# Dorsey Method for Interfacial Tension

July 27, 2004

The Dorsey method is an old graphical method for measuring surface tension on large sessile drops [*Dorsey, J.Wash.Acad.Sci, 18, 505 (1928)*]. The method is unique in that it is practical to do manually. Of course, it can also be done automatically. Fta32 software offers both options. The principal limitation is the sessile drop must have a diameter on the order of 10mm. It can not be used on small drops, nor on pendant drops. Finally, the major diameter must be visible. That is, the contact angle of the sessile drop must be greater than 90°.

The method involves two dimensional measurements:

- the major diameter, D, measured horizontally across the drop.
- the super height, H. This is more complicated. Imagine a protractor-like tool that is spread to 90° and held above the drop so each downward leg is at a 45° angle. This tool is lowered until the legs are tangent to the sessile drop. The vertical distance from the apex of the tool down to the top of the drop is what we call the super height.

With

$\gamma$ = surface tension

g = acceleration due to gravity

$\rho$ = density of liquid

f = an arbitrary factor defined by
$f = (2\ H / D) - 0.4142$

then

$$\gamma = (g\ \rho\ D^2 / 4)\ (.052/f - 0.1227 + 0.0481\ f)$$

The following screen shots show the method and compare it to the Laplace-Young integration on the same drop. The liquid is ordinary tap water at room temperature. The expected IFT is about 71mNm.

