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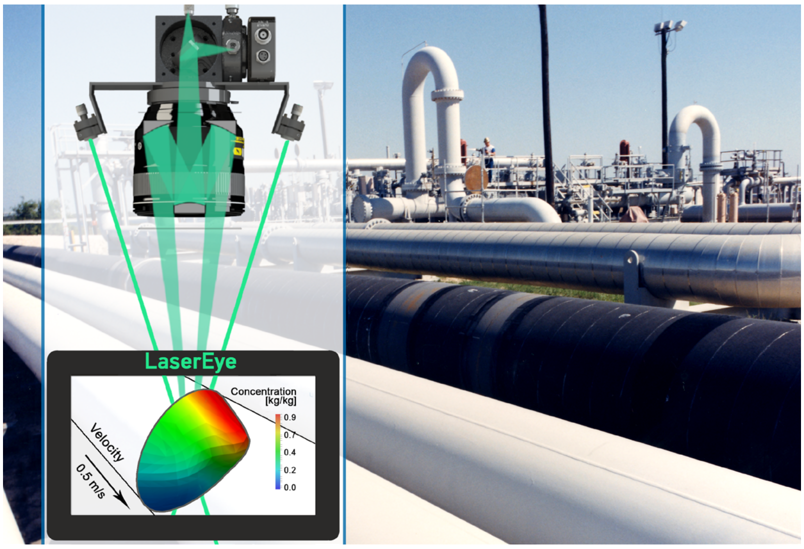
LaserEye

Flow and fluid characterization in a single shot



Accurate information about velocity profiles and the chemical composition of liquids and liquid mixtures in ducts or along a cross-section is essential for many applications in cheical and process engineering. These process parameters are of particular interest for process control and quality management in the chemical and pharmaceutical industries as well as for research and development of new process technologies.

At present, each process variable is usually recorded separately with separate measuring devices or probes through different measuring windows. A direct coupling of the measurement systems is often not possible, and consequently, precise simultaneous measurements of velocity and concentration profiles are difficult to achieve.

Objective

The two research groups Separations Engineering and Simulation (at ICEBE) and Process Analytics (at CTA), both at TU Wien, were aiming at a solution that would make it possible to measure velocity and concentration simultaneously with a single probe. The measurement approach should only require a single optical window, and thus the space requirements for the probe should be significantly reduced.

Solution

The researchers started from a suitable, high-resolution, non-invasive, physical measurement principle for each process parameter and tried to find a way to couple these techniques in order to receive signals for both velocity and chemical composition at the same time and place of the flow regime.

Two well-known high-resolution laser-based methods were selected for this purpose, laser Doppler velocimetry (LDV), which has been established in various applications for about 25 years, and spectroscopic methods, which have also been used successfully for a long time

The newly developed technology requires only one laser light source for both measurements. The scattered light is collected and analyzed through one or two – if required, separate – optical pathways. The characteristic so-called LDV bursts are analyzed for the velocity information when an indicator particle travels through the laser focal region. At the same time, spectroscopic analysis of the scattered light from the measurement volume is performed (e.g., with respect to Ramen-shift), which allows precise statements about the chemical composition.

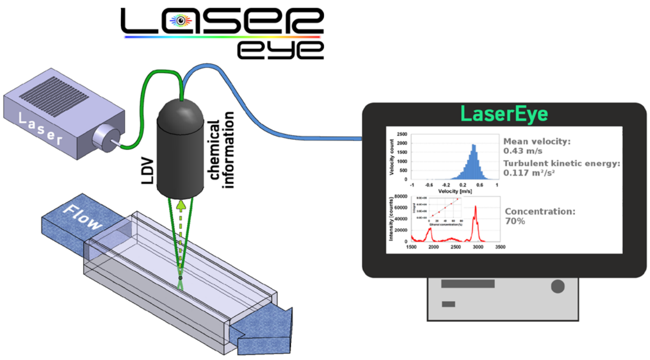
With the new technology the requirements for optical access of the probe has been substantially reduced as only a single optical window is needed for signal generation and detection. Through the integration into a single probe, the required space could be further reduced. The reduction to one light source for both measurements facilitates further cost reductions compared to separate systems. This results in a high-resolution, precise technology enabling new applications in process engineering, fluid dynamics, quality management, and laboratories.

Benefits

- time and space synchronized flow and concentration measurements
- fluid finger-printing
- high temporal resolution
- spatial resolution through traversing
- only one single optical access
- non-invasive
- explosive environments safe (ATEX)
- low costs compared to conventional multi-probe systems

Applications

- quality control in vessels as well as in flow lines – e.g. blending stations
- online monitoring and process optimization – e.g. mixing tanks
- product safety – e.g. pharma industry
- research and development



Notes

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