Three Dimensional Object Tracking Using a Rapid Scanning Double Droplet System Microscope

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The Double Droplet System (DDS) provides a unique type of adaptive lens, one that rapidly oscillates to scan a large range of focal lengths faster than other lenses can. In this project, a DDS of silicone oil in water was introduced to a camera microscope system to measure how an oscillating DDS changes the focal distance of the system. A DDS lens tank was built to replace the TV tube of a Zoom70XL microscope. An oscillating chamber utilizing magnetic coils driven by a microcontroller was built and used to actuate the lens and allow it to regularly oscillate. New methods to form large scale DDS's (up to 0.75" diameter) were developed and implemented. Videos from the microscope of an angled target and videos of the DDS profile were analyzed to calculate the change in focal distance (1.15mm) and compare it to the change in focal length of the DDS. The resolution of the microscope with the DDS was determined to be 2.2-4.4μm. Microscopic particles and moving one-celled organisms were tracked in three dimensions using the scanning focus of the microscope. This type of lens could be used to replace vertically scanning piezoelectric microscope stages and allow for three dimensional tracking of microscopic objects in a stationary system with only one camera.

Awards Won:

Second Award of $2,000

SPIE, the international society for optics and photonics: First Award of $1,000