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An Approach to Adapt Sensing Methodology via Magnetic or Pickup Sensing to Hall Sensing for Diesel Engine

Pulkit Sanadhya[1], Vivek Dixit[2], Manoj. S. Nagmode[3]

Electronics and Telecommunication, MIT College of Engineering, Pune, India[1]

Research and Engineering, Kirloskar Oil Engines Limited, Pune, India[2]

Electronics and Telecommunication, MIT College of Engineering, Pune, India[3]

Abstract: Sensors are used to measure different physical parameters which is being done by capturing the variation in a physical quantity to an equivalent electrical signal and vice versa holds good for the actuators. An array of sensors is being commonly used during advanced electronic engines platforms development to achieve precise and controlled emissions and to meet legislative requirements as per time and notifications as and when required. In order to achieve these requirements a sophisticated controlled electronic system is a need of hour and sensors are inevitable components for achieving the same. Different sensing control loops are applied and implemented in various electronic engines. This paper proposes an approach to develop the hall effect sensor for genset application which encapsulates optimized signal strength as well as increased fan-out by keeping the mounting dimensions same as that of existing sensor. The parameters scrutinized for defining the performance in the system are falling rate, fall time, frequency, rising rate and rise time.

Keywords: Hall sensor, Magnetic pickup sensor, Electronic control, Diesel Engine, Emission control, Genset application

I. INTRODUCTION

Sensors can be defined as the transducers that are used to convert a variation in physical quantity into the corresponding electrical signal.. They are used for interpreting precise information in highly constrained applications. Precision and accuracy are key to an application specific design . Sensors have been used efficiently in various electrical systems . But nowadays due to merging of various technologies, sensors have found their way in various automotive applications .An array of sensors are used in an automotive system such as inductive sensors , hall effect sensors ,capacitive sensors, Thermistors variable resistance sensors, strain gauze sensors and many more. Emissions are a vital cause of concern for any automotive system .

Pollution is a challenge that every automotive system designer must cope with. Due to increase in pollution a number of stringent rules and regulations concerning the emission are being imposed. A system designer has the obligation to adhere to these rules. Emissions can be controlled by making the combustion process more efficient . A number of factors contribute in making emissions more efficient.

One of these factors is timing of fuel injection. If fuel is injected at the precise moment, the fuel will nearly burn completely and the partial combustion of fuel can be minimized. This partial combustion leads to an increase in emissions. So a feedback system is required for meeting the stringent norms. This feedback system consist of sensors, actuators and an ECU which is used to control the functioning of these sensors and actuators. The timing of fuel injection has been conventionally controlled by using the magnetic pickup sensor for gen set application, but this sensor does not facilitate a signal of sufficient strength and signal processing which is a requisite for aforementioned application.

So instead of using magnetic pickup sensors, the development of hall effect sensors is proposed for sensing in CRDI engines for genset application, which actually provides a better signal strength and better sensitivity at higher RPM.

II. SYSTEM IMPLEMENTATION

A. Experimental setup

Fig 1 shows the Experimental setup of aforementioned control system. The major components of setup from the author's perspective of apprehension consisted of a 6 cylinder CRDI prototype engine, wiring harness, Electronic control unit (ECU) ,picoscope,BNC probes, Laptop PC ,breakout box, hall sensor, magnetic pickup sensor,ETAS CAN .

The setup consisted of various other mechanical and electrical components whose presence was indispensible for successful initialization of the system. The experimentation was done for magnetic pickup sensor as well as for hall sensor which is required to be developed for the genset application.

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Fig. 1 Experimental setup

III. EXPERIMENTAL RESULTS

The experimental setup shown in fig 1 remains same for hall sensor and magnetic pickup sensor. The mounting dimensions for both sensors are kept same which is a key issue for the development of sensor.

A. Experimentation via magnetic pickup sensor

Here, before starting the engine, the breakout box is connected between ECU and engine harness, now the probes from picoscope are connected to the breakout box. The picoscope is connected to pc for analyzing waveform obtained by the sensor against various parameters. Now as the engine is started, the waveforms are analyzed from null to 1500 RPM for zero load conditions. The RPM is varied using visual control interface (VCI). Initially the magnetic pickup sensor is mounted, the sensor parameters are analyzed for 1000, 1200 and 1500 RPM. Table I defining the signal characteristics of magnetic pickup sensor is shown below.

