AUTOMATED CALIBRATION OF OPTICAL TWEEZERS

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OPTICAL TRAP

- Research in the Furst Group involves microrheology using laser tweezers
  - The lazer tweezers are used to trap a particle
  - The trap is created by focusing a laser beam into a point using a high numerical aperture microscope objective.
  - The trap is a balance the scattering and gradient forces.

TRAPPING FORCE

Stationary Stage
- particle is held in the middle of the trap

Stage in Motion
- particle is forced from the middle of the trap

- **The trapping force is affected by the following**
  - Size of the particle
  - Laser power
  - Index of refraction mismatch
- **The trapping force must be calibrated for each experiment**

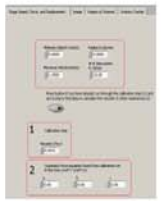
THE PROJECT

To design and implement a LabVIEW program that automates the calibration process.

WHY IT WAS NEEDED

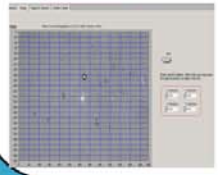
The old method was very time consuming.
- The particle had to be taped while it was moved.
- Then it had to be saved as images on to a computer.
- Using an imaging program, the position of the particle had to be found in these images.
- From these positions the displacement could be found.

THE PROGRAM



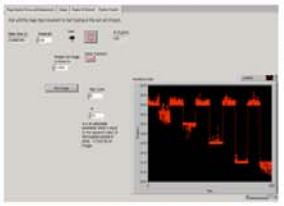
Initial Data
Top Half
- Radius of the particle
- Minimum Velocity
- Maximum Velocity
- # of data points

Bottom Half
- Viscosity
- Quadratic Force Eqn.



The image taken from the microscope and place where a region of interest is selected about a particle.

THE PROGRAM



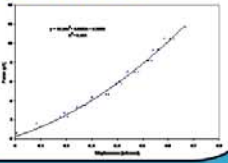
Part of the program where the particle tracking can be seen

Stokes' Drag Equation

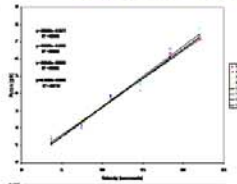
$F=6\pi\mu a U_0$

SILICA IN WATER

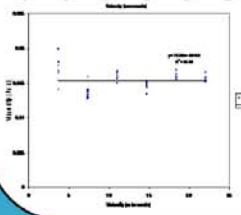
A Force vs. Displacement Calibration curve for Silica. A quadratic curve best fits the data.



SILICA IN STOCK FTP



This graph represents the linear relationship between the Force and Velocity for a particle being tracked.



A linear fit was set used with all the data to see if there were any trends.

CONCLUSION

The calibration step for one data set can be run in 10 minutes or less. This is much improved from the old way where it took several hours to run a calibration.

ACKNOWLEDGEMENTS

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