CMRR Presentation

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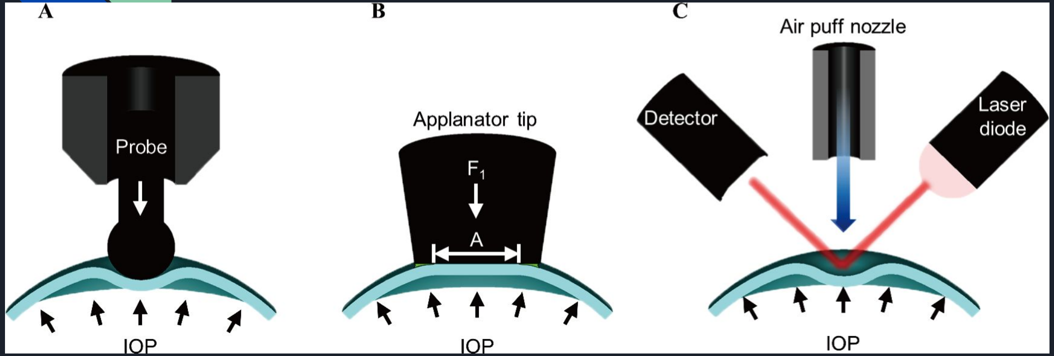
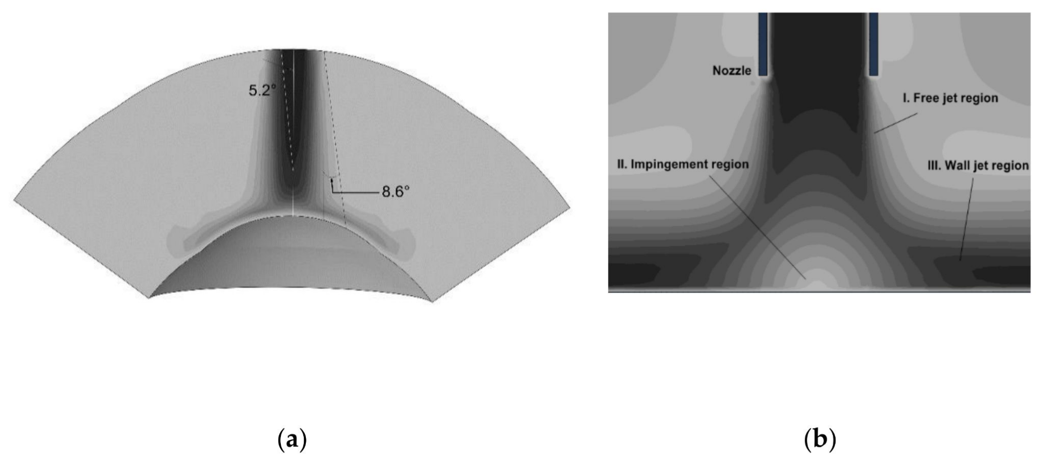
Tonometer Overview





Working principles of conventional intraocular pressure measuring system:

(i) Applanation tonometer

(ii) Rebound tonometer

(iii) Air-puff tonometer

Goldmann Applanation Tonometer

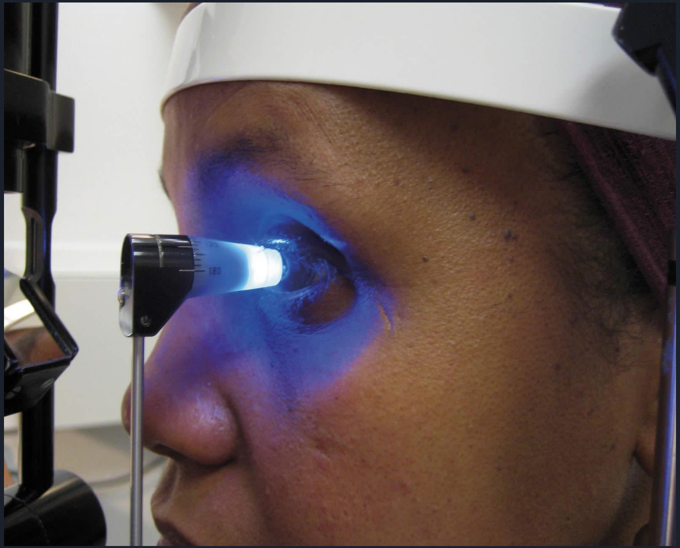
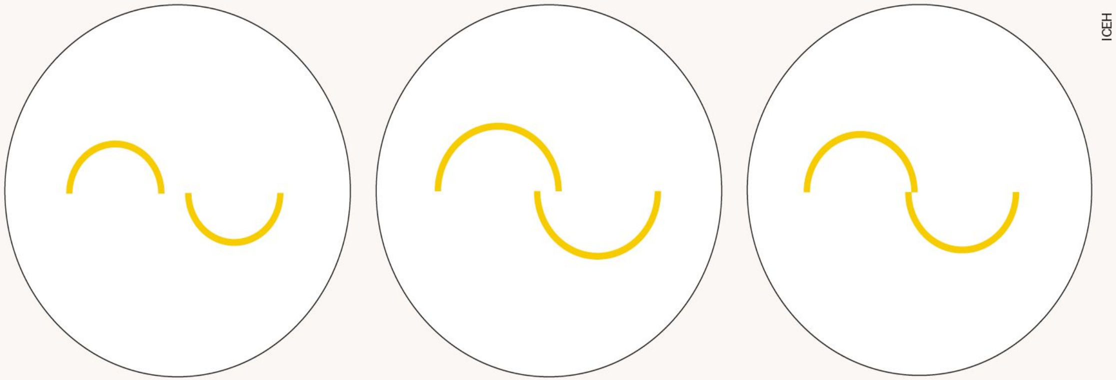