TABLE I. MAGNETIC PICKUP SENSOR SIGNAL CHARACTERISTICS

RPM	Rise time	Fall time	Rising Rate	Falling Rate	Frequency
1000	333.2 µs	106 µs	5.65 V/ms	28.1 V/ms	1.02Khz
1200	454 µs	91.9 µs	6.69 V/ms	33.1 V/ms	1.195Khz
1500	522.7 µs	72.18 µs	9.28 V/ms	42.8 V/ms	1.519Khz

The curve of RPM vs Rise time for signal from magnetic pickup sensor can be shown as in fig 2.

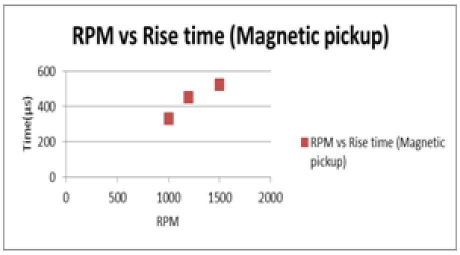


Fig 2 . RPM vs Rise Time curve of magnetic pickup sensor

Here , from the fig 2 it can be observed that the rise time for magnetic pickup sensor varies as the RPM of engine changes . Specifically it can be observed that on increasing RPM the rise time for signal is increasing which is undesirable as it signifies slower response of the system .

The curve for RPM vs Rising rate for the signal obtained for magnetic pickup sensor is shown in fig 3.

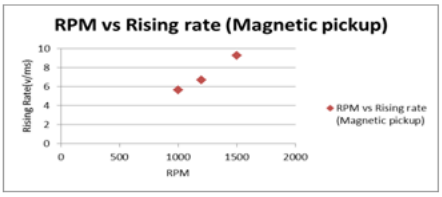


Fig 3 RPM vs Rising rate curve for magnetic pickup sensor

From the above curve it can be observed that the Rising Rate for waveform obtained from magnetic pickup sensor varies on varying the RPM. Specifically it can be said that the Rising rate of the sensor waveform increases on increasing the RPM which is undesirable for given application .

The curve for RPM vs Fall time for the waveform obtained for magnetic pickup sensor is shown in fig 4.

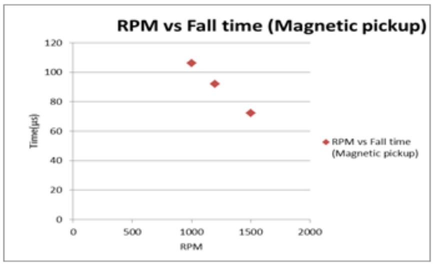


Fig 4 RPM vs Fall time curve for magnetic pickup sensor

From the above curve it can be observed that the Fall rate for waveform obtained from magnetic pickup sensor varies on varying the RPM. Specifically it can be said that the Falling rate of the sensor waveform decreases on increasing the RPM which is undesirable .

The curve for RPM vs Falling Rate for the waveform obtained for magnetic pickup sensor is shown in fig 5.

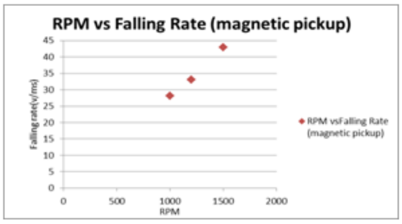


Fig 5 RPM vs Falling rate curve for magnetic pickup sensor

From the above curve it can be observed that the Falling rate for waveform obtained from magnetic pickup sensor varies on varying the RPM. Specifically it can be said that the Falling rate of the sensor waveform increases on increasing the RPM which is undesirable.

B. Experimentation via hall sensor

The experimental setup for hall sensor remains same as it was in case of magnetic pick up sensor. Table I defining the signal characteristics of magnetic pickup sensor is shown below.

TABLE I. MAGNETIC PICKUP SENSOR SIGNAL CHARACTERISTICS

RPM	Rise time	Fall time	Rising Rate	Falling Rate	Frequency
1000	22.8μs	129.3 ns	132.7 V/ms	17.18 V/μs	1.004 Khz
1200	22.97 μs	131.6 ns	133.9 V/ms	21.56 V/μs	1.198 Khz
1500	22.57 μs	141.3 ns	132.2 V/ms	18.25 V/μs	1.501 Khz

