The improvement and laboratory testing of regenerative suspension system

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Keywords: Regenerative, suspension; energy harvesting; energy efficient vehicle

ABSTRACT – Nowadays, the requirement for more efficient vehicle is essential in the field of alternative energy and very crucial for automation industry. The aim of this paper is to ensure the enhancement of regenerative suspension system (EReSS) in order to obtain energy efficient vehicle (EEV). Accomplishment of laboratory testing was to ensure the improvement in the suspension system. Consequently, the output voltage can be increased if an improvement in the materials has been occurred. The results indicated that the proposed system can minimize the vibration's energy wastage and result in an effective vehicle in terms of electrical and electronic utilization.

1. INTRODUCTION

A vehicle suspension system can be defined as a system that connect the vehicle tires and springs to vehicle wheels to enable vehicle motion. The main function of suspension system is to act as a mechanical system which enhnces the sprung and communicate with un-sprung masses of the vehicle and offer a conveninent vehicle stabilty, where the sprung mass refered to the vehicle body ,while the un-sprung mass refered to the vehicle wheel [1]. The vehicle suspension system comprises of damper and spring, the damper utilized to absorb the vibration generated and distributes the energy to the encirclement. This type of energy can be gained with assistance of a modified suspension system called as energy regenerative suspension system. In addition, the fuel consumption can be minimized by utilizing the regenerative shock absorber [2], since the gained energy is utilized to charge the battery of the vehicle as well as enable the battery to start up instead powering up the vehicle battery using alternator [3]. Various researches have been conducted in the field regenerative suspension system where the main focus of all the studies is to produce noticeable improvement in the suspension system [4]. However, the improvement has been accomplished still not suffice the requirements of the commercial applications [5]. Hence, the requirement for producing an improved and sufficient regenerative suspension system is very important in order to fit the power demand and produce an enhanced final output demanding.

2. METHODOLOGY

The flow of this research begins by opting the EReSS [6]. This opted system considered as the best system that can produce the highest voltage reading in terms of theoretical. Apart from that, the opted EReSS system is very easy to be fabricated, where it utilizes a single barrel housing that consists all the necessary part for the electromagnetic regenerative suspension system [7]. The EReSS opted system is verified via testing on the laboratory by utilizing parameters variations, such as the number of windings which were (100, 250, 400), also the diameter of the coil (0.29, 0.4, 0.8) mm, and the magnetic utilized is NdFeb (grade N35). The system implementation is achieved by conducting an experiment on the laboratory utilizing a testing rig which moves in vertical orientation similar to the suspension system of a vehicle as presented in Figure 1.

Figure 1 Test rig for the EReSS testing on laboratory.

During testing in the laboratory, the frequency was varied to fall in the range from 10 Hz to 50 Hz. As well as the rectifier bridge is installed as a simple power electronic circuit in order to convert AC to DC Current. The produced output voltage of the EReSS is measured by utilizing multi meter in which the measurement is conducted and recorded for each part in the system with respects to parameters variation as mentioned earlier.

3. RESULTS AND DISCUSSION

The regenerative energy suspension has been designed and tested in the laboratory and the result of the testing was recorded and analyzed .As shown in Figure 2 and presented in Table 1 the results of the testing is demonstrated in a graphical manner. As the aim of this research indicates the testing was done with respect to parameters variation in which the number of winding and diameter of the coil result in impacts on the voltage reading of the EReSS. As can be seen from the tabulated results show in table 1 the power reading is decreasing when the number of windings is increased where ,the highest reading of the test is 30.5W at 30Hz for 0.8mm diameter, 2.8W at 10Hz for 0.4 mm diameter and 1.4W at 10Hz for 0.29 mm diameter. As well as an obvious observation can be seen that 30Hz frequency produces higher power output from the test. Therefore, large amount of power utilized in order to reduce the engine loading produced by usage also minimizes of the alternator, increase fuel efficiency, reduce vehicle emissions and fuel consumption.

Table 1 Power reading for the EReSS with different number of windings and coil wire diameter.

	Power (W)		
No of windings/ coil wire diameter (mm)/ Frequency (Hz)	400 0.29	250 0.4	100 0.8
10	1.41	2.08	18.61
20	0.91	1.82	22.87
30	1.04	1.18	30.51
40	1.35	1.6	12.38
50	1.35	1.65	21.3

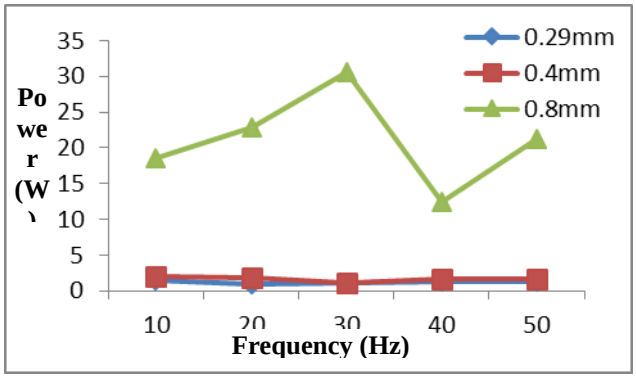

Figure 2 Graph plot of EReSS test with different diameter of coil.

4. CONCLUSIONS

In conclusion this study, concern in developing a harvest device for suspension system. The proposed suspension system utilizes the EReSS and tested on the laboratory test rig. According to the test results, it is observed that the maximum power reading for parameters variation for the system testing is 30.51W. In addition, the output power could be enhanced by improving the materials utilized in the electromagnetic system of the EReSS. Measuring instruments must be utilized in order to read the value of frequency of the test rig so that the produced output power can be recorded with respect to frequency variation Moreover, from the obtained results, it is noticed that, the output power of the EReSS is affected by varying the number of windings and coil wire diameter. Apart from that, varying the frequency during the test is also plays important role in producing better performance of the system. Lastly the proposed system utilizes the regenerative shock absorber to act as reduction tool of the fuel consumption in which the gained energy can charge the battery of the vehicle and help to start up the battery instead of using the alternator on the vehicle.

ACKNOWLEDGEMENT

The authors gratefully acknowledged the Advanced Vehicle Technology (AcTiVe) research group of Centre for Advanced Research on Energy (CARe), the financial support from Universiti Teknikal Malaysia Melaka and The ministry of Education, Malaysia under Short Term Research Grant, Grant no. PJP/2014/FKM(10A)/S01330 and Fundamental Research Grant Scheme (FRGS), grant no.: FRGS/2013/FKM/TK06/02/2/F00165.

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