Figure 1. Applanation tonometry semi-circles viewed through the Goldmann prism

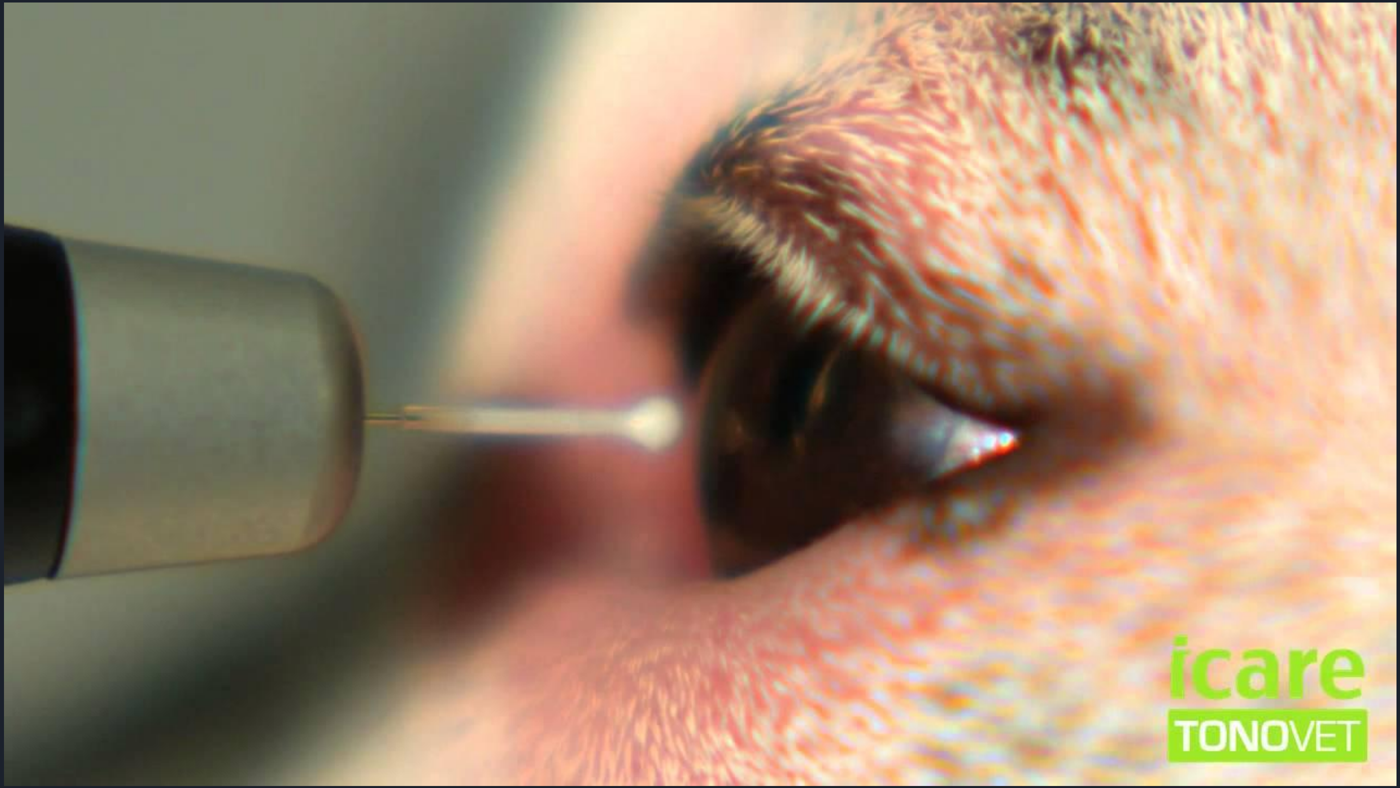


High intraocular pressure will result in this image. Turn the calibrated dial on the tonometer backwards to reach the accurate end point.

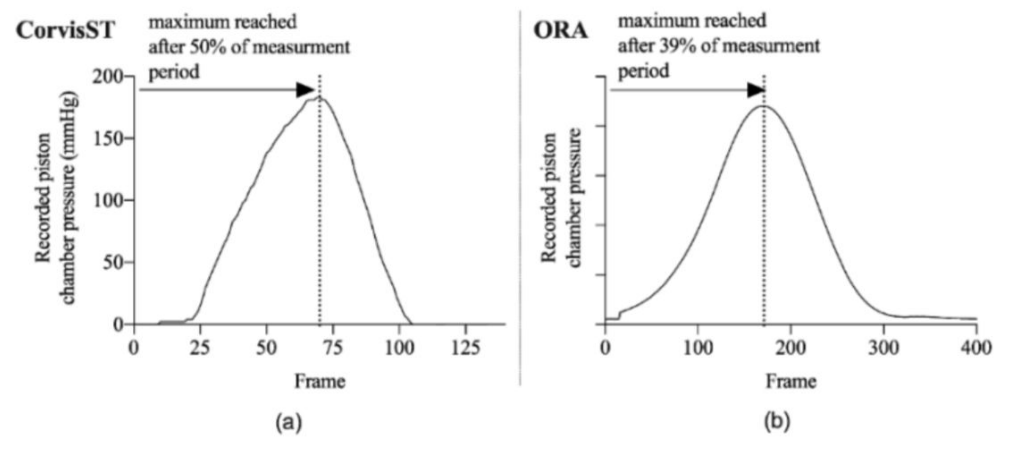
Low intraocular pressure will result in this image. Turn the calibrated dial on the tonometer forwards to reach the accurate end point.

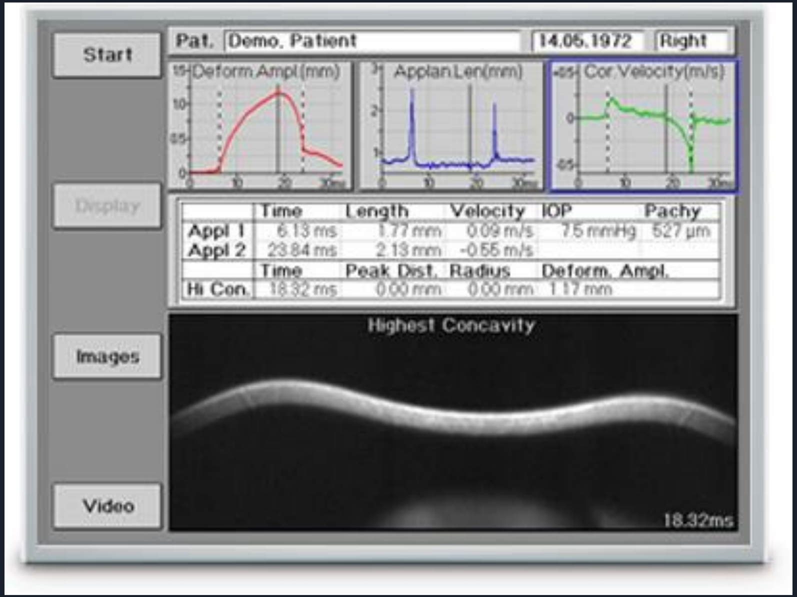
This is the correct end point – the inner edges of the semi-circles are just touching. This will give an accurate reading of intraocular pressure.

Rebound Tonometers



Corvis ST Tonometer (Air Puff Tonometer)





Talke Air Puff Device

Here we consider that the conical null-screen is a truncated cone with radius *s*, height *h*, it is oriented along the *z*-axis, and its base is located at $z = 0$.

