

EXPERIMENTAL ANALYSIS OF MAGNETO-RHEOLOGICAL FLUID BASED FRONT FORK TALLY LEVER SUSPENSION

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ABSTRACT

Magnetorheological (MR) fluid damper are semi active control device that have been applied a wide range of practical vibration control application. In this study, the methodology adopted to get a control structure is based on the experimental results. An Experiment has been conducted to establish the behavior of the MR damper. In this paper, the behavior of MR damper is studied and used in implementing vibration control. In this paper we investigated theoretically at fabricated Magnetorheological damper by using different Magnetorheological fluid. Here two types of MR fluid developed first by mixing of prepared nano size magnetic polymer particle by co precipitation method, second by separation of magnetic tape. And a comparative study had done between these magnetic polymer particles prepared MR fluid. Here an experimental performed on fabricated MR damper and discussed the behavior of MR damper. The beneficial properties of magnetorheological fluids are applied in the design and testing of a prototype suspension system. Because viscosity of these fluids increased tremendously under the influence of a magnetic field, a suspension shock absorber containing magnetorheological fluids fluid is proposed. The shock system tested displayed resistance to motion with respect to the magnetic field strength.

Keywords: Magnetorheological (MR) fluids; Magnetorheological dampers; Semi-active damper; nano particle; Magnetic field intensity.

1. INTRODUCTION

Typically, a fabricated MR damper consists of a hydraulic cylinder, magnetic coils and MR fluid offering design simplicity as soon is fig.2. This MR damper has a conventional cylindrical body configuration filled with 100 ml of MR fluid and comprising the piston, the magnetic circuit with a coil resistance of 20 H and the accumulator. The enclosing cylinder is 41.4 mm in diameter and the damper is 208 mm long in its extended position with ± 25 mm stroke. The device can operate within a current range from 0.0 A up to 2.0 A with a recommended input value of 1.0 A for continuous operation and can deliver a peak force of 1000 N at a velocity of 50 mm/s with a continuous operating current level of 1.0 A. The MR damper can reach at least 90% of maximum level during a 0.0 amp to 1.0 amp step input in less than 25 milliseconds.

2. EXPERIMENTAL SETUP DETAILS

The experimental set-up consists of (see Figure 6.2):

1. Variable voltmeter it's a control device here i used for control the current supply on MR damper with variable range (0 to 270v)
2. Speed controller it's also a control device used for control the speed of AC motor which are generate vibration on system Range (0-1500 rpm)
3. Exciter (AC motor) is used for generate the vibration on system, manufacturer by patil electric co. pvt. Ltd. Its maximum speed is 1500 rpm
4. MR Damper it's a main component of our experiment all analysis is perform on these mechanical system here I used a prototype of fabricated MR Damper.
5. Recorder it's a mechanical recording device which is record the amplitude vibration of system, speed by sound card oscilloscope
6. 3 Axis accelerometer sensor is a one type of transducer which is measuring linear acceleration in(X, Y, Z) axis.

