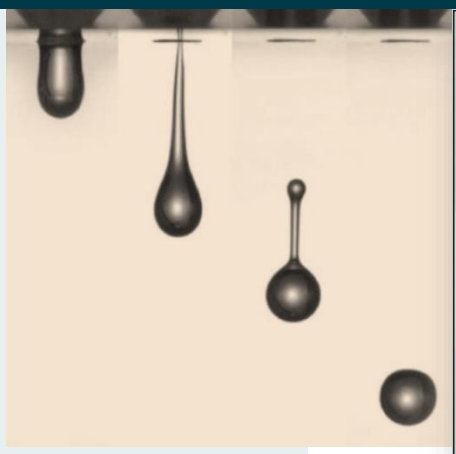
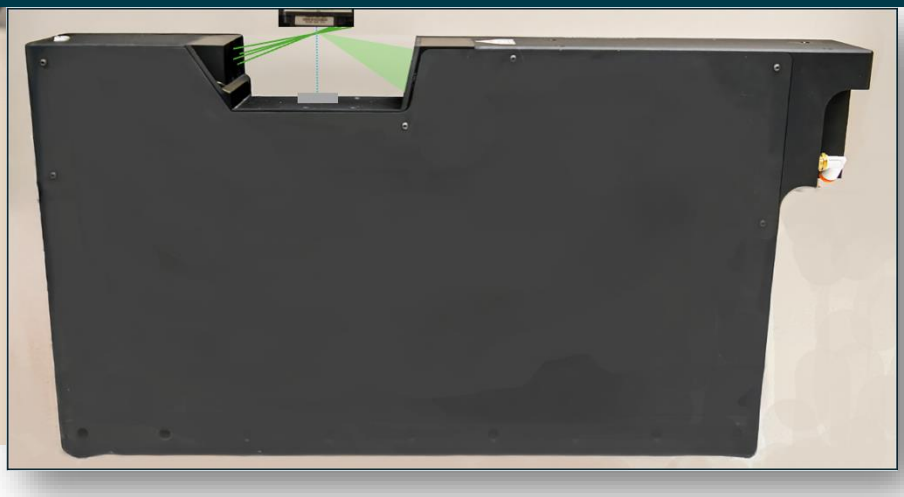




Inkjet Droplet Measurement

Accurate and easy droplet measurements for inkjet development, testing, monitoring, calibration, and quality control

TK Series: Inkjet Droplet Measurement (IDM) Instruments

A Long History of Instrument Development and Success

Artium has been providing instruments for the development of inkjet printer technology for over two decades beginning with delivery of instruments to IBM and Hewlett Packard. The phase Doppler technology, which is the basis of these instruments, was invented by Dr. William Bachalo, our current president, along with other senior scientists, in the early 1980s. Artium has continued the development with funding from U.S. governmental organizations including NASA, the Army, the Navy, the Airforce, and the Department of Energy. The method has proven to be ideal for inkjet printer development.

Our Inkjet Droplet Measurement (IDM) instruments measure droplet size, velocity, and angle of trajectory simultaneously in real-time. Measurements are easily performed in situ and non-intrusively with no interference of the droplet stream. The Turnkey (TK) line of IDM instruments are simple to operate and designed for long service life.

Over the past decades, the instrument has been thoroughly evaluated for inkjet spray applications and has proven high resolution, accuracy and reliability. We have supplied instruments for development and quality control applications to a major supplier of OLED display fabrication systems. The instruments measure at rates of 30,000 droplets per second (or greater) while continuously scanning large arrays of inkjet droplet streams.