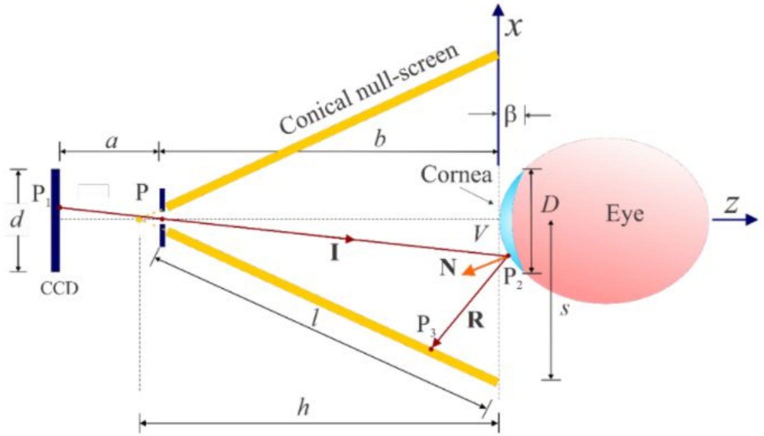
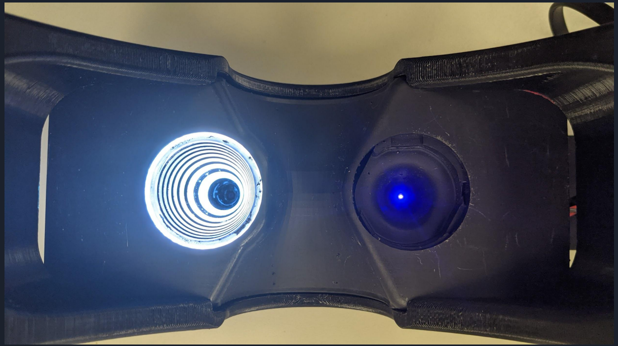
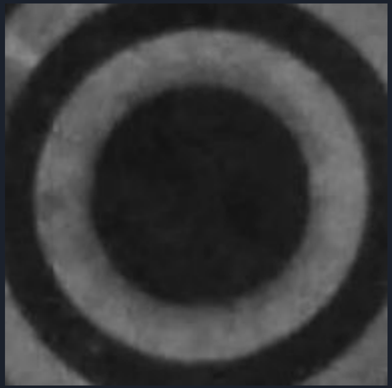


Figure 1. Schematic diagram of the conical corneal null-screen compact topographer.



Extract → Crop Images (Preprocessing)



K-Means Image Segmentation

- Unsupervised ML algorithm
- Randomly groups data points with similar brightness values in clusters (shown by same color)
- Useful for detecting distinct features (light rings) from surrounding information

