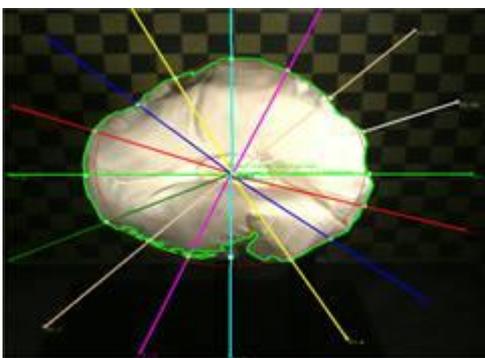
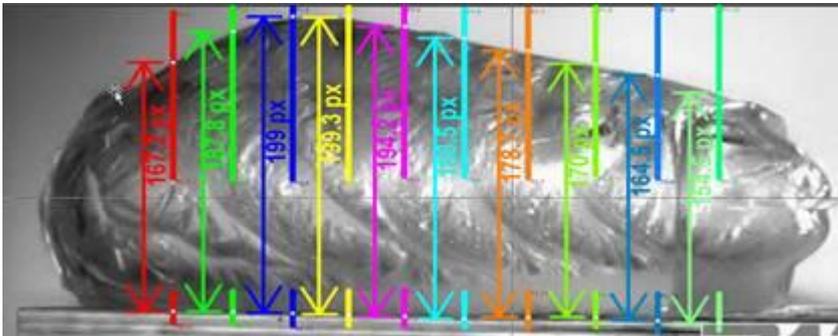
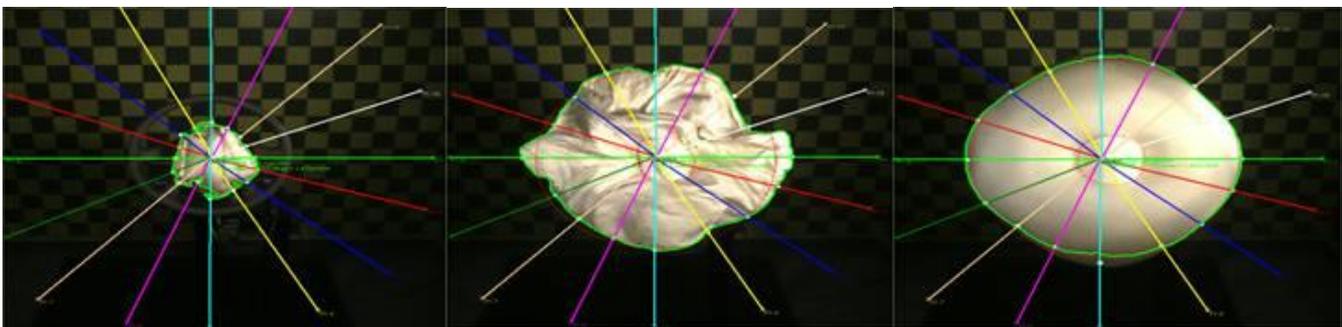




When attempting to measure the cavitation volume during ballistic gel research, the ProAnalyst software enables you to track the edges of an event:



You would need to step through the videos to show the maximum:



and then the area can be calculated.

Of course having a good contrast and defined area is vital.

However it is only from one perspective.

If we assume the cavitation effect is symmetrical, then you could possibly take this area and convert to volume. However, there isn't an accurate method for estimating a volume from an area.

The area in the images above could be calculated in a pretty straightforward manner using the Contour toolkit, but to extrapolate this to 3-D would be an approximation.

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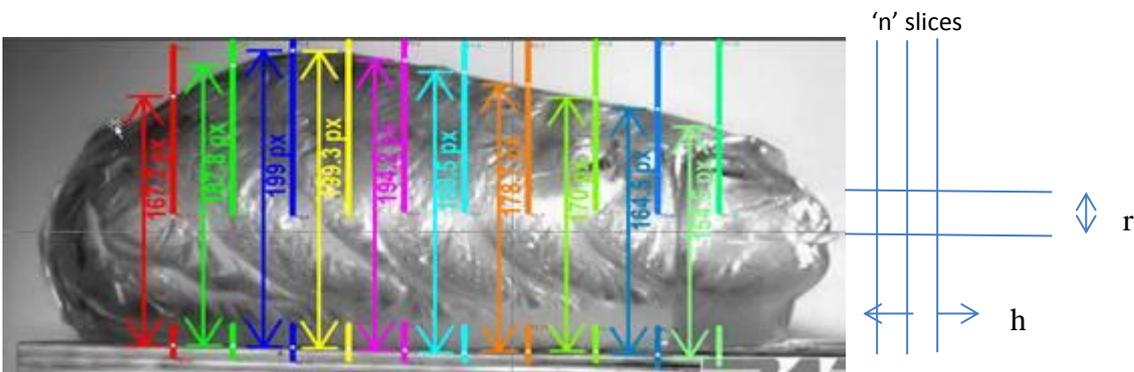


You could perhaps assume that it would be the equivalent of taking a curve and then rotating it 360 degrees around an axis. But then you would need to estimate the curve to use. For instance, the curve at the top and bottom (or left and right) of the object are not the same. So you would need to take an average of the top and bottom curves and then rotate that about the horizontal line halfway between the top and bottom. Most objects would not be symmetrical about this mid-line, so this is a pretty big assumption.

ProAnalyst does not perform this calculation automatically at the moment, but Xcitex could add something like that if necessary, or it can be done on the exported data using Excel (or Matlab, Python, etc). The equation for rotating a curve about a line is straightforward to calculate, but since it would be inherently very approximate because of what is described above, it is not currently in ProAnalyst.

Below are notes on the calculation that would be used.

Volume approximation



NOTE: This method is an approximation only, and only works for smooth area i.e. no double-backs/holes etc. e.g. this is not allowed:



Divide the area into 'n' slices (as small as possible for maximum accuracy). Each slice can then be approximated as a cylinder of radius 'r' and height 'h' (i = 1 to n)

Assuming symmetrical, volume is then:

$$\pi h (r_1^2 + r_2^2 + \dots + r_n^2)$$

Measurement of Volume by above method is accurate to about 90% to 110% of Actual Volume.

If it is possible to assign a curve of the form y=f(x) to the line bonding the area, then the 'volume of revolution' method could be used.

This could be the subject of further research, but due to the expected shape, only a series of 'micro-curves' could probably be used.

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