U.S. Patent 7,126,694 B1

Proven Capabilities

- Fast and accurate measurements of droplet streams in real-time
- Droplet size, velocity, and angle of trajectory measurements for each droplet
- Very high droplet size and velocity resolution and accuracy (drop size to +/-0.05 µm, velocity to +/- 1 mm/s)
- Droplet volume down to 0.0005 picolitre (drops size 1 µm)
- Allows continuous scanning of large numbers of inkjet droplet streams for quality control
- Highly developed hardware and software for easy integration with inkjet printer systems
- Very compact and stable optical system design using relatively low power lasers for safety
- Measurements can be made very near the injector exit and at positions downstream
- Measures transparent droplets, opaque droplets, and/or droplets containing solid material with high reliability
- Trajectory angle measurements enable on-target droplet placement

Measurement Method

The IDM instrument is based on the phase Doppler interferometry method. Phase Doppler interferometry uses the wavelength of light as the measurement scale to measure the droplet velocity from the Doppler shift in light frequency and the phase shift of scattered light to measure the droplet size. Our engineers have developed this method for a wide range of applications including fuel spray combustion, cloud measurements from aircraft, inhalable medical aerosols, and numerous other applications.

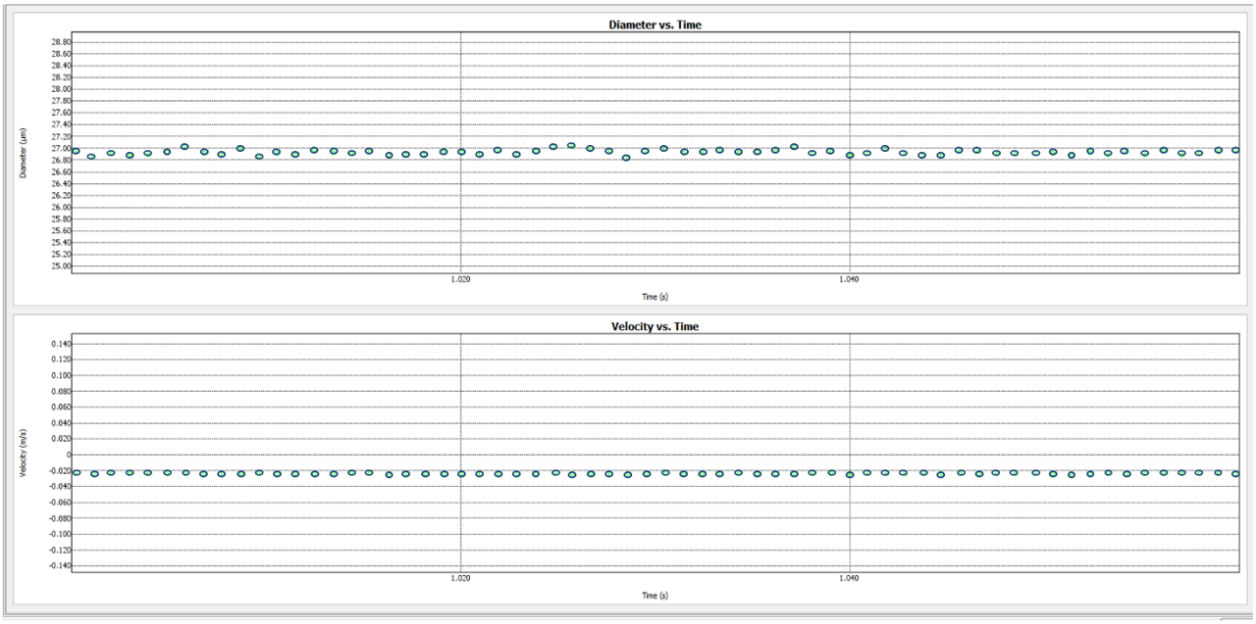
Inkjet Applications

From our early interactions with IBM and Hewlett Packard, we have gained significant experience in the measurement requirements for inkjet printer applications. Our IDM instruments are currently being used for inkjet printer development associated with coating displays, printing for OLED display fabrication, and for development of medical continuous manufacturing technologies. We have developed a full range of IDM instrument configurations customized for specific applications and system physical constraints. Numerous medical applications have been reported in the literature involving precise deposition of drugs, fabrication of drug-loaded polymer microparticles printed drug delivery strategies, and the production of medical devices.