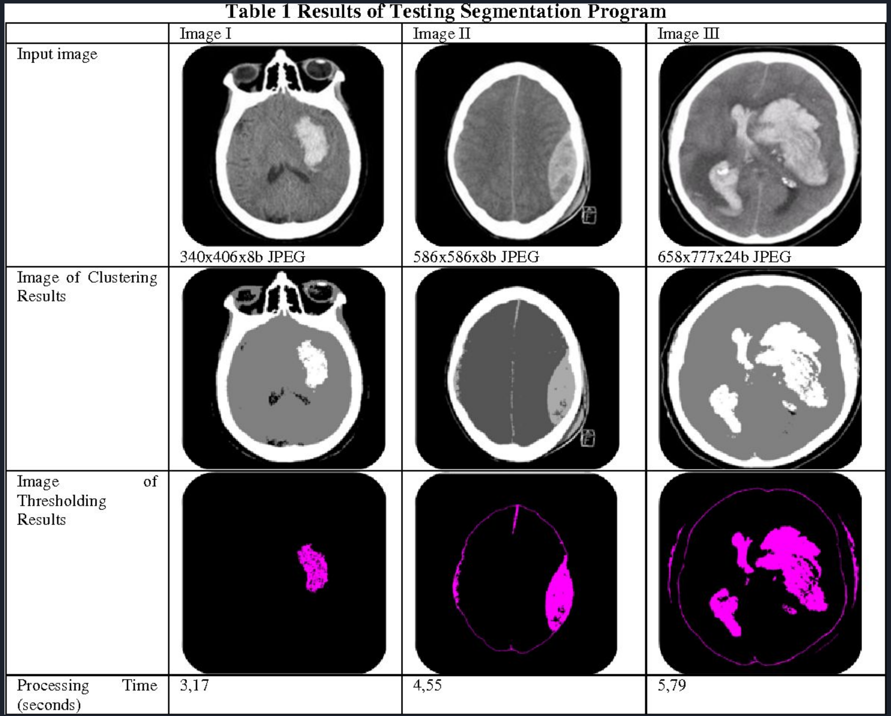
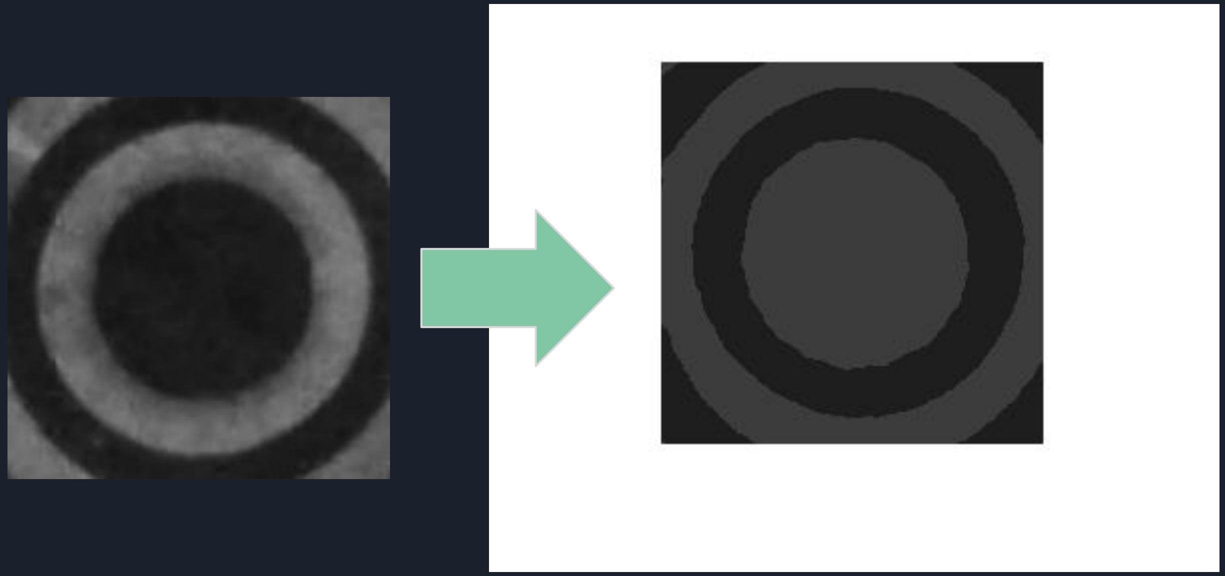


