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Application Note 1003

Distance Measurement Using the DRS1000 Non-Contact Speed Sensor

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Measuring distance using the DRS1000 Non-Contact Speed Sensor is a straightforward task and can be accomplished using simple counter hardware. This is also an excellent way to determine in-place offset angle correction of the non-contact speed sensor (refer to *Application Note 1000 - Non-Contact Speed Measurement Using Doppler Radar*).

One critical thing to remember is that the speed sensor will only measure travel when the speed is above 0.5 MPH (0.8 KPH). In practice, the acceleration of many vehicles will be such that the minimum speed is quickly achieved, and distance error is minimal over a given travel segment.

Summing Counts to Measure Distance

The output of the sensor is 100 pulses per second for every MPH measured. If the speed sensor were mounted on a vehicle pointed directly at a reflective target, with no offset angle, then over one mile of travel, the total number of pulses over one mile would be 360,000 regardless of the speed.

If the speed increases, so does the frequency and the overall count does not change with acceleration or changes in speed. At 2 MPH, the output is 200 pulses per second, but the travel time is half, so the overall number of counts is the same. If part of the distance is traveled at one speed and then another speed, the total number of counts over the distance remains constant.

The basic conversion between the speed sensor output and distance is given in Equation 1.

$$\left(\frac{100.0\,Hz}{MPH}\right)\times\left(\frac{3600\,\mathrm{sec}}{Hour}\right)\times\left(\frac{\frac{1\,Count}{\mathrm{sec}}}{Hz}\right)=360000\,\frac{Counts}{Mile}=68.1818\,\frac{Counts}{ft} \qquad \text{(Equation 1)}$$

Offset Angle Correction Ratio

In most cases, the center axis of the non-contact speed sensor is offset from the axis of travel. A nominal correction ratio (cosine of the angle, assuming offset in a single plane) is then applied for cosine error. Additional factors, however, such as uneven return because of beam geometry, vehicle pitch and other causes may skew the correction from nominal, making it difficult to simply calculate this ratio using geometry.

A distance comparison is simple and among the most accurate ways to correct the speed sensor output for speed and distance measurement. It can account for cosine errors, beam geometry and other factors in a single step. Most other sources of error (vibrations or bumps encountered by the vehicle, for instance) will be minimized or averaged out.

To accomplish the correction, the vehicle travels a known distance while the distance measured by the sensor is recorded by summing counts. The correction factor is determined as shown in Equation 2.

$$\text{OffsetCorrection} = \frac{\text{KnownDistance}\,(\mathit{length})}{\text{MeasuredDistance}\,(\mathit{length})} = \frac{\text{KnownSpeed}\left(\frac{\mathit{length}}{\mathit{time}}\right)}{\text{MeasuredSpeed}\left(\frac{\mathit{length}}{\mathit{time}}\right)} \qquad \text{(Equation 2)}$$

For example, if the number of counts over a known mile is 280,000, then the average correction factor is 360,000 / 280,000 or about 1.286.

As mentioned already, it is very important to remember that there is a minimum speed at which the non-contact speed sensor produces an output. Travel below the minimum speed is not measured.

Contact Us

GMH Engineering personnel are available to discuss applications using non-contact speed sensing. If you have questions, please contact us at 1.801.225.8970 or info@gmheng.com.

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