The curve of RPM vs Rise Time for hall sensor is as shown in fig 6

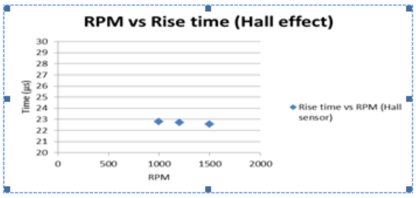
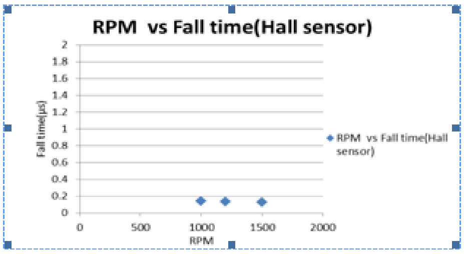


Fig 6. RPM vs. Rise time curve for hall sensor

It can be observed from the curve shown in fig 6, the rise time for hall sensor remain almost constant with a slight deviation from the expected value which fall within the appropriate limits for gen set application. The curve of RPM vs Fall Time for hall sensor is as shown in fig 7



It can be observed from the curve shown in fig 7 that the fall time for hall sensor remain almost constant with respect to RPM with a slight deviation from the expected value which fall within the appropriate limits for gen set application The curve of RPM vs Rising Rate for hall sensor is as shown in fig 8

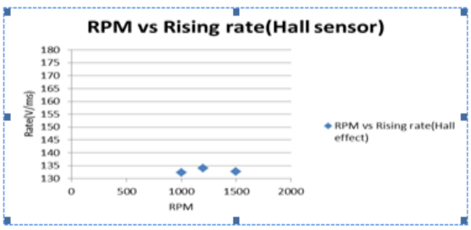


Fig 8 RPM vs. Rising rate curve for hall sensor

It can be observed from the curve shown in fig 8 that the rising rate for hall sensor remain almost constant with respect to RPM with a slight deviation from the expected value which fall within the appropriate limits for genset application. The curve of RPM vs Falling Rate for hall sensor is as shown in fig 9.

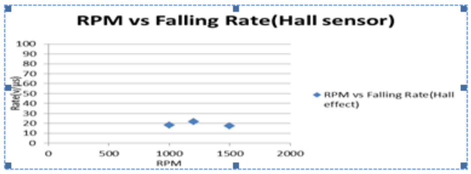


Fig 9 RPM vs. Falling rate curve for hall sensor

It can be observed from the curve shown in fig 9 that the rising rate for hall sensor remain almost constant with respect to RPM with a slight deviation from the expected value which fall within the appropriate limits for genset application.

IV. CONCLUSION

The output of hall sensor and magnetic pickup sensor were analyzed and were scrutinized against various signal parameters. The waveforms were analyzed via indicative device by varying the sampling rate and scaling the time period of signal. The signals were compared for rise time, rising rate, fall time, falling rate, frequency. The rise time, rising rate, fall time, falling rate of the signal are crucial parameters for a control system. So from the observed waveform it was perceived that these parameters remained nearly constant for hall sensors for variable RPM of the engine while these parameters diverted to a predefined trend for magnetic pickup sensors which was undesirable for the system. So from the above results it can be concluded that the hall effect sensor is successfully developed for the genset application.

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REFERENCES

[1] Hammerschmidt, D. and Leteinturier, P., "Automotive Sensors & Sensor Interfaces," SAE Technical Paper 2004-01-0210, 2004, doi:10.4271/2004-01-0210.
[2] W. J. Fleming, "Overview of automotive sensors," in IEEE Sensors Journal, vol. 1, no. 4, pp. 296-308, Dec 2001..
[3] F. Gustafsson, "Rotational speed sensors: limitations, pre-processing and automotive applications," in IEEE Instrumentation & Measurement Magazine, vol. 13, no. 2, pp. 16-23, April 2010.
[4] J. Lenz and S. Edelstein, "Magnetic sensors and their applications," in IEEE Sensors Journal, vol. 6, no. 3, pp. 631-649, June 2006.
[5] S. Taghvaeeyan and R. Rajamani, "Magnetic Sensor-Based Large Distance Position Estimation With Disturbance Compensation," in IEEE Sensors Journal, vol. 15, no. 8, pp. 4249-4258, Aug. 2015.
[6] H. J. Ahn and K. R. Kim, "Hall sensor array for measuring displacement of a 2D magnet array," Automatic Control Conference (CACS), 2013 CACS International, Nantou, 2013, pp. 413-416
[7] C. S. Anoop and B. George, "A reluctance-Hall Effect based linear digital angle sensor," 2013 IEEE International Instrumentation and Measurement Technology Conference (I2MTC), Minneapolis, MN, 2013,pp.1362-1366.