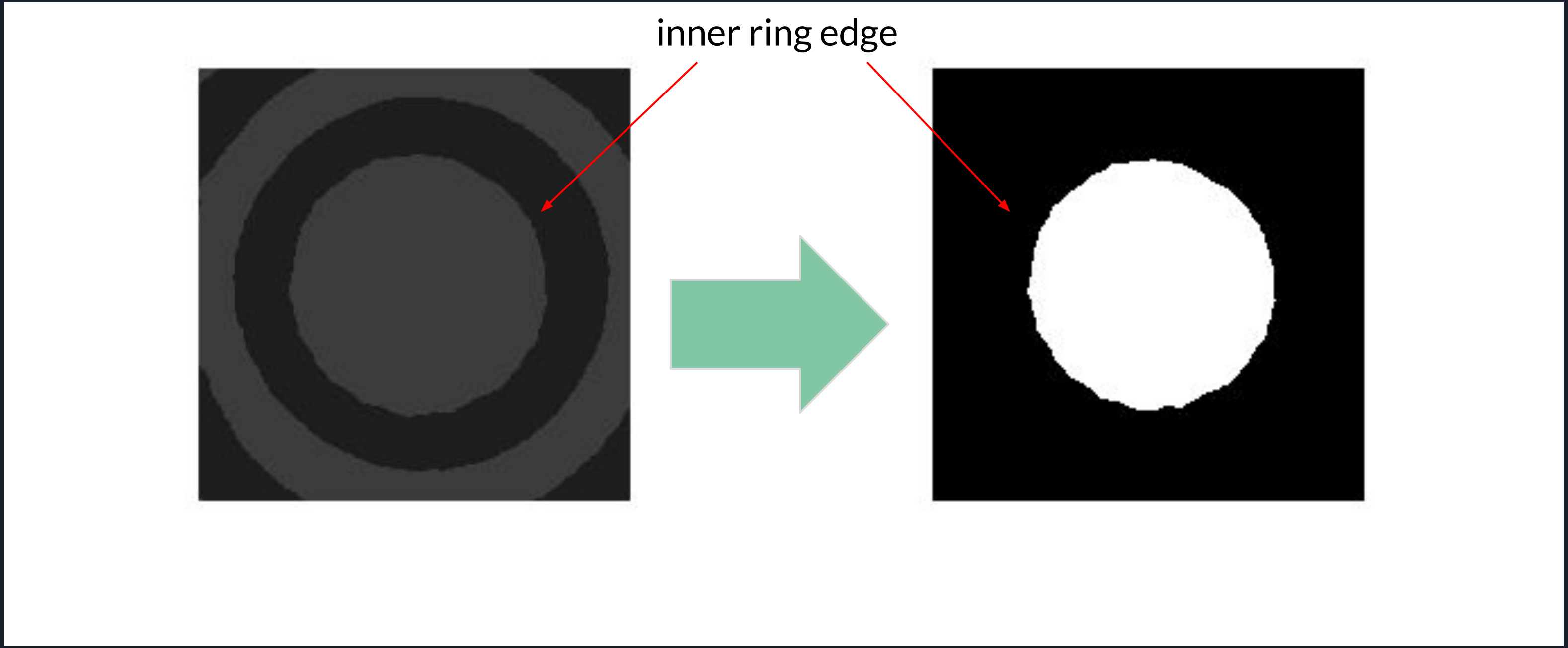
Table 1 Results of Testing Segmentation Program

	Image I	Image II	Image III
Input image	340x406x8b JPEG	586x586x8b JPEG	658x777x24b JPEG
Image of Clustering Results			
Image of Thresholding Results			
Processing Time (seconds)	3,17	4,55	5,79

K-Means Image Segmentation

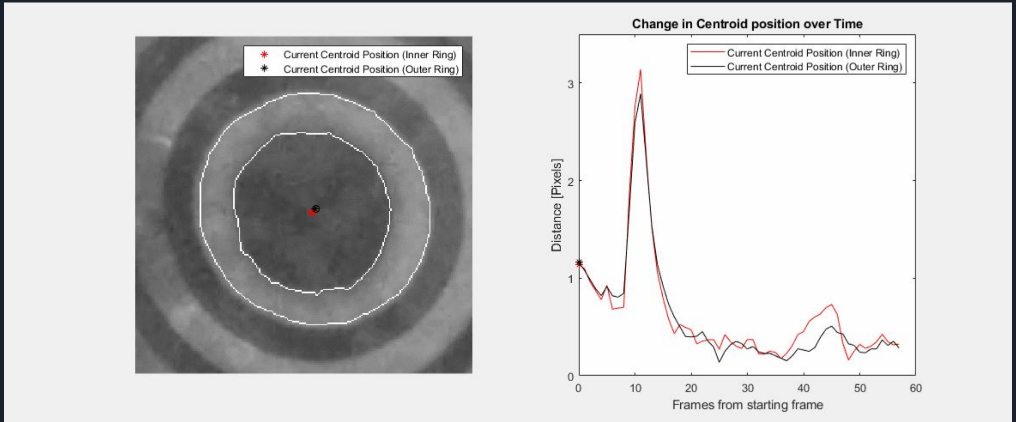


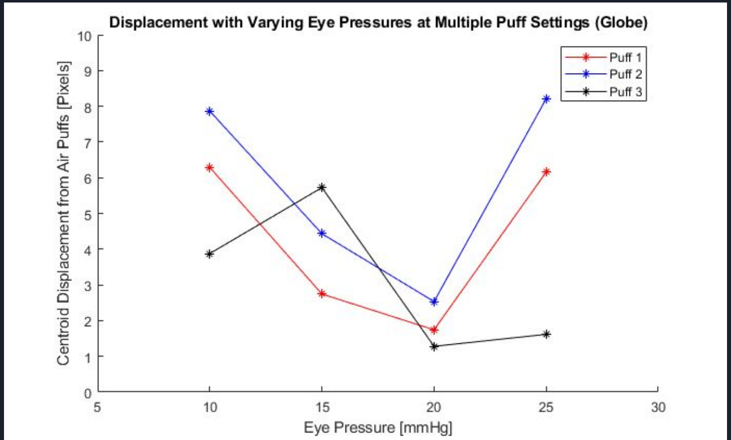
Isolate Inner Edge of 1st Ring, Make Binary Image



