

Application of the Time-Shift Technique for Spray Measurement

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The paper reports on the progress in the development and application of the time-shift technique, which offers the possibility of characterising single particles using backscattered light. The concept of the time-shift technique and investigations about its accuracy and dynamic range, have been presented in previous publications [1-3]. Of particular interest is the potential of measuring inhomogeneous and suspension droplets with this technique, since these are inaccessible using the phase Doppler technique [3,4].

1. Operating Principle

In the time-shift technique the incident field distribution, e.g. of a laser beam, is imaged by the incident points of the individual scattering orders onto the receiver (Fig. 1). By using a highly focused laser beam, single incident points can be illuminated and the corresponding scattering order is the only contribution to the detected signal. For a moving and sufficiently large particle the detected signal is composed of separate signals from individual scattering orders which are time-shifted. By measuring the time-shift the size of the particle can be estimated. For smaller particle sizes the signal contributions overlap in time and a size estimation from a single signal is impossible. Nevertheless, still a time-shift of the whole signal in relation to the central location in the beam exists and offers the possibility to relate a time-shift between two detectors to the particle size.

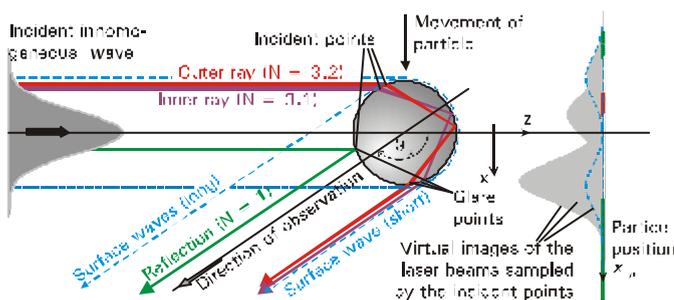


Fig. 1: Scattering orders of a shaped beam in backscatter

The actual preferred hardware configuration uses a laser light sheet (HeNe-laser) for particle sizing and the optical components of a two-velocity component laser Doppler system (blue and green line from a Ar+ laser). The laser Doppler system is needed to convert the time-shift into a length, which is related to the particle size. A schematic cross section of the measurement volume is shown in Fig 2. The system is assembled with commercial optical components, an integrated optics for the light sheet generation and two additional receivers in the backscatter. In previous studies single signals were stored and processed [1,2,3], whereas the present paper presents a combination of

a commercial two-component laser Doppler processor for velocity measurement and a fast AD-converter card, which includes pre-trigger and segmented memory. Therefore numerous signals of successive particles can be stored and processed by using the additional velocity information from the laser Doppler processor. A phase Doppler technique has been operated parallel to the time-shift equipment for validation of the size measurement.

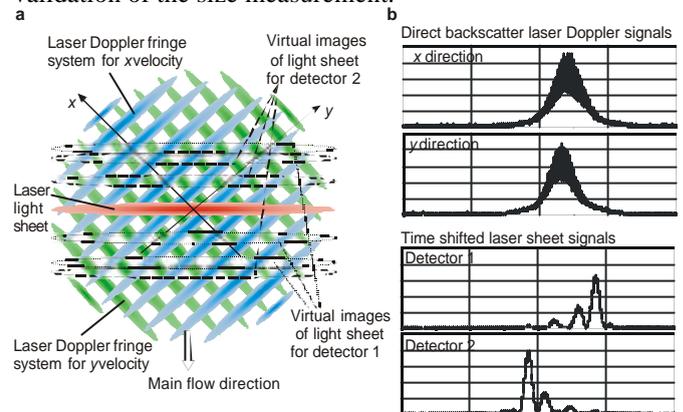


Fig. 2 a) Measurement volume, b) example signals

2. References

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