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ANEMOMETERS TO MEASURE MICROTURBULENCES (UOL151)

THE PROBLEM

Turbulences play an important part in many areas of daily life, for example, in combustion and mixing processes, in air tunnels or weather forecasts. However, an analytical approach is hardly possible because of the strong spatial and temporal irregularity of turbulent flows. Instead, many estimations and calculations are based on statistical values which are determined experimentally. A particular challenge consists in the measurement of micro turbulences (<1mm) which is currently done by means of hot-wire anemometry. This type of anemometry uses two crossed, electric-heated wires and determines, from the heat lost, the flow angle and the velocity of a fluid. Hot-wire anemometry has two known drawbacks, such as its small angle resolution and a limited angle range. Limiting is also the regular subsequent recalibration of the measuring sensor.

THE SOLUTION

Researchers from the University of Oldenburg, Germany, developed a laser cantilever anemometer (LCA) which utilizes the laser pointer principle of a scanning-force microscope to capture the velocity and the angle of fluid flows. To this end, a cantilever (bending beam) is set into the flow and focused with a laser. The deflection of the laser beam depends on the deformation of the cantilever which, in turn, is caused by the fluid particles set in motion. So far, cantilevers with a rectangular inflow cross-section have been used. In the current development, the tip of the cantilever is additionally structured, which has resulted in a distinctly improved angular resolution. The measuring principle enables measurements in problematical areas, for example, in fluids, near walls or in flows containing particles. The invention is in a state of application readiness and can be connected to a computer using a USB port for signal evaluation.

ADVANCES AND APPLICATIONS

The LCA provides a spatial resolution of only 150µm and enables measurements in an angular range of 180 degrees. Scanning of the signal proceeds between 60 and 100kHz. Fluid velocities of 1m/s and more can be very accurately measured, whereby the accuracy will even increase with increasing velocities. The system works robust and without recalibration and is clearly less expensive than any commercially available hot-wire system. The presented anemometer addresses the application field of hot-wire anemometers: instationary effects (flow separation), aeroacustic effects, boundary effects and measurements of turbulence degrees. Due to its robustness and long service life it is also useful to (remote) long-term measurements.

Laser Cantilever Anemometer

FIELD OF APPLICATION

Aerodynamic and hydrodynamic optimization: aerospace industry, shipbuilding, automobile industry, wind power

KEYWORDS

Microturbulence, laser cantilever anemometer

PROPERTY RIGHTS

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