shown in the image below.

- Zoom in slightly to capture a close view of the orifice.
- Ensure the lights are focused onto the valve cusps keeping the background dark.

2)Press movie button to start recording

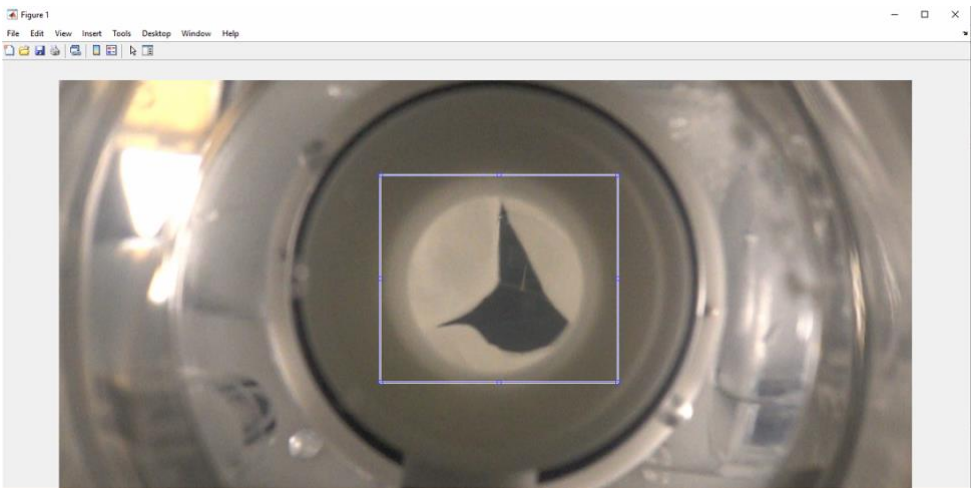
1)Press centre button to put on standby mode

Plotting GOA curve using MATLAB

- Move both the Matlab file in the same folder as the video
- Open Matlab software

<u>Play HCCV_Code1.m to chop video</u>

- Open the folder with saved video files by clicking on browse folder icon, displayed on the left in Matlab user interface, in the bar above current folder.
- Play HCCV_Code1.m
- Click 'Run' , displayed on the top bar in the editor tab
- A dialog box will appear, select the MP4 video file and click open.
- Image processing tool box will appear as shown below, using the cross cursor draw a box around the orifice to crop the image.



- Press enter or right click to select the option 'crop image' (note: whilst the code is running it will show 'busy').
- 'Press any key' indicating on the bottom left in the Matlab interface to complete the process (note: whilst the code is running it will show 'busy').
- Minimise the image processing dialog box as the code will save the cropped video file in the current folder.

Image tracing of leaflet and graph plotting

- Open the folder with saved video files by clicking on browse folder icon, displayed on the left in Matlab user interface, in the bar above current folder.
- Play HCCV_Code2.m
- Necessary changes can be made to the code depending on each video settings(refer to the image below to make changes to the code).

```
close all
clear all
[fname,pname]=uigetfile('*.avi','Video');
filename=[pname,fname];
v=VideoReader(filename);
boundingbox=[28/2 29/2 320/2 321/2];

%% CHANGE HERE %
loadprev=0; %0
plottype = 'both';
% Control mask size (thresholds..etc)
blend=-10; %bigger shrinker def (-10)
stelsize=10; %bigger, bigger def (10)
thresh2=-0.02; %def (-0.02)

% Timing setting
starttime=0;
fps=480; %500 for ucl camera, def (960)
endtime=v.Duration*(v.framerate/fps);

%method of creating finalmask
optionno=2; %2,3,4,5 def (3)
%pick closest to centre 'd'      or largest area 'aa'
```

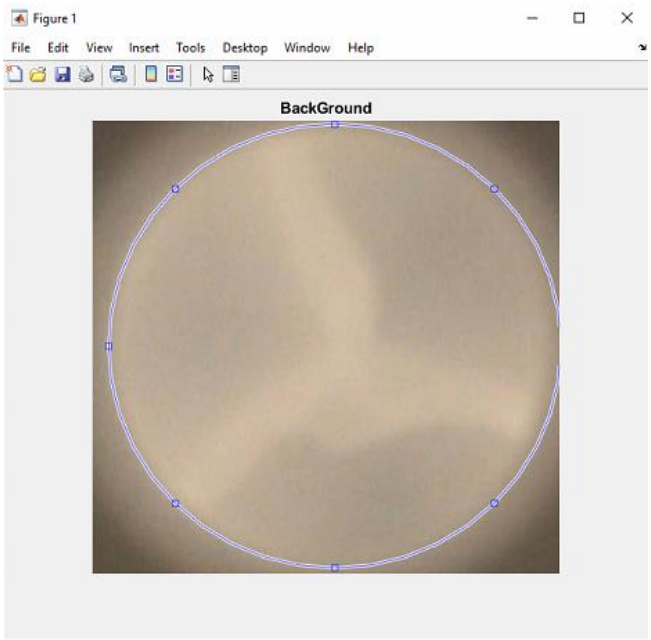
For total or change to 'fractional'

