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Peer Review

Review of: "Detecting Turbulent Patterns in Particulate Pipe Flow by Streak Angle Visualization"

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The manuscript, titled “Detecting Turbulent Patterns in Particulate Pipe Flow by Streak Angle Visualization,” presents a method for detecting the transition from laminar to turbulent flow in particulate pipe systems by visualizing and analyzing the streak angles of neutrally buoyant particles. The study further identified a critical Reynolds number using Kullback-Leibler divergence based on the statistical distribution of streak angles.

The article is well-structured and interesting to read. It can be considered for publication if the authors can address the following comments.

1. In Figure 1, please explain how the signal and data obtained from different measurement systems were synchronized. In Figure 1, the experiment used a PIV at location 5, a streak visualization system at location 6, and monitored the pressure drop through location 4. Since a time delay occurs when a puff or slug travels from location 5 to location 6, how can it be ensured that Figure 6(a) and (b) correspond to the PIV data circled in Figure 6(c)?

2. In Section 3, it is stated that it is advantageous to apply Gaussian smoothing where the images are noisy or grainy. However, Gaussian smoothing can blur the object edges in the image. It is suggested to use a bilateral filter instead.

3. In Section 3, the image processing strategy involved adaptive grayscale thresholding to convert pre-processed images into binary images, followed by the Canny operator and Hough transform to detect particle streaks and their angles. However, since the Canny operator identifies edges based on local grayscale gradients—which are identical in a binary image—its use may be unnecessary. As shown in

 doi.org/10.32388/1LQZGM

Figure 3(d), the author can directly identify streaks and their corresponding pixels in binary images, then compute the streak angles using linear fitting. Please clarify the advantages of using Canny edge detection and the Hough transform in the study.

4. Since the particle streaks were visualized through a curved pipe window, the hemisphere liquid and curved surface could act as a convex lens. How was the aberration introduced by the curved surface addressed? Please discuss how the pipe's curvature may have affected the images and results.

5. Were any crossing streaks in your images observed? If so, how were they processed?

6. Please discuss how variations in the Stokes number could impact the effectiveness of the proposed method.

There are also some minor issues:

1. Use justified alignment for the abstract.

2. In the first sentence of section 2, please add "Ref." before [53]. Please check for similar cases throughout the text.

3. All units following numerical values should not be in italics. For example, on page 5, the last row, it should be "1.2 m" rather than "1.2 m". Please check for similar cases throughout the text.

4. There should be a space between numerical values and units. For example, on page 6, it should be "2500 kg/m3" instead of "2500kg/m3". Please check for similar cases throughout the text.

5. On page 6, delete "~" in "~to~". Please check for similar cases throughout the text.

6. All parameters, e.g., "St", "Φ", and "Re", should be italicized. Please check for similar cases throughout the text.

7. On page 7, "[53]" does not need to be in superscript as it follows "Ref.". Please check for similar

cases throughout the text.

8. On page 17, correct the repeated “the” in the sentence “When the friction is close to the turbulent friction value, the the flow between …”

9. You firstly discussed Figure 6 in Section 5.1 and then discussed Figure 5 in Section 5.2. To maintain logical order, swap the positions of Figures 5 and 6.

10. It is suggested to use the discrete form of KL divergence instead of the continuous form for equation 6, as the streak angle distribution is discrete.

Declarations

Potential competing interests: No potential competing interests to declare.