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Atmospheric Measurement Techniques Discussions

Interactive comment on "A Convolutional Neural Network for Classifying Cloud Particles Recorded by Imaging Probes" *by* Georgios Touloupas et al.

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The approach of using the convolutional neural network (CNN) for processing images from cloud imaging probes can certainly be considered novel, given that it has not been attempted prior to this study. What puzzles me, however, is why it is being put to such mundane use as only determining if an image is circular or not, given that there are a number of less complicated and less compute intensive approaches that have already been tested and implemented in the literature. What would have been truly novel, given that they actually show dendritic crystals in the example, would be to show how the CNN could identify different crystal habits, not just separate circular from non-circular.

I do not think that this analysis approach will be widely implemented by the cloud physics community at large, given the existence of much simpler, faster, and likely as effective methods to separate circular from non-circular. The majority of cloud physicists that use cloud probes are not currently working with holography and are unlikely to consider the CNN since only holographic examples are used in this paper.

That being said, although I think this submission is much less interesting due to the mundane application, I won't reject it on those grounds. There are, however, a number of additions that I think are necessary to include before I would accept this paper for publication.

1) How are holographic images currently being processed to separate ice from droplets? If other than those machine learning references given in the paper, then they need to be discussed and compared with the CNN.

2) What are the techniques that are currently being used to separate ice from droplets in other imaging systems like optical array probes (OAPs)?

3) If the techniques being used for processing images in OAPs can be used in holographic images (I can see no reason why they can't given the rendering of holographic images into 2D for the CNN) how do the error rates compare with those from CNN?

4) Nowhere in the introduction, or elsewhere, do the authors discuss how errors in discriminating liquid from ice will impact how measurements are interpreted with respect to scientific questions associated with mixed phase conditions. This is a critical omission when assessing the efficiency of one technique versus the other. Particularly when it comes to ease of implementing one technique versus the other. Creating training sets for every data set is time consuming and one that is unnecessary if using one of the common techniques used in OAP analysis.

5) Why hasn't the uncertainty in human-typing images been assessed, i.e. having at least two or more observers classify the same data set? Isn't that a fundamental step

when determining how well any automatic classification scheme performs?

6) In addition to the number of hours needed to create a training set, what are the computational times to analyze sample data sets of 10000 images by each technique?

7) The list of references is missing a large number of studies on pattern recognition of cloud probe images. These have to be included.

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