Can be adjusted allowing to trace valve leaflets

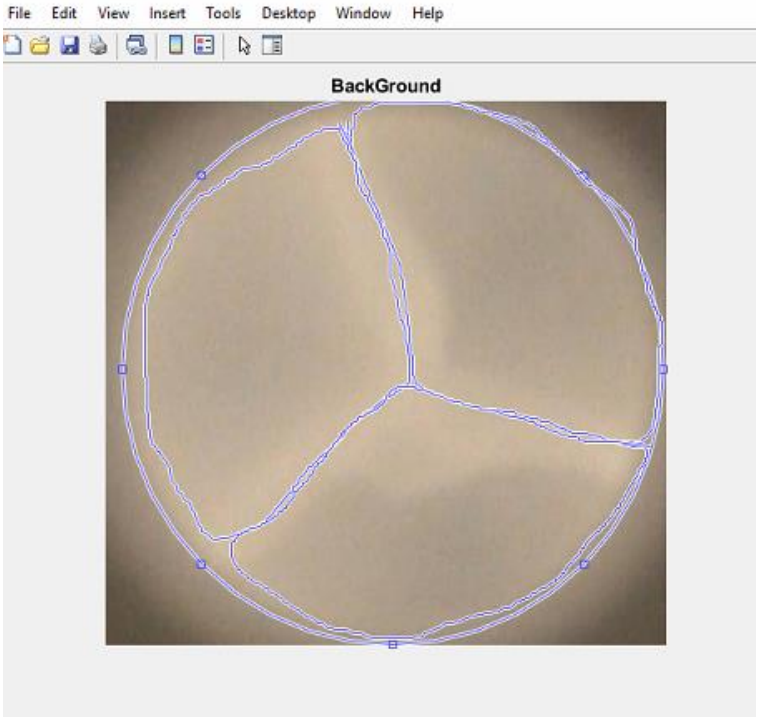
Frame rate must be adjusted to match the camera setting

Switch to 2 or 3 mostly for better results, eliminating background signals

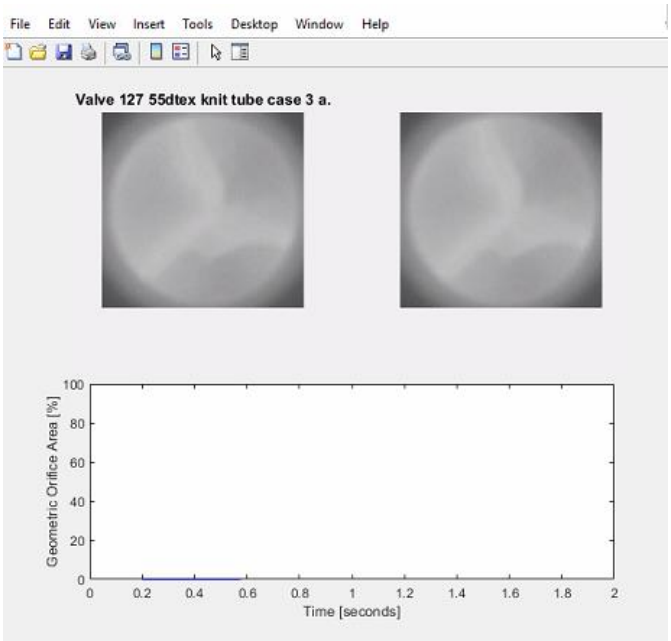
- After making suitable changes Click 'Run' displayed on the top bar in the editor tab.
- A dialog box will appear, select the cropped video file (AVI.file) generated from the previous code saved in the current folder and click 'open' or double click to open the file.
- Image processing tool box will appear, align the orifice using the circle tool and adjust it accordingly (see the image below).

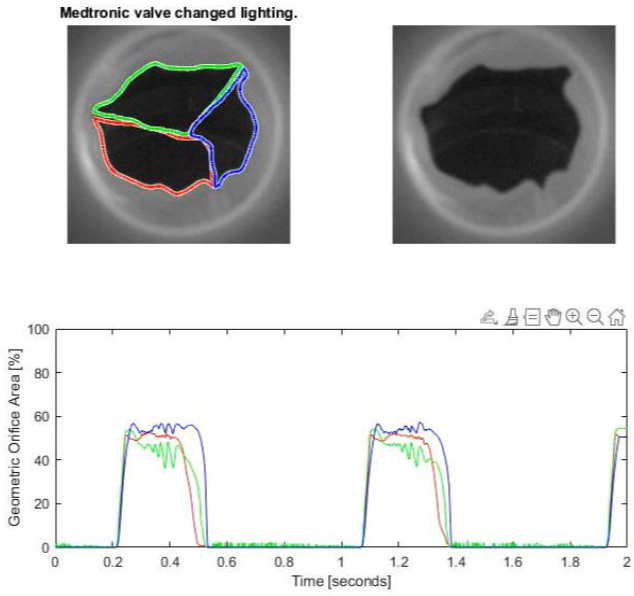


- Press any key, a cross cursor will show, using it trace the edges of three leaflets like shown in the image below (note: after tracing one leaflet, press any key to start tracing the next).

