Review comments on amt-2021-427-author_response-version3
2022-10-22

Thank you for considering my comments and your changes to the manuscript. I agree that removing the analysis of the size aspect from the manuscript seems unfortunately the best solution. You are right that a fair comparison of sizing is difficult on emulations and would require a true instrument comparison, which isn't easy to do.
With these changes, I think the conclusions from the remaining comparison of shape estimation techniques stand out more clearly.
I only have a few suggestions for small modifications (see below points *1-5*) prior to publication. In addition, I am reporting my reflections on your response about the aspect ratio capping.

1)
In Sect. 3.1:
Delete the sentence "Furthermore, IMAQ uses one corner … pixel center." You already specify that corners are used two sentences earlier.

2)
In Sect. 4:
Your changes in L184-202 explaining that PIP image processing is now applied to the raw PIP images PRIOR to applying the shape-fitting algorithms are very useful. You can improve them by making clear that this happens before emulation and fitting. E.g., insert a "prior" or "first" in an appropriate place.

Reflections on your response to my previous comment 3. Artificial cap:

Thank you for testing the perimeter stretching factor of circles.
Three questions to make sure I understood your procedure:
Circle: "based on the distance of each pixel center from a randomly perturbed center … spatial ant-aliasing". What is the result of this, B&W "pixelized" image of circle?
Perimeter: IDL contour function to produce contour (=perimeter) at value of 0.5 or 1. I assume that with these values you refer to the pixelized image with value 1 for any circle pixel and 0 for any outside pixel.
How have you determined area?

The value of 0.5 would be the obvious choice (similar to choosing 0.5 as threshold for images blurred between 0 and 1). With that value the perimeter stretching factor has a value close to the minimum value that I expected based on the observed "cap". [The contour for the value 1 is of course smaller. The size dependence is not surprising. I cannot comment more as I don't know how you have determined area.]
Thus, your perimeter-stretching-factor test with circles seems to confirm that "pixelation" alone would be sufficient to explain the pronounced "cap". However, as you have applied a different method to your "pixelized" circles, we cannot draw any firm conclusion. With different method

I mean that you have used the IDL contour function to determine the perimeter (and something to determine area) instead of the method used in the paper, i.e. using the IMAQ area and perimeter.

3)
As we cannot conclude anything concrete from your testing, I think the new section in L 350-355 (In theory, … algorithm) doesn't add value to the paper. I would just delete it or replace it with something like (not as new paragraph):
"As the details of the IMAQ perimeter calculation are not well documented, it remains difficult to determine the exact influence of pixelation effects on the PIP shape fitting algorithm in case of perfect circles."

4)
In the preceding sentence (L347-349) you may consider including a parenthesis:
"Small increases in perimeter, such as this, can be introduced by a few very small deviations of the particle edge from a perfect circle (DUE TO AN ACTUAL NON-SPHERICITY OF THE PARTICLE OR DEFECTS IN THE IMAGE QUALITY) as well as by the inability to perfectly represent a circle using square pixels (i.e., pixelation effects)."

As you have acknowledged, there is more to it, e.g.:
Pixelation may affect the other instruments too (only that its effects are more pronounced for PIP ellipse fitting).
The PIP image processing may also affect the perimeter.

5)
In Conclusions:
Consider splitting the second bullet point (L447-451) in two bullet points. The first one would be about "overestimating the long dimension and underestimating the short dimension". The second one would be about the high sensitivity to small perimeter changes. Both points are important conclusions. Both taken together make the results from PIP ellipse fitting unreliable, as you have discussed.