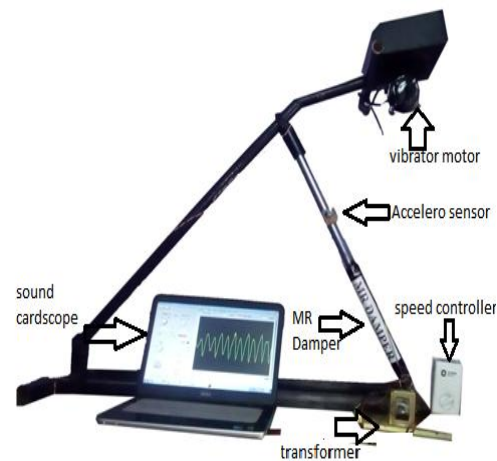


Figure 6.1 show experimental setup for MR Damper Testing

3. Result and analysis

3.1 Analysis of maximum and minimum amplitude using mat lab time scope without magnetic field.

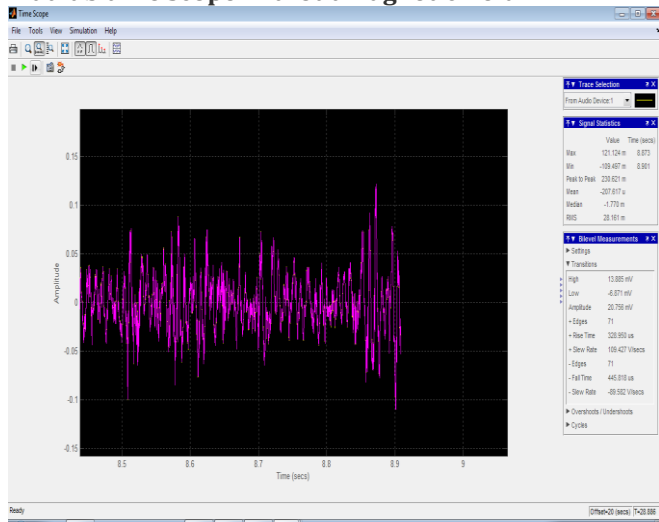


Figure 2 Maximum and minimum Amplitude without magnetic field using mat lab
The above graph shows the effect of Amplitude of vibration using without magnetic field. The result Amplitude is 20.756mv.

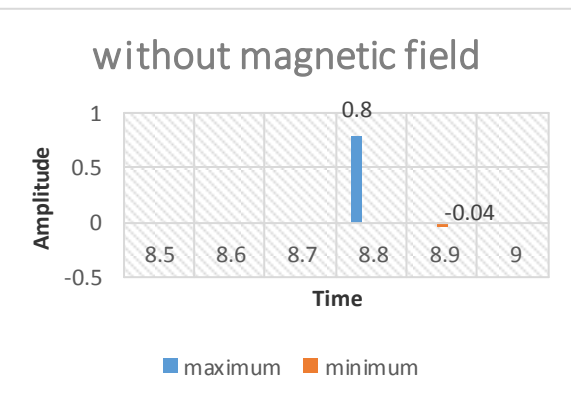


Figure 3 Maximum-minimum amplitude without magnetic field
The above graph shows the effect of maximum and minimum Amplitude with respect to time. Maximum amplitude is +0.8, at response with 8.8 sec. and minimum amplitude is -0.04 at response with 8.9 sec.

3.2 Analysis of maximum and minimum amplitude using mat lab time scope with Magnetic field

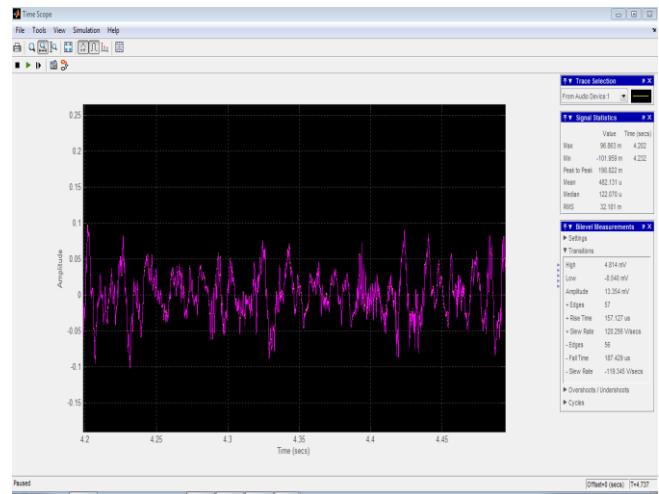


Figure 4 Maximum and minimum Amplitude with magnetic field using mat lab The above graph shows the effect of Amplitude of vibration using MR Damper with magnetic field. The result Amplitude is 13.354mv.

Figure5 Maximum-minimum amplitude with magnetic fieldThe above graph shows the effect of maximum and minimum Amplitude with respect to time. Maximum amplitude is +0.09, at response with 4.2 sec. and minimum amplitude is -0.1 at response with 4.25sec.

