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Improving the response time of an ultrasonic wind speed measuring system using a temperature measurement

T. P. D. Pieris* and N. W. K. Jayatissa

Department of Physics, Faculty of Science, University of Kelaniya, Sri Lanka
*dhanushkamsg@gmail.com

Natural wind in the open air is a three-dimensional vector but vertical component of the wind is ignored in the most meteorological operations. Therefore, the surface wind is considered as a two-dimensional vector in this study. Wind speed changes rapidly. So, the anemometers must have better response. Ultrasonic waves with frequency more than 20 kHz that are inaudible to humans propagate at a speed of 340 m/s in wind free conditions. Ultrasonic wind speed measuring systems are used to measure the wind speed due to few advantages such as its sensitivity for low wind speeds and lack of moving parts. This anemometer has two pairs of ultrasonic transmitting/receiving devices fixed facing each other across a specified span. Ultrasonic wave pulse signals are repeatedly emitted alternately by each pair of transmitters at certain time intervals. Emitted signals are received by the ultrasonic receivers. The time taken for the sound wave to travel is measured by a system for both directions. The wind direction and speed are derived through vector analysis. Two simultaneous equations were obtained using speeds of sound wave, time taken for the travel and distance between transducers. The speed of sound wave obtained from the two equations above is the summation of the wind speed and the speed of sound through still air for one direction and vice versa. From the two simultaneous equations, the speed of sound through still air was rejected and wind speed was obtained. A sensor that has a filtering system was used to reject the ultrasonic noises from the environment. Usually, the systems use average values to avoid gusting. Gusting is a random fluctuation of wind speed and direction. Due to the averaging, the response time of the system was decreased to around 20 seconds. The speed of sound through still air can be calculated using the ambient temperature. This temperature measurement is directly related to the wind speed. Hence, the wind speed can be calculated with a single time measurement and single equation instead of rejecting the speed of sound through the still air. Then, the response of the system is improved.

Keywords: Anemometer with temperature sensor, high response anemometer, ultrasonic anemometer, ultrasonic wind speed measuring system