

## THERMAL ANEMOMETERS MEASUREMENTS

O. Shcherbakov, *student*,  
A.M.Dyadechko, *ELA*

Thermal anemometers measure fluid velocity by sensing the changes in heat transfer from a small, electrically-heated element exposed to the fluid. In the "constant temperature anemometer," the cooling effect caused by the flow passing the element is balanced by the electrical current to the element, so the element is held at a constant temperature.

The change in current due to a change in flow velocity shows up as a voltage at the anemometer output. A key feature of the thermal anemometer is its ability to measure very rapid changes in velocity. This is accomplished by coupling a very fine sensing element (typically a wire four to six microns in diameter or a platinum thin film deposited on a quartz substrate) with a fast feedback circuit which compensates for the drop in the natural sensor response. Time response to flow fluctuations as short as a few microseconds can be achieved. For this reason, the thermal anemometer has become a standard tool for researchers studying turbulence. The small sensor size, normally only a millimeter in length, also makes the technique valuable in applications where access is difficult or larger sensors obstruct the flow.

Since the actual measurement is of heat transfer between the sensor and its environment, the thermal anemometer will respond to changes in parameters other than velocity, such as temperature, pressure, and fluid composition. While this adds to versatility, it also means that when more than one parameter is changing, special techniques must be used to extract velocity. Modern systems will automatically correct the velocity reading for temperature changes. When selecting a thermal anemometry probe, the user must choose between film and wire sensors. The choice is based on the fluid characteristics, the velocity range, the number of velocity components, contamination in the flow, and access to the flow.

The traditional sensor for research thermal anemometry has been a fine wire. For very low turbulence intensities, the wire sensor is still superior—and the smaller the wire, the better the results. For those applications that require a wire sensor, the 4 micrometer-diameter platinum-coated tungsten wire is almost a standard for measurements at normal room temperatures and below.