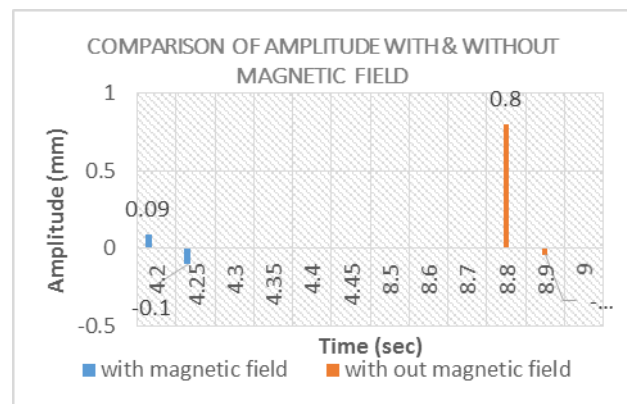
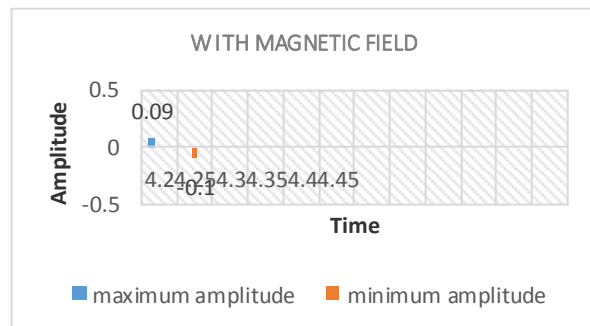


Figure 6 Effect of amplitude of with and without use of MR damper & magnetic field.

The above graph shows the Using mat lab sound scope measuring the value of maximum and minimum amplitude and observed parameters of the damper. By applying with and without magnetic field amplitude value is compare. According to our experimental analysis we have reduced amplitude by applying magnetic field on MR damper

3.3 Effect of amplitude of vibration without use of MR damper & magnetic field at variable length of exciter

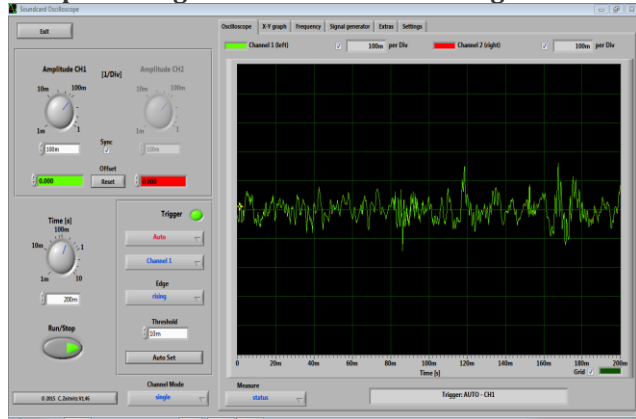


Figure 7 Effect of amplitude of vibration without use of MR damper using CRO

The above graph shows the effect of amplitude changing the vibration of exciter using without MR Damper& magnetic field. The variation of amplitude is 0 to 7 mm at variable length of exciter. In this experiment show when the variable length of exciter is varying the amplitude of vibration also vary.

3.4 Analysis of frequency with changing the variable length of exciter used of without magnetic field.

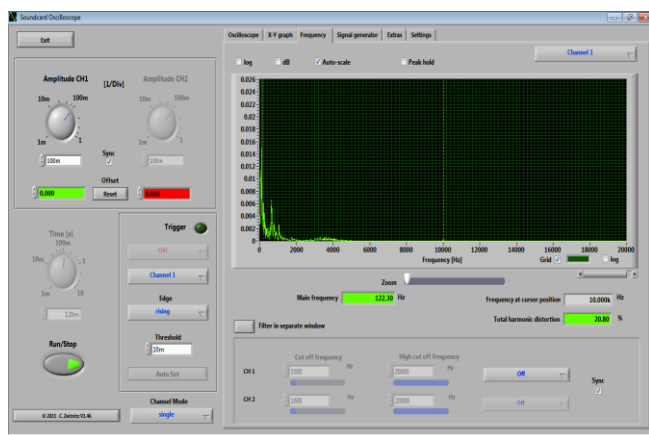


Figure8 Result Frequency without magnetic field

The above graph shows the effect of frequency of vibration changing the length of exciter using without MR Damper

