A comparative study of a digital and analog anemometer

M. ATIF*
Physics and Astronomy Department, College of Science, King Saud University, Riyadh, Saudi Arabia
National Institute of Laser and Optronics, Nilore, Islamabad, Pakistan

In the current study a digital anemometer was fabricated and its performance was observed with the available standard analog anemometer. The percentage difference of the instrument was calculated by applying paired t-test and the percentage difference from the standard found to be 2.87.

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1. Introduction

The digital anemometer is an instrument, which measure the wind speed. The various types of digital anemometer use different methods. Anemometers are mainly classified into two classes, "analog and digital". Digital anemometer is the very useful and important. It gives accurate results. A digital anemometer was fabricated and its performance was compared with the standard instruments.

The principle of anemometer is that it determines both wind direction and velocity by means of a vane and revolving cups mounted in suitable position.

The wind speed shaft consists of three hemispherical cups which turn when caught by the wind. The speed of rotation depends on the speed of the wind and number of cup revolutions per minute varies with wind speed. Wind speed is generally according to Beaufort scale (twelve-point wind scale). Now a days wind speed is measured in the units of m/s or in knots [1-6].

In this study a digital anemometer was fabricated and its performance was compared with the standard available instruments.

2. Experimental arrangement

The experimental arrangement used was as shown in Fig. 1. The digital anemometer consisted of IC's (integrated circuits), resistors, capacitors, semiconductors and seven segment LCD display. The anemometer used an AC motor with rotor shaft. The revolutions of the vertical speed shaft are converted into AC voltage.

The magnetic flux change with the number of revolutions, which change, with the speed of cups mounted on shaft. The AC voltage is amplified using an operational amplifier and then this amplified signal is rectified by diodes. A variable resistor attenuates the DC signal. The attenuated DC signal is supplied to ICL 7106, which converts the analog reading to digital display. The integrated circuit consists of A/D converter. Seven segments LCD displayed the wind speed.

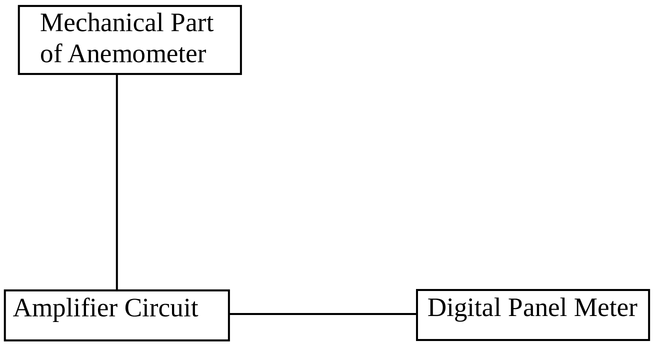

Fig. 1. Block diagram of digital anemometer.

3. Results and discussion

Attention has been given to the fact that the instrument should consume less power, cheaper, more accurate, simple, easy to operate and that all the components are locally available.

In this regard range of digital anemometer performance of different semiconductor devices, the transistor and the IC's were studied. Comparison between the available instruments and the fabricated instrument is listed below. The principle of operation is the same in both the anemometers.

Performance of the fabricated digital anemometer was studied by measuring wind speed using the digital anemometer and a standard analog anemometer. The observations recorded are given below.

Analog Anemometer reading (mph)	Digital Anemometer reading (mph)	difference b/w two readings (d)	d^2	% difference from the standard	time (min)
0	0	0	0	0	0
6.6	6.9	-0.3	0.09	-4.54	15
6.9	7.1	-0.2	0.04	-2.89	30
8.1	8.5	-0.4	0.16	-4.93	45
8.2	8.5	-0.3	0.09	-3.66	60
9.2	9.3	-0.1	0.01	-1.08	75
9.5	9.7	-0.2	0.04	-2.10	90
10.0	10.4	-0.4	0.16	-4.00	105
10.5	10.6	-0.1	0.01	-1.33	120
$\overline{x}_1$=7.66	$\overline{x}_2$=7.88	Σd=-2	Σd^2=0.6		

Where $\overline{x}_1$ is the mean analog anemometer reading, $\overline{x}_2$ is the mean digital anemometer reading, Σd is the sum of the difference between the two readings, Σd^2 is the sum of the square of the difference between the two readings.

$$H_o; Ana\log = Digital$$
$$H_1; Ana\log \neq Digital$$

No. of observations $= n = 9$

Mean difference $= \overline{d} = \frac{\Sigma d}{n} = \frac{2}{9} = 0.22$

Standard deviation $= s_d = \sqrt{\frac{\Sigma d^2}{n} - (\overline{d})^2}$

Putting the values of the above parameters, we get

$s_d = 0.14$

Calculated value $= t_c = \frac{\overline{d}}{\frac{s_d}{\sqrt{n}}}$

Substituting the values, we get

$t_c = 4.4$

Table value $= t_t = 4.781$. Hence $t_c < t_t$ then H_o accepted.

It means that Analog reading = Digital reading at $\alpha = 0.001$. The paired t-test of statics was applied on this data collected from Analog and Digital anemometer. Its percentage difference from the standard one was 2.87. The graph 1 shows the variation of analog and digital wind speeds versus time.

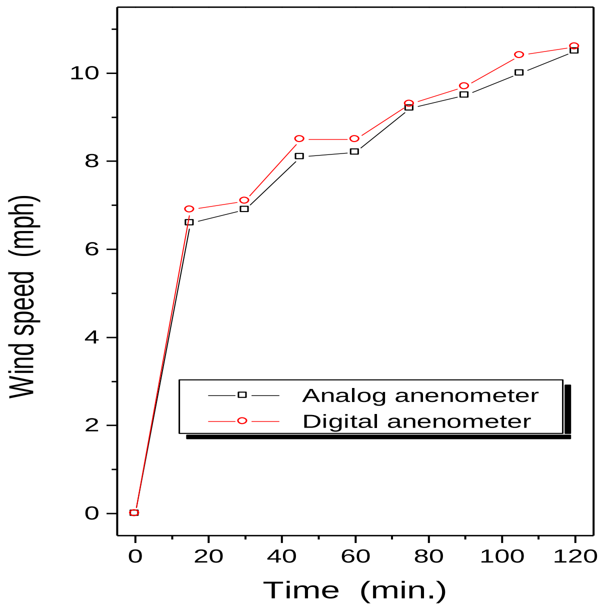

Fig. 2. Shows the variation of analog and digital wind speeds versus time.

4. Conclusion

The fabricated anemometer was found suitable to measure wind speed easily and accurately. Its advantages over analog anemometer are easy to operate, easy digital readout, direct measurements, wide range, portable, low power consumption. Its percentage difference from the standard one was 2.87.

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*Corresponding author: atifhull@gmail.com