Metrics of IOP - Centroid Distance from Baseline

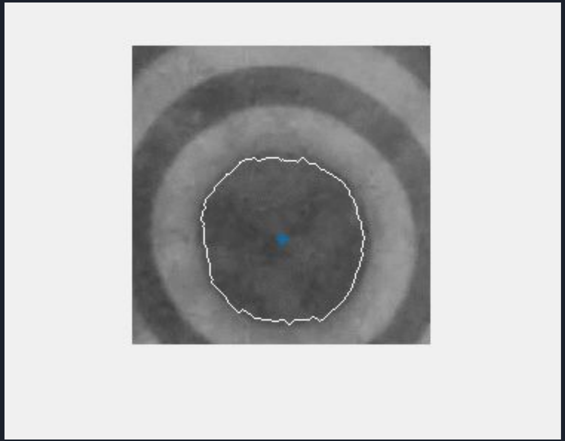
- Compares centroid of perimeter to the averaged centroid (obtained by ignoring outliers from air puff frames)
- Strong relationship between IOP and centroid distance

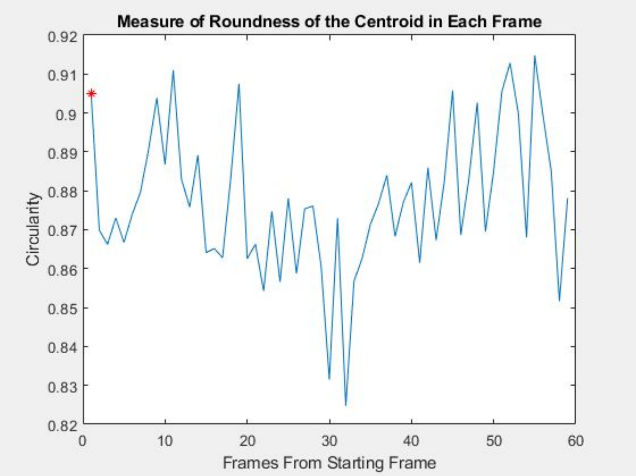




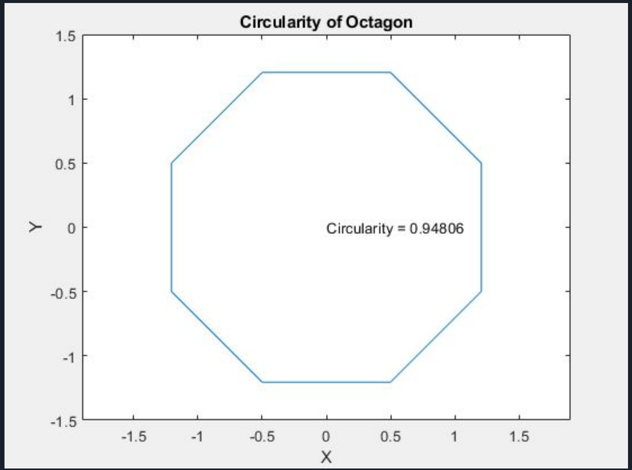
Metrics of IOP - Circularity

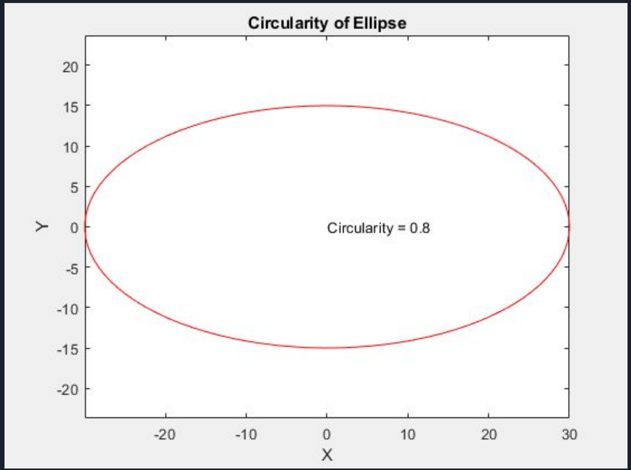
- Roundness is based on the ratio between the inscribed and the circumscribed circles, i.e. the maximum and minimum sizes of circles that fit inside and enclose the shape
- Approximated by $\frac{2\pi A}{P^2}$
- Strong relationship between IOP and circularity metric at a higher image resolution