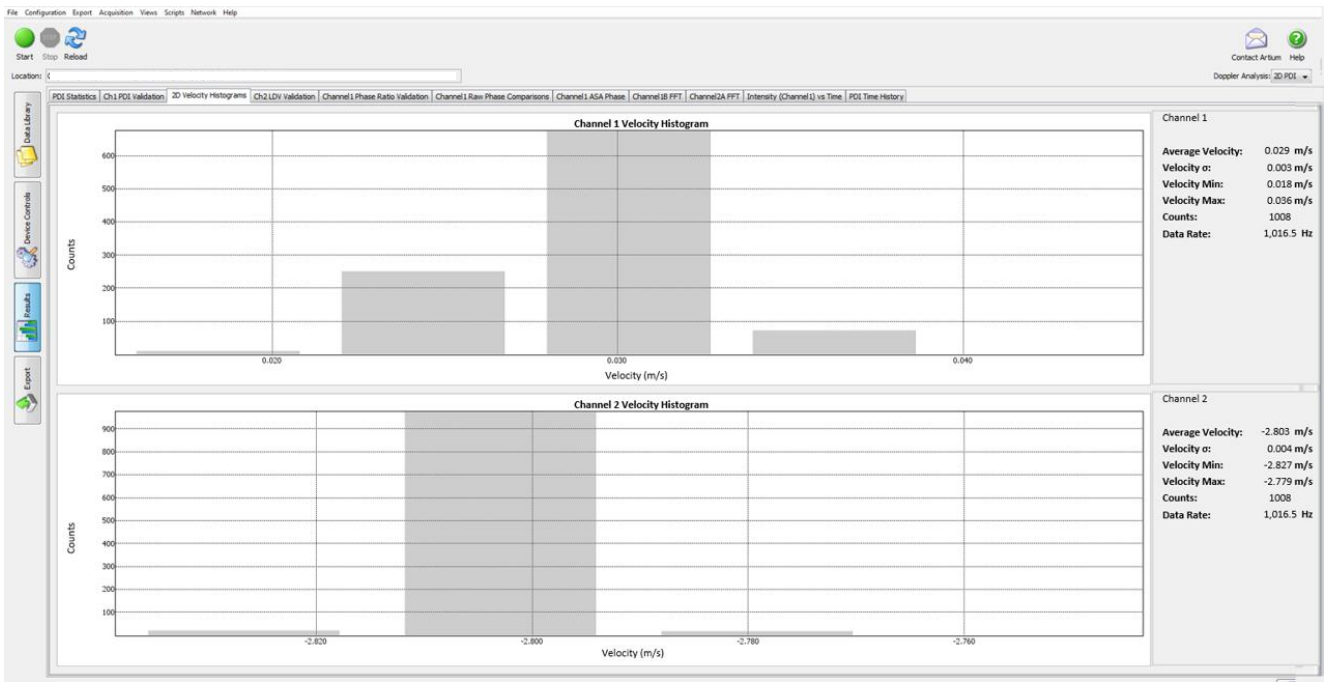
Instrument Description

The IDM instruments consist of a sealed optical head that uses the latest developments in diode pumped solid state lasers (DPSS), miniaturized photodetectors, and electronics. These systems have proven reliability and longevity with expected lifetimes of 10,000 hours. The instruments are factory calibrated and require little or no maintenance or re-calibration. The signal processing electronics are made very compact and reliable by using state-of-the-art large scale integrated circuits and dedicated optical interfaces to the data management system.

