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Atmospheric Measurement Techniques Discussions

Interactive comment on "A video precipitation sensor for imaging and velocimetry of hydrometeors" *by* X. C. Liu et al.

Anonymous Referee #2

Received and published: 23 January 2014

1. Does the paper address relevant scientific questions within the scope of AMT?

This work presents an innovative precipitation measurement system, based on an optical method giving also precipitation microstructure information. This topic is certainly of relevance for the scientific community and within the scope of AMT.

2. Does the paper present novel concepts, ideas, tools, or data?

Yes, the paper presents a concept, which was not implemented in such instrument before.

3. Are substantial conclusions reached?

First results of the new instrument are presented in the paper, which indicate that the

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presented principle might be promising. The paper itself states that there are issues that require further research. Considering that first results have been reached, this seems to be a sufficient stage for a publication.

4. Are the scientific methods and assumptions valid and clearly outlined?

Here a few serious shortcomings are to be noted. The paper should be revised addressing at least the following remarks:

a) the instrument is based on a double exposure principle, where a software algorithm then identifies two images to stem from the same individual particle. Since particles have different fall velocities, such algorithm may not be trivial. Fig. 10 (a) 'Fall velocity' and (b) 'Axis Ratio' show results partly significantly deviating from literature expectations. The authors should explain the algorithm, how images are paired, and if the outliers in Fig. (a) and (b) might be caused by failure of such algorithm.

b) In 10170 line 4 states: 'Each particle is exposed twice in a single frame'. For an imaging height of 30 mm and an exposure repetition time of 2 ms, (area-less) points with fall speeds of more than 7.5 m/s may be photographed just once, depending on their location relative to the height of the image. For objects with vertical extensions (as hydrometeors are) an even lower fall speed is required, to have two full images of EACH particle photographed. Fall speeds of 7.5 m/s are expected already for rain drops of only 2.8 mm and bigger. The authors should present an analysis, what hydrometeors in fact are expected to be fully photographed twice (e.g. percentage over rain drops' diameter or similar) and should derive the impact on the figures of merit (rain rate etc.). Potentially this analysis might be extended to the horizontal dimension (wind speeds and actual trajectory, rain drops' actual full stay within the imaging section of 30 mm x 40 mm).

c) 10171 line 21 reports on sizes of calibration targets, ranging from 1 to 4.5 mm. This range does not cover the size range of rain drops. Why not use calibration targets covering the full size range of rain drops ? The authors should either do that, or inform

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on the reason why not doing so.

d) 10172 line 7 presents a probability function that a certain particle with a certain size and fall velocity can be captured. Such instrument characteristics is often rated as the sampling area (e.g. $\sim$ 50 cm^2 for the impact type disdrometer, etc.). It would be very helpful for the reader, if the authors would express the probability function in an EQUIVALENT sampling area (potentially as function of raindrop size).

e) the algorithms used by the authors to derive axis ratio and canting angles should be explained. The effects of rain drops' orientation in three dimensional space being photographed in a two-dimensional image should be addressed.

5. Are the results sufficient to support the interpretations and conclusions?

It would be desirable, that also rain events with higher rain rates are discussed.

6. Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)?

The hardware setup is sufficiently described, lack of algorithm description has already been addressed in above item 4.

7. Do the authors give proper credit to related work and clearly indicate their own new/original contribution?

This information is given.

8. Does the title clearly reflect the contents of the paper?

Yes.

9. Does the abstract provide a concise and complete summary?

Yes.

10. Is the overall presentation well structured and clear?

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Yes, apart from lack of descriptions as indicated in above item 4.

11. Is the language fluent and precise?

Yes.

12. Are mathematical formulae, symbols, abbreviations, and units correctly defined and used?

Not all abbreviations are explained (e.g. 10168 line 22 'EP and XP').

13. Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated?

No, but the above mentioned lack of descriptions (item 4) shall be addressed.

14. Are the number and quality of references appropriate?

Yes.

15. Is the amount and quality of supplementary material appropriate?

Yes.

Interactive comment on Atmos. Meas. Tech. Discuss., 6, 10165, 2013.