Evaluation of spray/wall interaction data

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The impingement of sprays onto walls and liquid films occurs in many engineering applications. There is a great interest in reliable predictions of the outcome of spray/wall interaction. Numerical simulations of this phenomenon are based on impingements models, which have their origins in experimental investigations of the process. They are aimed at accurately describing important parameters such as deposition rate of the liquid on the wall or characteristics of the splashed fraction – velocity, size and flux of the drops in the secondary spray. Of all existing measurement techniques, the phase Doppler technique is probably the most suitable one to acquire the necessary data with sufficient accuracy and resolution. When applying the phase Doppler technique to characterize spray/wall impingement, the measurement volume is usually placed immediately above the wall surface. The in-going droplets are then distinguished from out-going droplets through the sign of the velocity component normal to the wall. The wall reference area of the detected drops can be determined analysing the drop trajectories. If the tangential velocity of the drops is significant or if the wall surface is curved, the total wall reference area of the detected drops can be rather large. Since the spray is not uniform, the distribution of the detected drops is partially determined by their distribution over the wall reference area. In such situation the analysis of spray impact requires additional efforts, which are described in this paper. In this study an appropriate evaluation procedure is introduced and described in detail.

1. Phase Doppler measurement system

The experimental set-up used in this study is presented pictorially in Fig. 1, showing a hollow-cone spray impinging onto a hemispherical target and a two-velocity component phase Doppler instrument to measure velocity and size of individual droplets. A dual phase Doppler system from Dantec Dynamics is employed with laser wavelengths $\lambda_{\text{green}} = 514.5\text{nm}$ and $\lambda_{\text{blue}} = 488\text{ nm}$. The Doppler frequency and the phase shift are used to determine the perpendicular velocity components $U_1$, $V_1$, see Figure 2, and the drop diameter $D$, respectively, cf. [14]. $U_1$ and $V_1$ both lie in the measurement plane which is spanned by target and injector axes. The third orthogonal velocity component is assumed to be zero due to the rotationally symmetric spray used.