& magnetic field. The result frequency is 122.30 Hz. in this experiment show when the frequency varying with variable length of exciter.

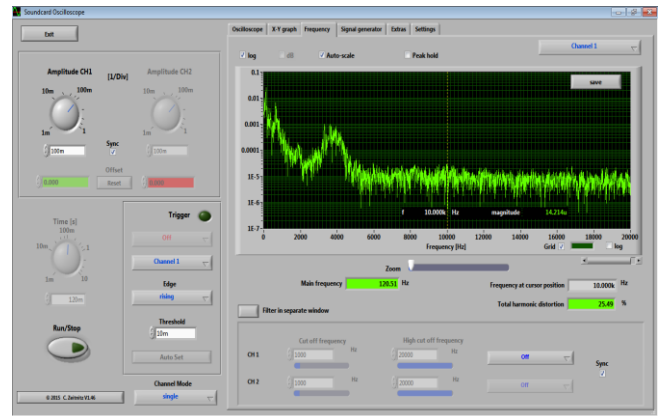


Figure 9 Frequency & log value without magnetic field

The above graph shows the effect of frequency and log value of vibration changing the length of exciter using without MR Damper & magnetic field. The result frequency is 120.51 Hz. in this experiment show when the frequency varying with variable length of exciter.

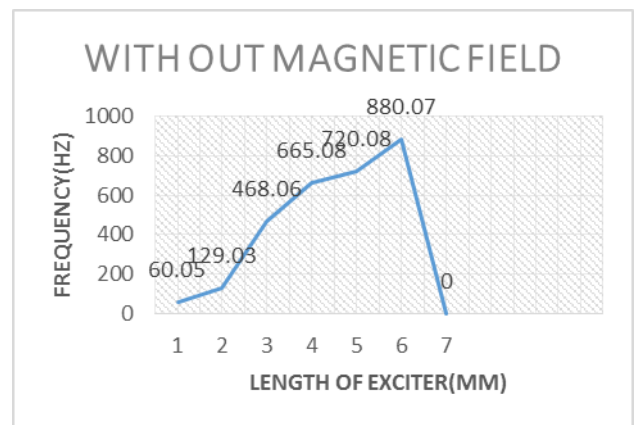


Figure 10 various frequency values at cursor position without magnetic field

The above graph shows the effect of various frequency value of vibration changing the length of exciter at 0 to 7 mm using without MR Damper & magnetic field.

3.4 Effect of amplitude of vibration with use of MR damper & magnetic field at variable length of exciter

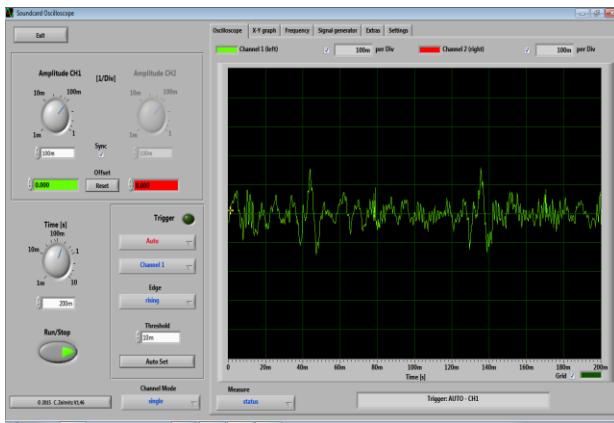


Figure 11 Effect of amplitude of vibration with use of MR damper using CRO

The above graph shows the effect of amplitude of vibration changing the length of exciter using MR Damper with magnetic field. The variation of amplitude is 0 to 7 mm in this experiment show when the variable length of exciter is varying the amplitude of vibration also vary.