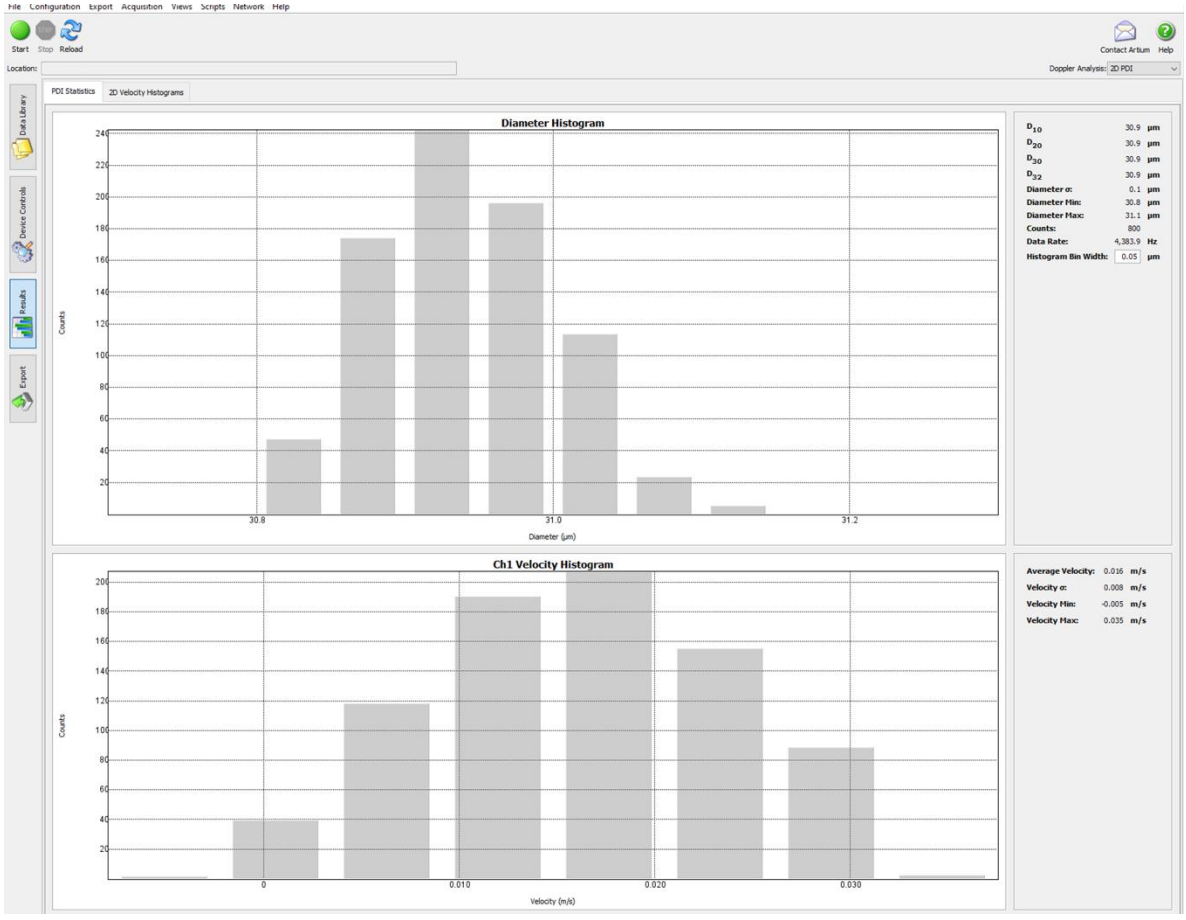
The IDM instruments have been demonstrated to be capable of long periods of operation when installed on inkjet printer systems. Continuous scans are performed during system checks at droplet arrival rates as high as 30,000/sec without missing droplets. Proven measurement resolution of better than +/- 0.05 µm is typical of this instrument's capability. As described in our patent disclosure (US 7,126,694 B1), simultaneous measurements of drop size and up to three components of velocity are possible to provide droplet size and trajectory for each droplet. The IDM instruments offer permanent optical alignment for long term use in laboratory and industrial environments. Custom optical designs are available to ensure compatibility with a wide range of inkjet, R&D, and quality control situations.



Time history for droplet diameter and velocity produced by an inkjet printer.
Each symbol represents an individual droplet measurement and shows the minor deviations in the droplet size and velocity as a function of time.



Two components of droplet velocity measured with stability of 3 to 4 mm/s and a resolution of 1 mm/s.



Droplet size and velocity distributions collected while scanning across a multiple-nozzle inkjet printhead. Drop size standard deviation across all nozzles less than 0.1 µm.