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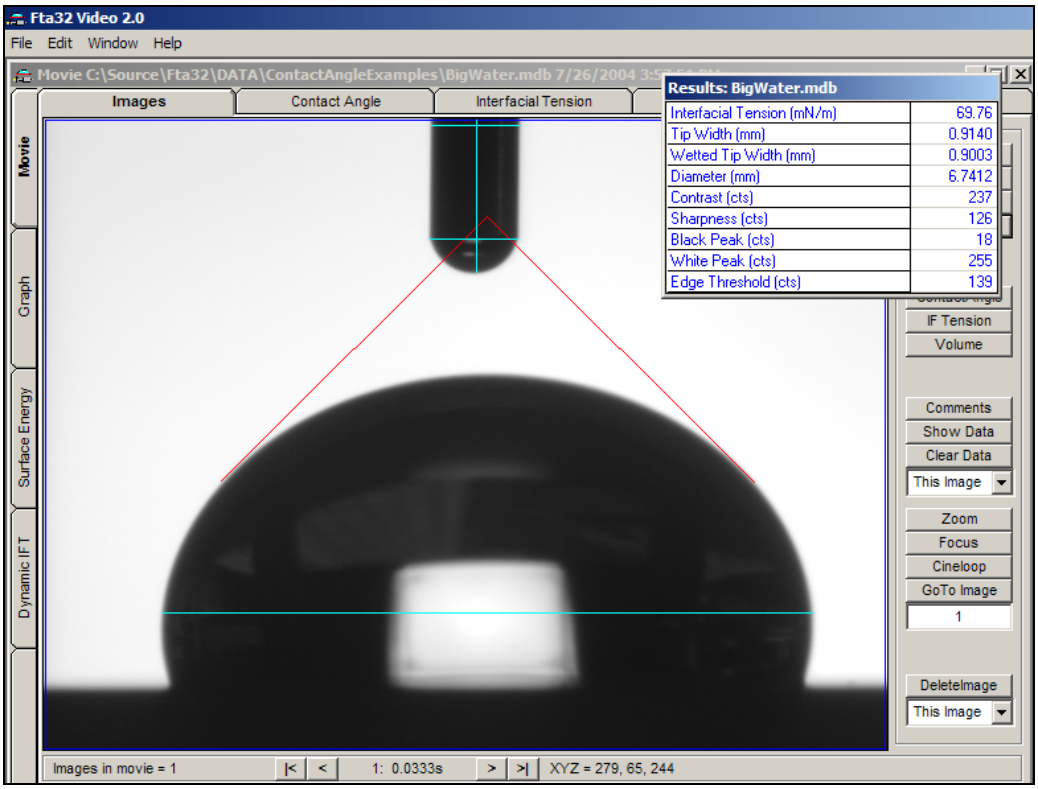
