

#### Illinois Wesleyan University Digital Commons @ IWU

John Wesley Powell Student Research Conference

2015, 26th Annual JWP Conference

Apr 18th, 2:00 PM - 3:00 PM

#### Contact Angle Measurement

Wenting Zhao
Illinois Wesleyan University
Mark Liffiton, Faculty Advisor
Illinois Wesleyan University

Follow this and additional works at: http://digitalcommons.iwu.edu/jwprc Part of the Computer Sciences Commons

Wenting Zhao and Mark Liffiton, Faculty Advisor, "Contact Angle Measurement" (April 18, 2015). *John Wesley Powell Student Research Conference*. Paper 21. http://digitalcommons.iwu.edu/jwprc/2015/posters2/21

This Event is brought to you for free and open access by The Ames Library, the Andrew W. Mellon Center for Curricular and Faculty Development, the Office of the Provost and the Office of the President. It has been accepted for inclusion in Digital Commons @ IWU by the faculty at Illinois Wesleyan University. For more information, please contact digitalcommons@iwu.edu. ©Copyright is owned by the author of this document.



# Measuring Contact Angles

Wenting Zhao Advisor: Mark Liffiton Department of Computer Science

# Algorithm visualization

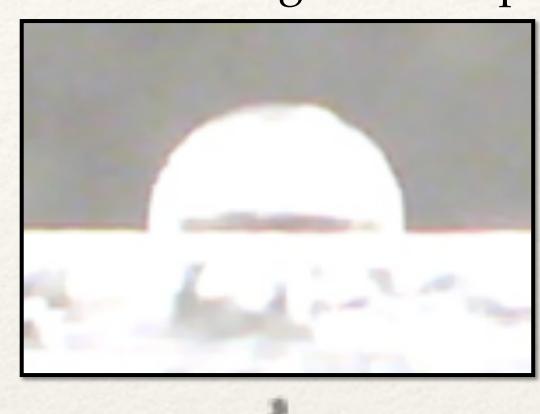
### Introduction

The contact angle, where a liquid/vapor interface meets a solid surface, has been widely used to measure the wettability of a surface in physics and chemistry. Scientists place a drop on a surface of interest, take an image of the drop in profile, and measure the angle the drop makes with the surface. We have developed a Contact Angle Measurement plugin for the ImageJ image analysis framework, which provides researchers a easier way to access experiment data. The goal of our algorithm is to automatically detect drops and surfaces via image analysis, so that the contact angle can be measured.

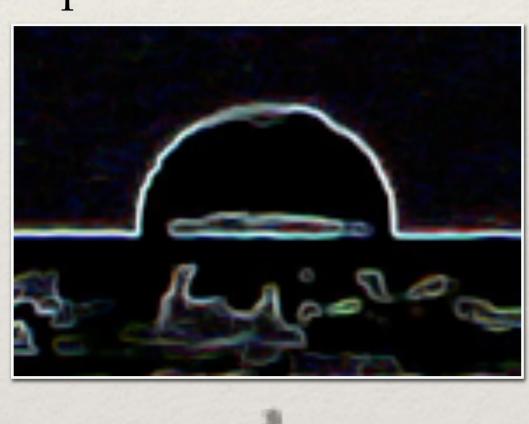
## Challenges

- All shapes (e.g., lines and circles) we see on an image is in fact a set of discrete points.
- Detecting those shapes actually is solving discrete problems.
- No efficient solution method is known for discrete problems. Potentially, it might be necessary to test each possibility sequentially in order to determine if it is the best fit for the pattern of interest.
- The number of possibilities could grow exponentially due to the size of images.
- We need to narrow down the search space (i.e., avoiding exhaustive search), so that computers are able to produce results within the limited runtime.

The raw image of a drop.



We apply Edge Detection to the image to collect a set of points of interest.



Then we randomly sample nearly- or pure-white pixels which could potentially be points on the circle (i.e., the drop).

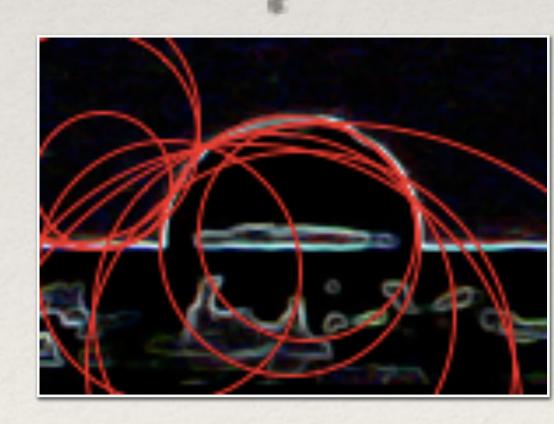




To locate the surface on which the drop rests, we collect the light pixels outside the circle.

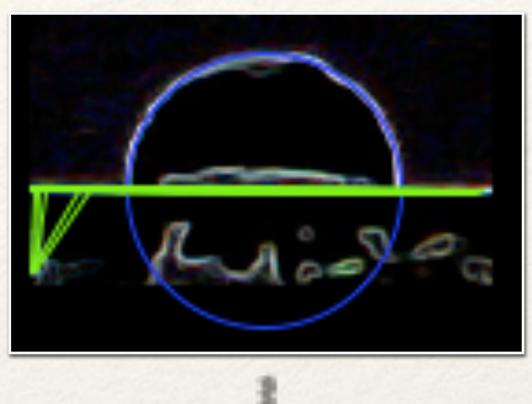


And we adjust the radius and center further by using various methods.

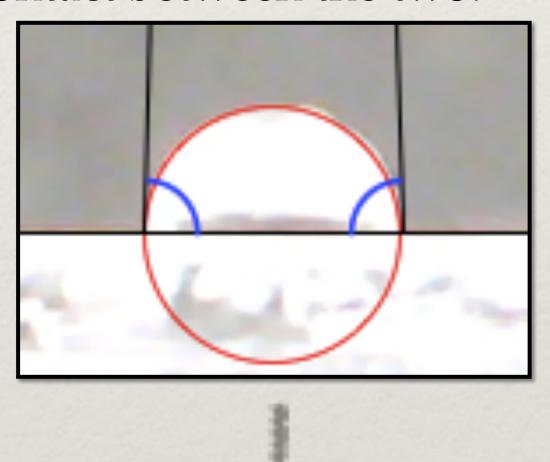


We generate candidate circles from randomly selected sets of 3 white pixels (given that 3 points defines a circle). Of these, we select the candidate circle that overlaps with the largest number of white pixels.

Then we apply Theil-Sen estimator, an advanced linear regression method, to analyze all surface candidates. We pick a line "in median" to be our actual surface.



The geometry of the detected circle and surface is analyzed to determine the angle of contact between the two.



## Future Work

For now, our algorithm to calculate contact angles relies on a manually selected region. Potentially, a relatively big input region could lead to a bad fit. In the future, we plan to make the plugin entirely automatic to analyze the images without manually choosing any region.

Acknowledgement: Many thanks to Arthur McClelland, Senior Microscopy Scientist at Harvard University, for providing the project motivation and sample images.