In-situ atmospheric particle imaging with a portable digital holography instrument

Osku Kemppinen[a,*], Matthew J. Berg[a], Yuli W. Heinson[b], and Stephen Holler[c]

[a]*Kansas State University, 1228 N. 17th St., Manhattan, KS 66506, USA*
[b]*Washington University in Saint Louis, One Brookings Drive, Box 1180, Saint Louis, MO 63130, USA*
[c]*Fordham University, 441 E. Fordham Rd., Bronx, NY 10458, USA*

[*]*Presenting author (okemppin@phys.ksu.edu)*

Digital holography is a contact-free imaging method that does not require trapping or otherwise preparing the imaged particle prior to the measurement. We have designed and are currently manufacturing a proof-of-concept model for a lightweight digital holography instrument that can capture holograms of freely flowing particles, sizes ranging from tens of micrometers up to millimeters, in the atmosphere, and developed the necessary algorithms to automatically reconstruct the particles' two-dimensional silhouettes, with additional limited three-dimensional information [1].

The current estimate for the mass of the instrument is approximately 5 kg with batteries, light enough to be flown on an off-the-shelf Unmanned Aerial System (drone), with approximately 20–30 minutes of flight and measurement time between landings. The current material cost estimate for one model is roughly $10K, not including the platform, such as a drone.

The instrument concept, if proven successful in the upcoming test campaign, will allow imaging large atmospheric particles almost anywhere in the lower boundary layer with minimal set-up required, and with very low operational costs. We expect the instrument will greatly add to the knowledge of coarse-mode aerosol particle morphology by providing statistically significant amount of measurements that have been slow, costly, and in some cases impossible to perform thus far.

References

[1] Kemppinen, O., Heinson, Y., and Berg, M. J., 2017: Quasi-three-dimensional particle imaging with digital holography. *Appl. Opt*. **56**, F53–F60.

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