



High Resolution Cloud Particle Imaging Incorporating State-of-the-Art Digital Cameras with Pulsed LED Illumination

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Citation: Bachalo, W.D., "High Resolution Cloud Particle Imaging Incorporating State-of-the-Art Digital Cameras with Pulsed LED Illumination," SAE Technical Paper 2023-01-1421, 2023, doi:10.4271/2023-01-1421.

Received: 13 Dec 2022

Revised: 01 May 2023

Accepted: 1 May 2023

Abstract

Super-cooled large drops present serious threats to aviation safety and as a result, the problem has been addressed by the FAA with the additional icing certification requirement. SLD clouds often consist of bi-modal drop size spectra leading to great challenges when it comes to simulating and characterizing these conditions in situ and in icing wind tunnels. Legacy instrumentation for measuring drop size distributions and liquid water content has been challenged under these conditions. In this report, a high-resolution particle imaging instrument is described; this instrument addresses the need for measuring drop size distributions and liquid water content over a wide range of drop sizes (10 to 2500 μm or larger). A high-throughput megapixel

digital camera is used to record shadow images of the particles. High-quality illumination of the particle field is provided with high-power LED illumination with driving electronics designed to provide pulse durations as short as 25ns with sufficient fluence. Image processing software has been developed to enable automated setup of the instrument, image acquisition and processing, and efficient storage of the particle images. Calibration methods regarding the dependence of the depth-of-field to drop size were developed to enable sampling statistics bias corrections due to variations in the sample volume. Measurements acquired in the NASA Icing Research Tunnel (IRT) are provided as an example of the measurement capabilities of the newly developed instruments.

The full paper is available through SAE International.