PARTICLE-I IMAGING SYSTEM Flight Probe

Wind Tunnel and Aircraft-Based Droplet and Ice Crystal Measurements

Size and shape

Number density

Liquid and Ice Water Content

Cloud studies

Icing wind-tunnel applications

Turnkey operation

The Particle-I Imaging Flight Probe has been developed specifically for aircraft-based cloud studies that require precise measurement of liquid droplet and ice crystal size distributions, number density, liquid water content (LWC), and ice water content (IWC).

The PI-FP is a high-speed imaging system that takes advantage of the latest advances in CMOS sensing technology and combines it with an innovative particle illumination method to deliver precise measurements of particulate size and shape. The flight probe incorporates multiple lasers that are used to simultaneously illuminate the particulate field from multiple directions.† A dedicated laser and photodetector are used to detect the presence of particles in the measurement probe volume. This information is used to pulse the multiple illumination beams. The laser beams are combined by a receiver lens which creates a shadow (or bright-field image) of the particles on the CMOS sensor.

The use of multi-beam illumination significantly reduces measurement errors due to depth-of-field variations that are a problem for bright-field imaging instruments. The optics and electronics are packaged in a rugged design that is proven to be air-worthy. The probe heads are well heated to prevent ice accretion while flying in extreme icing environments. The pulsed lasers used in the probe provide stability, compactness, ruggedness, and high reliability.

The PI-FP offers turnkey operation with a fully automated setup feature. The complete instrument includes the flight probe, data acquisition computer, image acquisition card, and the AIMS system software. The software analysis package includes sophisticated algorithms for identifying particles that are in focus, calculating various shape parameters, and classifying ice crystals into its various habits. Methods for differentiating between liquid drops and ice crystals are also included.

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High-precision measurement systems for energy, environmental, and industrial applicati

Technical Specifications

PMS-style canister design available	
Anti-shatter particle probe tips available	
Heaters for cold operation	< -50°C
Altitude operation requirement	< 15km
Size dynamic range	100:1
Estimated size accuracy	+/- 2.5µm
Estimated size resolution	+/- 2.5µm
Velocity measurement range	< 300m/s
Liquid Water Content (LWC) accuracy	+/- 15%
Distance between receiver and transmitter windows	100mm
Illumination type	Multiple solid-state lasers or LEDs
Wavelength	860nm / 470nm
Optional particle trigger detection	532nm DPSS laser and PMT
Camera (CMOS Digital)	
Camera frame rate	to 400fps
Camera resolution	4200 x 2160 pixels | ~9.0 Mpix
Sampling area at 3µm/pix	~6mm x 2.7mm
Continuous sampling	< 1 terabyte

†***U.S. Patents***
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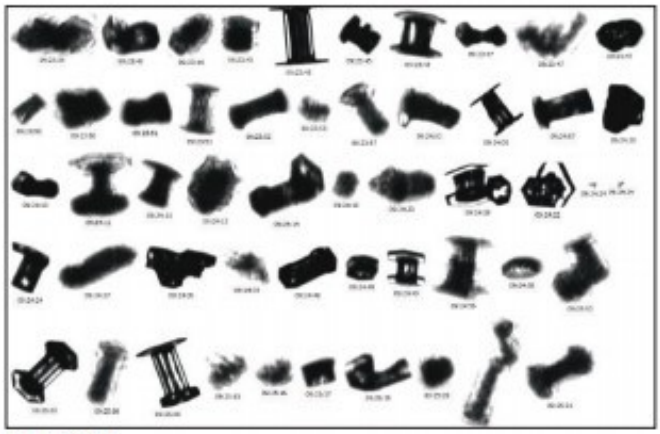
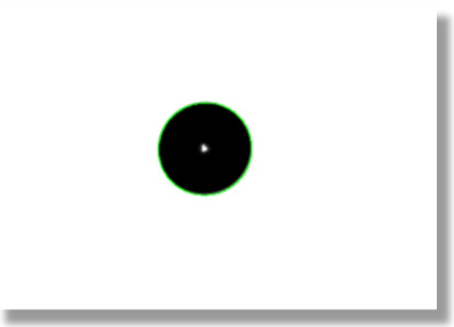


Ice Crystals.



Droplet image for a flow speed of 200knts
Quasi-real time display of results
(Real time display of all data is not possible)

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