Data Acquisition System:

Analyzing Vibration and Road Noise in Passenger Vehicles

Presented by: Ikechukwu Chima, Evan Asklar, Maxwell Kolarich, Daniel Wilkinson

CURCA
CENTER FOR UNDERGRADUATE RESEARCH AND CREATIVE ACTIVITIES
University at Buffalo The State University of New York

University at Buffalo
The State University of New York

Abstract

Since the advent of the automobile road noise and vibration have been an area of major improvement over time. The purpose of this research is aimed at analyzing road noise and vibrations using data acquisition to aid in the design of vehicle suspensions and cabins, to better improve comfort and ride quality in various vehicles today. By using accelerometers, sound sensors, vibration sensors and hall effects sensors to analyze major components that contribute to road noise we can modify things such as the suspension and tires which can be optimized for vehicle ergonomics.

Introduction

Analyzing road noise, vibration, and acceleration in vehicles is a major contribution to improving overall comfort in vehicles today. In order to measure these phenomena the use of a data acquisition is required for accurate measurement which can then be used to further improve vehicle comfort and handling. Data acquisition systems that analyzes such phenomena are useful in the car industry today. Vehicle ergonomics are an important factor when deciding to buy a vehicle. Due to this manufactures invest heavily on research and development to improve vehicle ergonomics, which is used to make a vehicles more suitable for consumers.

Hardware and Setup

- **Arduino UNO** is an open source microcontroller board used to process data from all sensors.
- **Accelerometer** measures acceleration due to linear movement and rotation.
- **Hall Effects Sensor** measure revolutions per minute of a rotating component using a magnet.
- **Sound Sensor** measures sound levels using a microphone.
- **Vibration Sensor** measures magnitude of movement in any direction.

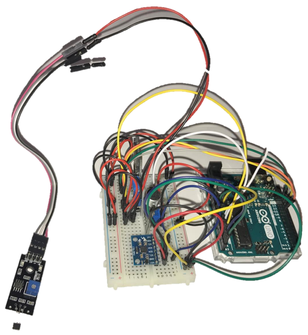

Figure 1: Data Acquisition System Setup

Testing

Testing was conducted on our own personal vehicles for baseline data to use and improve upon. Additional testing was done using a remote controlled off-road racing truck and UB SAE Baja car to compare data between different vehicles that had distinct purposes..

Figure 2: Testing Done on Personal Vehicle Using Sound Sensor (Left) and Hall Effect Sensor (Right)

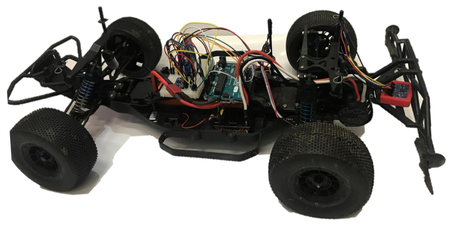

Figure 3: Data Acquisition System Used on Radio Controlled Racing Truck

Data

The data shows a g-force plot showing acceleration as the vehicle is accelerating, braking and cornering. Also the sound levels, vibrations and wheel speed is shown as a function of time which can then be used along with on board video recording to further analyze conditions.

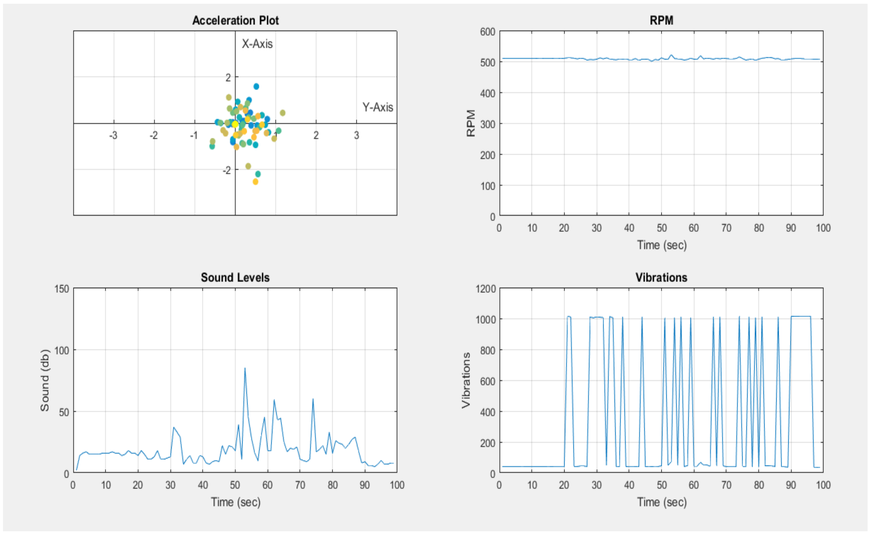

Figure 4: Data Obtained From Testing

Future Implementation

During testing it was found that the data acquisition system had the capability of being used for analyzing different vehicle setups which can be used for racing performance purposes. This data acquisition system is planned to be used in partnership with UB SAE clean snowmobile team to find ways to improve efficiency. Likewise, continued use with the UB SAE Baja team is expected and is to be used during competition to make adjustments over the course of a race to optimize handling based on track conditions. Also, plans on transferring this system to be used in the development of passenger and race vehicles are also being considered.

Figure 5: UB SAE Baja Car

Figure 6: UB SAE Clean Snowmobiles

References

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[2] Lieh, J. *"Semiactive Damping Control of Vibrations in Automobiles."* J. Vib. Acoust. Journal of Vibration and Acoustics 115.3 (1993): 340. Web.

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