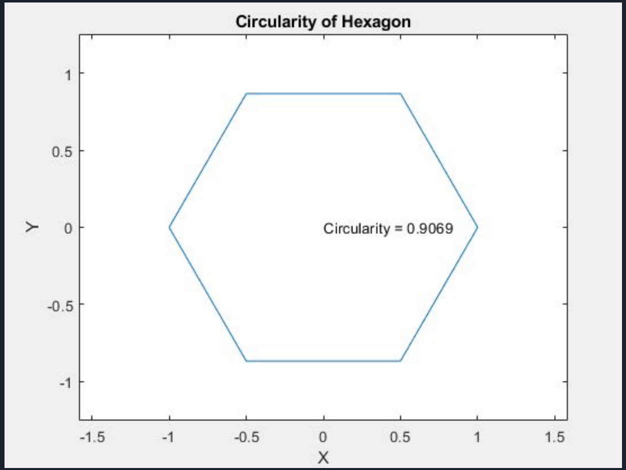


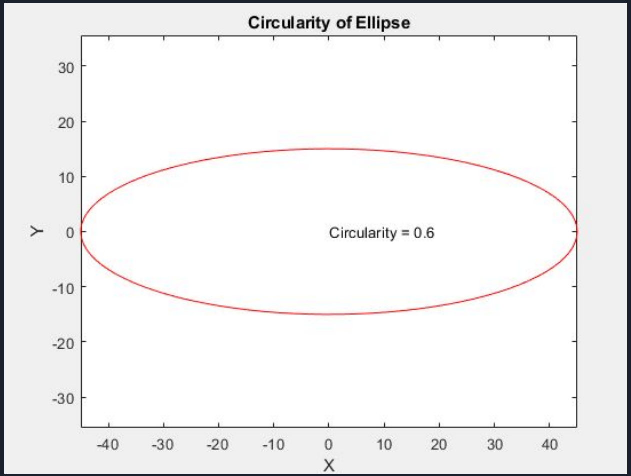


Metrics of IOP - Circularity



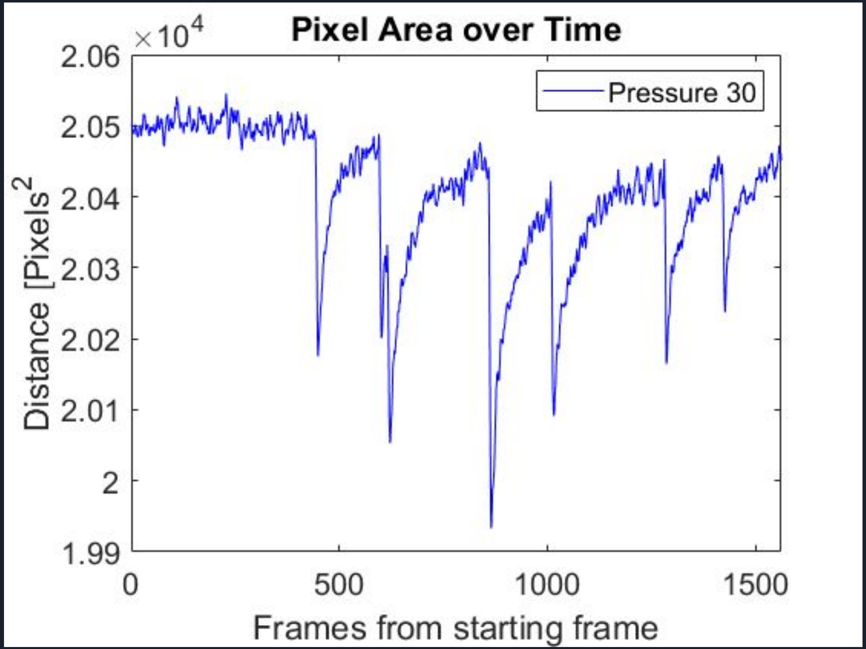






Metrics of IOP - Area

- Compares the overall area of the rings with the overall area of the rings with the previous frame
- Best relationship between IOP and area metric given our current image resolution due to the enormous changes in area after each air puff



Next Steps

- Experiment w/ new 3-in-1 device (higher FPS)
- Obtain data from experiments relating IOP to metrics
- Write paper describing device and results