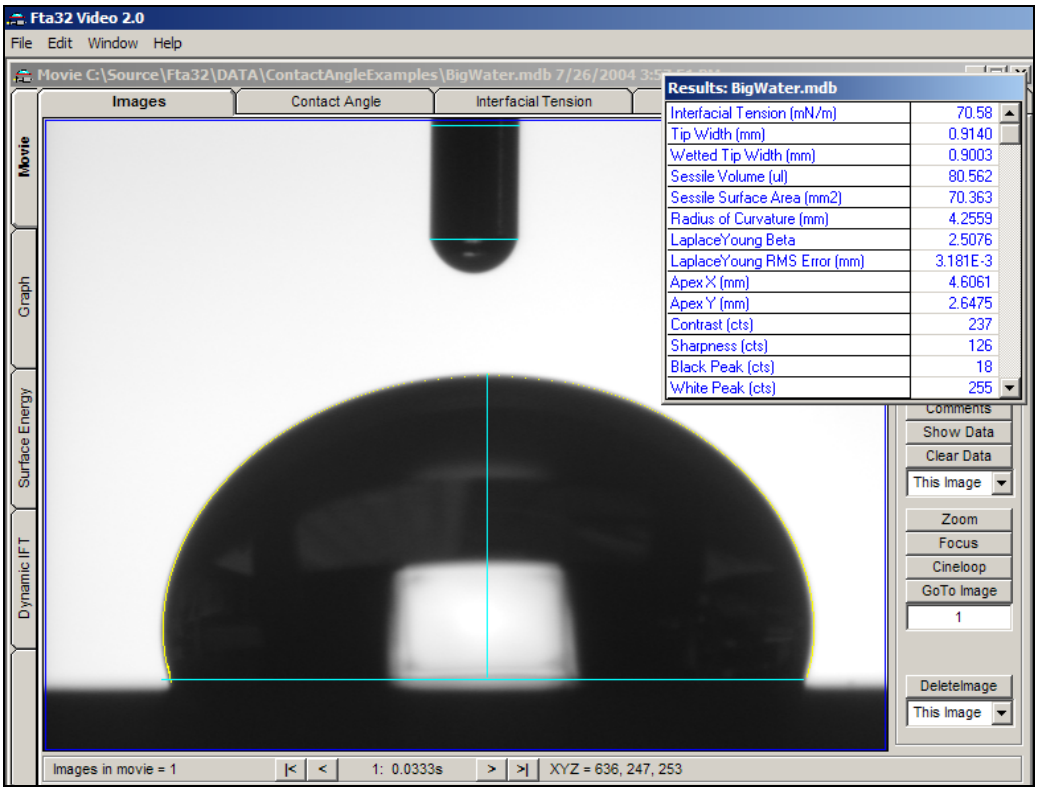
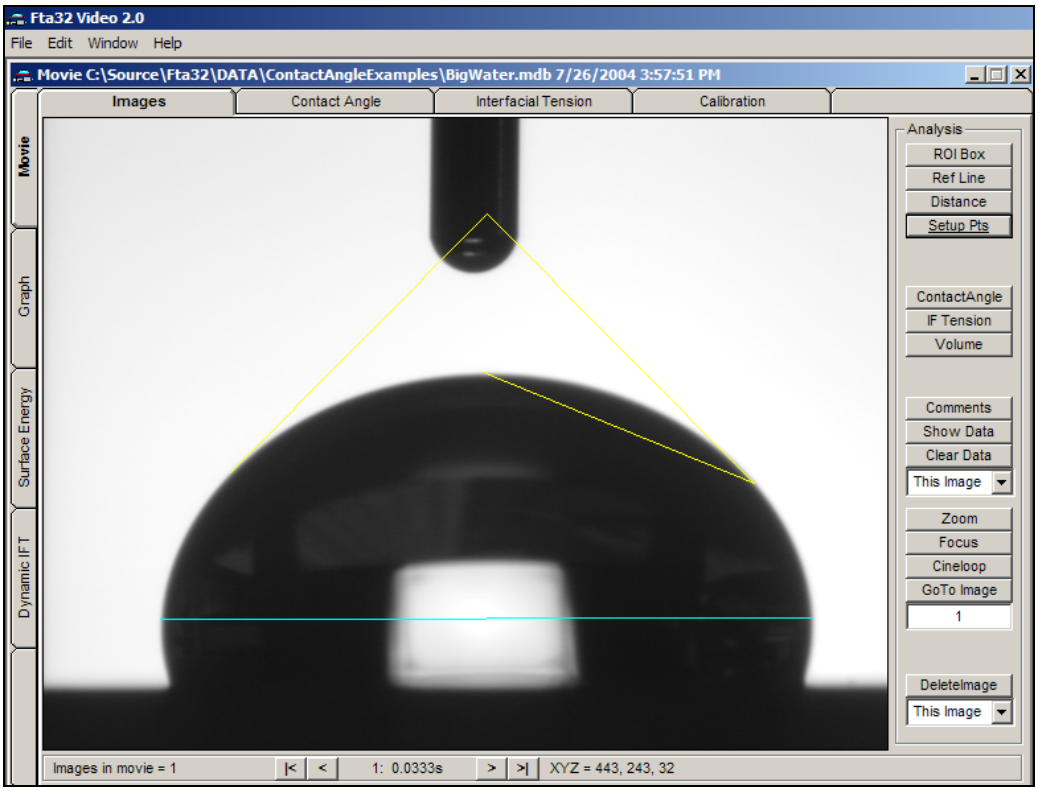