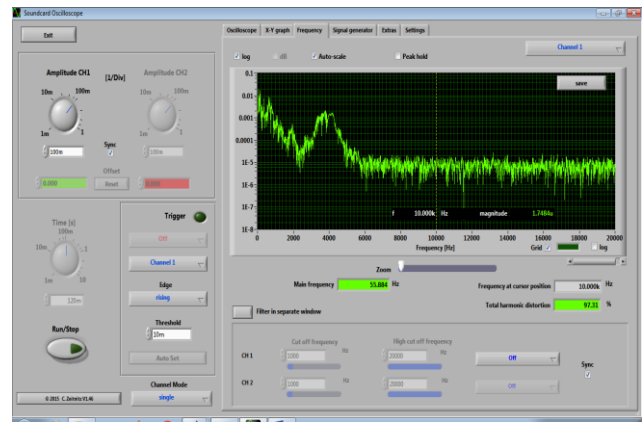


Figure 13 Frequency & log value with magnetic field

The above graph shows the effect of frequency and log value of vibration changing the length of exciter using with MR Damper & magnetic field. The result frequency is 55.884 Hz. in this experiment show when the frequency varying with variable length of exciter.

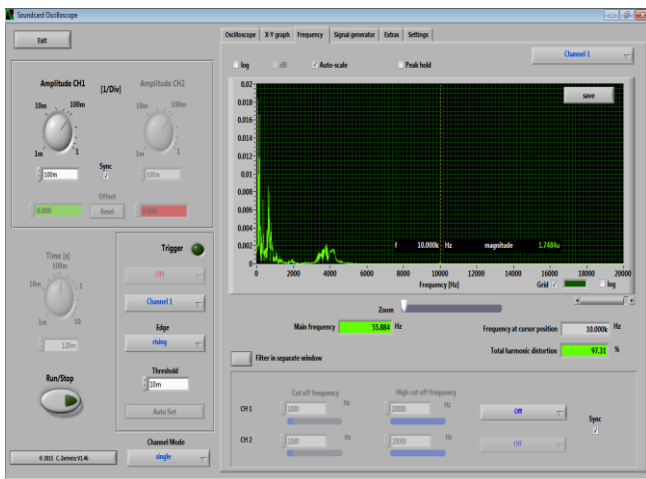


Figure 12 Result Frequency with magnetic field

The above graph shows the effect of frequency of vibration changing the length of exciter using with MR Damper & magnetic field. The result frequency is 55.884 Hz. in this experiment show when the frequency varying with variable length of exciter.

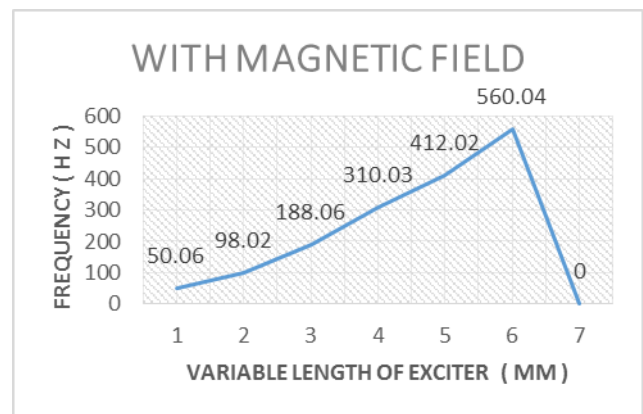


Figure 14 various frequency values at cursor position with magnetic field

The above graph shows the effect of various frequency value of vibration with changing the length of exciter at 0 to 7 mm using with MR Damper & magnetic field.