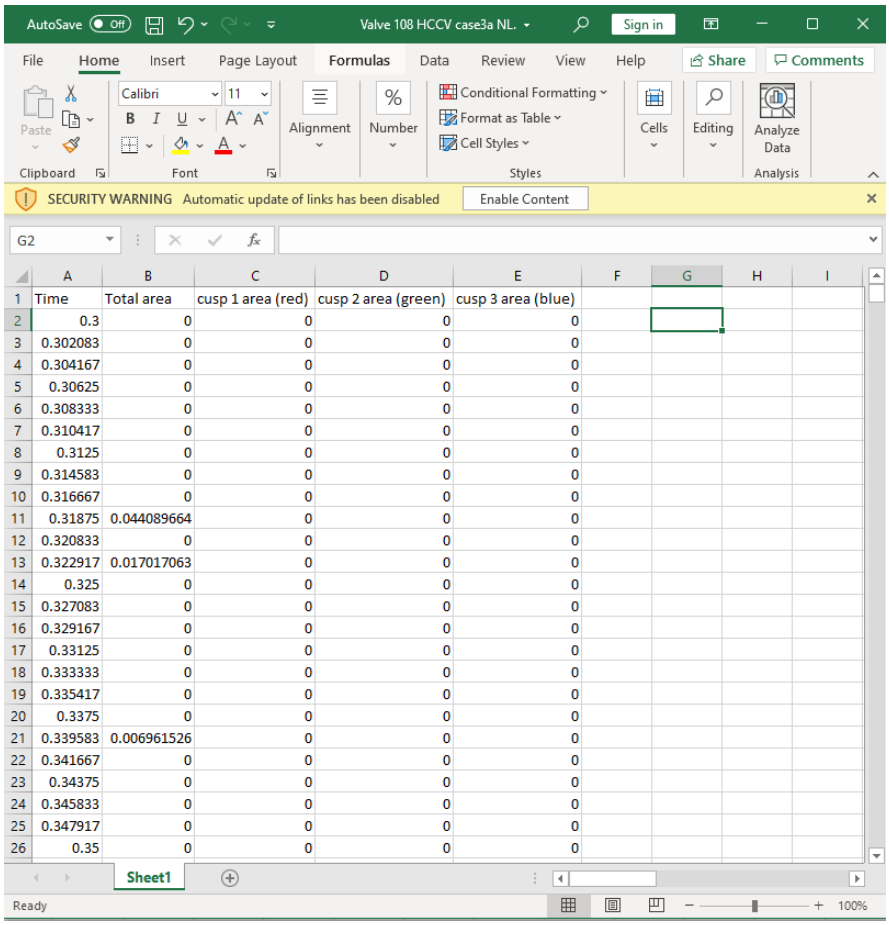


- Press ‘enter’ to continue processing.
- The code will display a video processing toolbox, plotting the curve for each leaflet (see the image below). This can take few minutes, leave the code running for the analysis to complete (note: whilst the code is running it will show ‘busy’).





- The video file will be saved in the current folder open. The code will also generate an Excel file with data showing the time points, total area of orifice and area of each cusp at given time point. See the image below of Excel file with labelled columns.



	A	B	C	D	E	F	G	H	I
1	Time	Total area	cusp 1 area (red)	cusp 2 area (green)	cusp 3 area (blue)				
2	0.3	0	0	0	0				
3	0.302083	0	0	0	0				
4	0.304167	0	0	0	0				
5	0.30625	0	0	0	0				
6	0.308333	0	0	0	0				
7	0.310417	0	0	0	0				
8	0.3125	0	0	0	0				
9	0.314583	0	0	0	0				
10	0.316667	0	0	0	0				
11	0.31875	0.044089664	0	0	0				
12	0.320833	0	0	0	0				
13	0.322917	0.017017063	0	0	0				
14	0.325	0	0	0	0				
15	0.327083	0	0	0	0				
16	0.329167	0	0	0	0				
17	0.33125	0	0	0	0				
18	0.333333	0	0	0	0				
19	0.335417	0	0	0	0				
20	0.3375	0	0	0	0				
21	0.339583	0.006961526	0	0	0				
22	0.341667	0	0	0	0				
23	0.34375	0	0	0	0				
24	0.345833	0	0	0	0				
25	0.347917	0	0	0	0				
26	0.35	0	0	0	0				