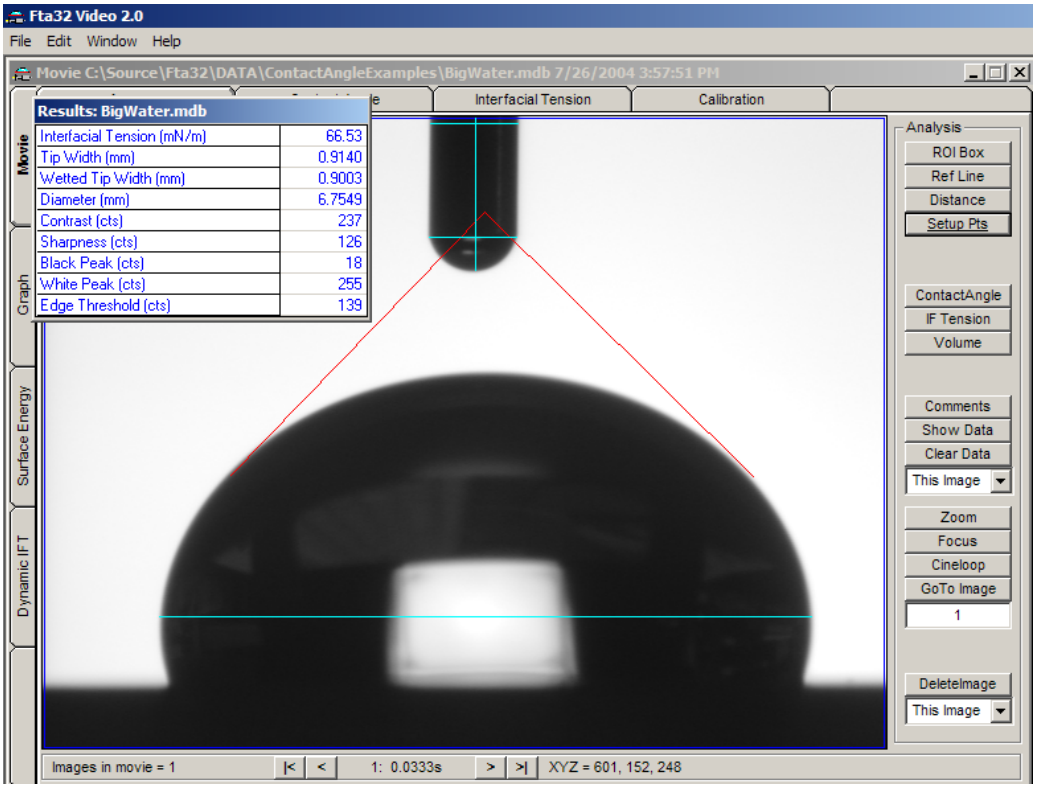

Automatic Dorsey method. $\gamma$ = 69.76. Diameter D = 6.7mm, below recommended 10mm.




Laplace-Young method. $\gamma$ = 70.58




Manual mode points. Left clicks made yellow points; right clicks blue.




After clicking Contact Angle, Dorsey method yields $\gamma$ = 66.53 for manual points.

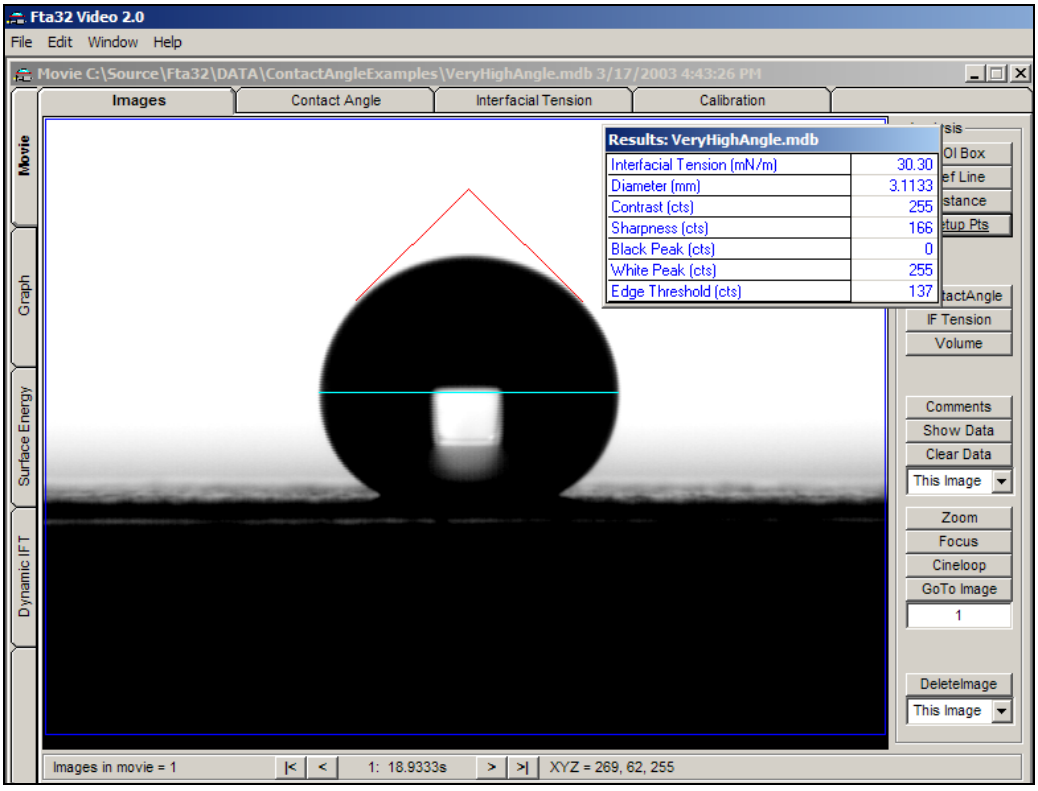
When using the manual method, the points clicks must be in the following order:

- Right 1 = left maximum diameter
- Right 2 = right maximum diameter
- Left 1 = left 45° tangent point
- Left 2 = apex at 90° angle
- Left 3 = right 45° point
- Left 4 = top of drop

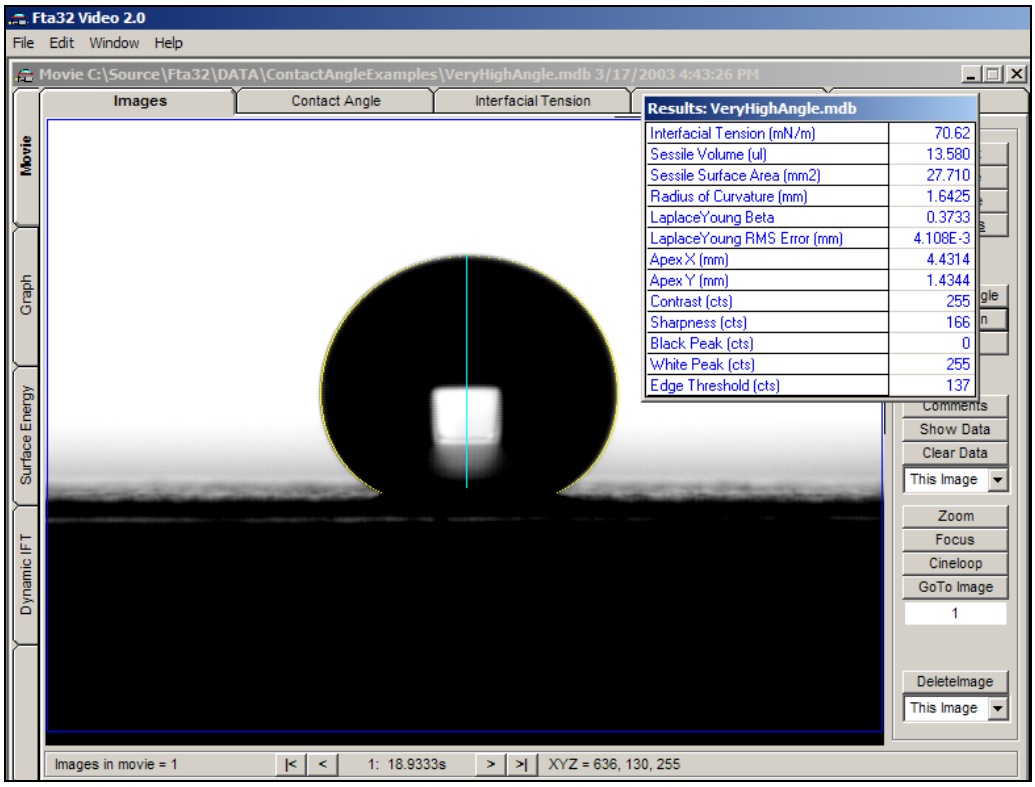
Remember you can drag points once you have made them in order to get better positions.

You must be very precise. You will find seemingly small errors lead to large changes in surface tension.

The size of the drop is very important. Notice what happens on the following smaller drop when the Dorsey method is applied (the results is significantly low). The sample is again water.




Dorsey method reports $\gamma$ = 30.3 (!) on this 3.1mm diameter drop.




Laplace-Young method $\gamma$ = 70.62.

To do the Dorsey method manually:

1. Click the Dorsey checkbox on the Interfacial Tension tab of the Movie.
2. Click the points, in order, as described above.
3. Click the Contact Angle tool button. The Results box will appear.

To do the Dorsey method automatically:

1. Click the Dorsey checkbox on the Interfacial Tension tab of the Movie.
2. Click the Contact Angle tool button. The Results box will appear.

File: Dorsey.doc