Drop-In-Flight Measurement Techniques

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Inkjet technology is in the process of revolutionizing traditional coating, as well as dispensing and printing industries. An ever-increasing number of startups and established companies have been working hard to create their own proprietary inkjet knowledge and advanced materials. Machine vision tools have become integral to this R&D process, especially for imaging and measuring drops in flight. In order for measurements to be accurate and repeatable, however, it's very important that proper methods are used. In this paper, we will discuss both proper imaging techniques, and appropriate algorithms for drop-in-flight velocity and volume measurements.

Drop in flight imaging is usually accomplished using a strobe light synchronized with the firing frequency, together with a camera and workstation (Fig. 1).

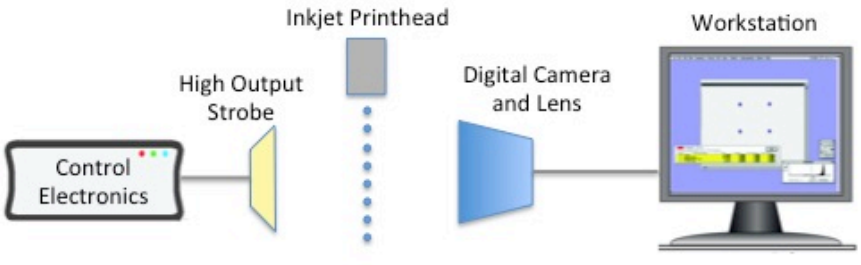

Figure 1 Basic Drop Analysis System Layout

There are several important attributes that any drop watching system must have, in order to capture useful images of drops in flight, for analysis.

Firstly, the system must have **single event** capabilities. This means that it must be capable of imaging a single drop, rather than averaging or summing images of many drops. (Fig, 2).

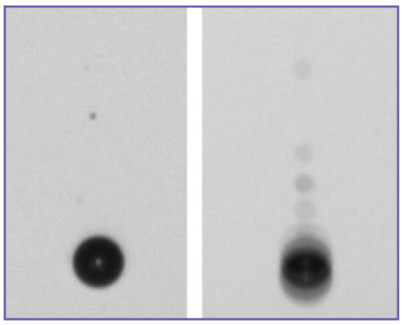

Fig 2: Single Event Image (left) Vs. a 5-Drop Aggregate Image (right)

Secondly, the system must also be capable of short pulse widths, in the range of one microsecond or less.

Thirdly, if the system is intended to measure drop velocity or trajectory, the system must be capable of capturing **double strobe** images. Double strobe images are captured by flashing the strobe twice, with a short, known interval between flashes. Because the camera shutter is left open during this process, the two flashes result in two images of each drop in the field of view, each at a different point in time.

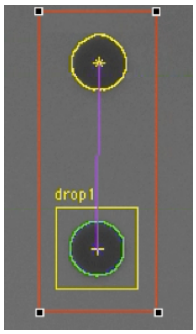

Fig 3: Double-Strobe Image Under Analysis

This double strobe image is analyzed by finding the centroid of each image of the drop, and measuring the distance between the centroids (Fig. 3). Because the time between the flashes is known, the drop velocity may be easily calculated. Drop volume is then calculated based on the average drop radius.

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