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Multi-Intensity-Layer PIV application to a practical burner

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ABSTRACT

PIV applicability to a spray was investigated by comparing with PDA results and showed the good agreement of detected velocity. But some region discrepancy can be observed. The new technique 'Multi-Intensity-Layer PIV' which can detect velocity and droplet size at same time was proposed and applied to a spray burner for evaluation. Evaluation was done under comparison with size-classified PDA since this new technique tries to describe droplet behavior and flow structure for each droplet size classes. In the new technique Mie theory is applied and the source image was distributed into three images (layers) to distinguish following, alternative and penetration effect in a large scale turbulent structure. Layer distribution was done with using the pixel intensity on source images and each criterion was selected carefully with consideration of diameter square information. Good agreement of size-classified PDA and Multi-Intensity-Layer PIV data was observed around the central axis but very large discrepancies were also observed around r=20mm region. For the investigation of these agreement and discrepancy velocity-diameter correlation was taken into account and found that discrepancy is due to the wide ranges of velocity and diameter droplet existence and flow complexity. In these regions PIV would generate erroneous or incorrect vector because PIV technique uses spatial average in the interrogation window. With consideration of this error source in a spray measurement flow structure analysis was done with this 'Multi-Intensity-Layer PIV' technique Source images were distributed in three layers and three different vector maps were produced from a pair of images. By comparing these vector maps of different layers we succeeded to describe the droplet behavior and flow structure such as droplet following and penetration, hollow cone structure and shear flow region with its size dependency. And finally concluded that this technique can be useful tool to understand droplet behavior in the spray flow fields.