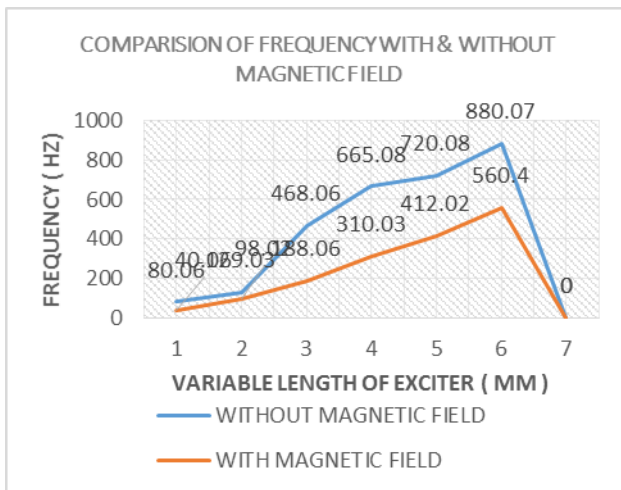


Figure 6.15 Comparison of frequency with & without magnetic field

The above graph shows the comparison of various frequency values of vibration with changing the length of exciter, and observed parameters of the damper by applying with and without magnetic field frequency value is compare. According to our experimental analysis we have reduced frequency by applying magnetic field on MR damper.

The experimental shows the good efficiency of prepared MR fluid in presence of external magnetic field. The MR fluid is tested on Sound card oscilloscope which shows the result as magnetic field is applied to MR fluid; it changes the physical state that is liquid state to semi-solid state. Sound card oscilloscope shows reading of magnetic field intensity by varying the current. Graph shows that as current increases then magnetic field intensity of MR fluid also increases. For our application we have used MR fluid in magneto rheological damper which shows better damping performance under the influence of external magnetic field.

4. CONCLUSION & FUTURE SCOPE

MR fluids with the existence of an external magnetic field can provide more resistance to motion than air or oil in a traditional shock absorber. It is also noticed that the higher the compression coefficient of a spring has, the smaller the resistance difference between the MR material and the oil will be. Also the stronger the magnetic field is; the larger the resistance of MR fluid will have.

There were a couple of places which could generate errors. One place that most of noise came from was the short points of the test platform design. The release trigger of the compress lock makes the table shack. And also the connection with shock block and spring also make a lot of noise. The disconnected between the spring and block make a type of noise that look like a flat top rather than a peak.

Magneto rheological (MR) fluid dampers have provided technology that has enabled effective semi active control in a number of real world applications. Because of their simplicity, low input power, scalability and inherent robustness. The design calculations of the volume, thickness and width of the annular MR fluid within the damper are derived. The equivalent damping coefficient of the MR damper in terms of input voltage, amplitude and frequency are investigated. The system with the MR damper is analyzed by studying its transmissibility. Also, the relative displacement with respect to the base excitation is quantified and compared with that of the without MR damper and with MR damper.

1 It was shown that, by minimizing the objective function, the frequency and amplitude conductive time constant are significantly improved at any value of applied current. The vibration of the optimized damper was also significantly reduced.

2 The magnetic polymer particle is more efficient for reduction of vibration as compare to use of magnetic Ferro particles particle on making of MR fluid.

3 MR Damper is mainly depended on magnetic flux density.

4 AS compare to conventional damper use of MR damper plays an important role in reducing the vibrations because, for every load condition the behavior of MR damper is change positively.

5 Magnetic circuit and structure integrated optimal design of MRF damper was well completed in our work. Multiple structure parameters and magnetic circuit parameters were simultaneously designed at the same time and it was with highly efficiency.

In this research, MR fluid was tested that could be used in shock absorber and had good results. After testing the shock absorber with MR fluid, it was concluded that this application could become useful in the future. In the future, a computer controlled electromagnet will be used. This could solve problems like the asymmetric magnetic field, etc. Also a better design of trigger releasing mechanism, the plate to mount roller bearing block as well as adding a sensor is necessary to get better data.

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