

Manuscript [hess-2020-188](#): “*Spatial distribution of tracers for optical sensing of stream surface flow*” by Pizarro et al.

We report a detailed response to each of the comments and suggestions below (text in red).

### **Reviewer 1**

**Obs. 1:** This study reports a novel approach to refining image-based flow velocity estimates, with a specific focus on the effects of particle seeding. The use of simulated images to isolate these factors while eliminating the confounding effects of other environmental variables is innovative and could be a useful approach for conducting similar controlled experiments in the future. The paper is generally well-organized and reasonably well written, and the figures are clear and insightful, so I am generally supportive of the work and believe that the manuscript could be published pending some minor revisions. Please refer to the attached PDF for the details, as well as a large number of in-line text edits to improve English usage, but here are a few of the highlights:

**Ans. 1:** We thank the anonymous Reviewer 1 for the detailed feedback, comments, and suggestions provided.

**Obs. 2:** Title: I suggest augmenting the title a bit to make what you actually did in this study more clear, perhaps start with “Identifying the optimal density and ...”

**Ans. 2:** We agree with the reviewer and decided to change the title as follows: “*Identifying the optimal spatial distribution of tracers for optical sensing of stream surface flow*”.

**Obs. 3:** Line 11: You need to clarify from the beginning what you mean by aggregation. It wasn’t until well into the paper that I got a clear understanding of what you mean by this term. Essentially clustering or dispersion of the tracers, right?

**Ans. 3:** Thank you for pointing out this issue. In order to avoid confusion, we will only refer to the term clustering or dispersion rather than aggregation.

**Obs. 4:** Line 17: Similarly, clarify what you mean by converging seeding density - is this only in areas where the flow streamlines come together? I never really got a clear sense of what this refers to.

**Ans. 4:** We agree with the reviewer, and we thank him/her for pointing out this aspect. The term was improperly used to identify the minimum seeding density that assures an error of about 2 – 3% in Figure 4. This error value is a reference value after which an asymptotic behaviour of the errors is observed. We will reformulate the description on lines 217 – 220 to better clarify this concept.

Obs. 5: Line 58: This would be a good place to elaborate a bit on what you mean by this term (aggregation).

Ans. 5: See Ans. 3.

Obs. 6: Line 78: Relative in what sense? In comparison to field measurements? Please clarify.

Ans. 6: Thank you for this comment. The word “*relative*” will be removed in the new version of the manuscript.

Obs. 7: Line 88: This (unidirectional, constant velocity) is a significant and somewhat unrealistic assumption and I think you should acknowledge this in some way within the text.

Ans. 7: We appreciate this suggestion since it is an explicit limitation of the proposed framework. Therefore, we will add a final section introducing the strengths and limitations of this research.

Obs. 8: Line 134: What kind (of current meter)? Please provide more detail, similar to the level of detail used to describe the camera system.

Ans. 8: Velocities and river discharge were measured using a current meter (SEBA F1, SEBA Hydrometrie GmbH & Co, Kaufbeuren, Germany). The accuracy of measurements is within 2% of the measured values, corresponding to 0.001 and 0.014 m/s for the minimum and maximum velocities in question. This information will be added to the main text, respectively.

Obs. 9: Line 138: Were there two different kinds of tracers? The last couple of sentences of this paragraph are unclear.

Ans. 9: Only one type of artificial tracers (wood chip) was considered to extra seed the ROI. Two operators were involved in the process of deploying the material. The sentence in question will be slightly modified to be clearer.

Obs. 10: Line 156: This figure (3) appears to have only one image, not an original and enhanced version. Please modify the text and caption to remove the reference to the original image, or update the figure to include the raw image.

Ans. 10: Figure 3.B shows two images in one. Riverbanks are shown in the original greyscale acquisition modality, while the darker area where water flows corresponds to the same pre-processed frame overlapping this area. A better explanation of this figure will be added to the main text in the new version of the manuscript.

Obs. 11: Line 168: Did you try the new ensemble correlation method available within PIVlab? This approach is designed for low particle densities and could be helpful in this study, so I suggest adding a bit of analysis to assess the performance of the ensemble correlation method in addition to the standard PIVlab technique.

Ans. 11: Thank you for pointing out this matter. We did not apply the new-available-in-PIVLab ensemble correlation method within our analysis, mainly motivated by the small number of frames used within the synthetic framework (20 synthetic images). To have full benefits of the ensemble correlation method, it is suggested a large number of images and low seeding conditions. Nevertheless, this matter can be considered for future research.

References:

1. <https://pivlab.blogspot.com/2019/09/the-benefit-of-ensemble-correlation-in.html>
2. Westerweel, J.; Geelhoed, P.F.; Lindken, R. Single-pixel resolution ensemble correlation for micro-PIV applications. *Exp Fluids* 2004, 37, 375–384.

Obs. 12: Line 170: Were the SA and IA the same? Typically, the step size is half the size of the IA.

Ans. 12: IA was the half of SA for the three passes considered within the analyses as is shown between parentheses on line 170 (e.g., 128x64). We will slightly modify the sentence to clarify this issue better.

Obs. 13: Figure 4: These graphs are a bit confusing at first glance because the error values are all negative, which makes the axes appear backward because smaller errors actually plot higher on the graph. You might want to point this out in the text to help the reader understand how to interpret these plots.

Ans. 13: Thank you for this suggestion. This matter is already explicitly written on lines 190 – 193 (before Figure 4), where it is pointed out that only negative errors were observed within numerical analyses. Nevertheless, a clarification will be added to the figure caption.

Obs. 14: Line 218: I still don't know what you mean by converging seeding density.

Ans. 14: Please, see Ans. 4.

Obs. 15: Line 270: You should provide some more information about this algorithm.

Ans. 15: Thank you for this suggestion. More information will be added to the main text to clarify better how the algorithms work. Further information about this algorithm is also provided in the following paper:

1. Dal Sasso, S.F.; Pizarro, A.; Manfreda, S., Metrics for the Quantification of Seeding Characteristics to Enhance Image Velocimetry Performance in Rivers. *Remote Sens.* 2020,



12, 1789.

Obs. 16: Please also note the supplement to this comment.

Ans. 16: We would like to thank again Reviewer 1 for the detailed feedback provided. We will go through the supplement document in detail, checking all the matters pointed out.