Maintenance and Modernization to Increase Prevention of the Railway Accident

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Abstract - ***Railway infrastructure is increasingly coming under the close scrutiny of the Health and Safety Executive over incidents that may be due to track irregularities. In order to show compliance with safety targets and to make maintenance and future investment decisions, it is proposed that an attempt should be made to improve the current methods of linking particular types of track irregularities with derailments. This would also allow operators and infrastructure managers to monitor these irregularities more effectively and to direct maintenance over the long term.***

Indian Railway transport is one of the major modes of transportation, so it must offer high comfort level for the passengers and the staff. The first step includes identifying hazardous characteristics of a railway system and potential threats from railway accidents. The combination of nadal's theory and the lateral and vertical vibrations of ride comfort have been calculated. is widely used for this task, which is based on analysis of various accident-related reports and information. The combination of nadal's theory and the lateral and vertical vibrations for understanding how hazardous events and hazardous conditions contribute to a railway accident examines the etiology of railway accidents and analyzes the detailed sequence of events that caused the railway accident. This can be accomplished by applying the accident analysis method. This method is the process of understanding, analyzing, and describing the accident and the behavior patterns of hazardous conditions through the use of published sources, focus groups, questionnaires, and personal interviews. The approaches most frequently used are failure modes and effects analysis (FMEA) and fault tree analysis (FTA). These approaches have several limitations, however. FMEA is limited in that it does very little to analyze problems arising from human errors or adverse environments. FTA has limitations; this approach analyses only those problems related to a central subject and excludes any intangible problems that could arise from human errors. With regard to these problems, most of these approaches only take into account technical failures. On the other hand, the accident analysis method using an accident scenario analysis is often useful in that this method examines patterns of accidents and provides clues to building better prevention strategies for each pattern of accident. Drury and Brill devised a limited number of accident scenarios with descriptions of the actors (victims), the props (products), the scene (environments), and the action (task).

Prevention of derailment accidents raises a very crucial issue for a railway company since the resultant damage is very likely to be directly connected to human life. Derailment is caused by many factors. One type of derailment is caused by a factor that can be specified as a particular cause, such as collision with an automobile at a crossing, collision with a falling rock, expansion of rail gauge by earthquake, axle breakdown and excessive train speed. In the other type of derailment, one particular factor cannot be specified as a cause for derailment, and multiple causes related to the car and track have combined to cause the derailment

Key Words: *Vibration monitoring, Dynamic Control, measuring motion, acceleration, inclination, graphical user interface….*

1. INTRODUCTION

International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 02 Issue: 03 | June-2015 www.irjet.net p-ISSN: 2395-0072

Derailment assumed to be caused by multiple factors can be divided in to three types according to the form.

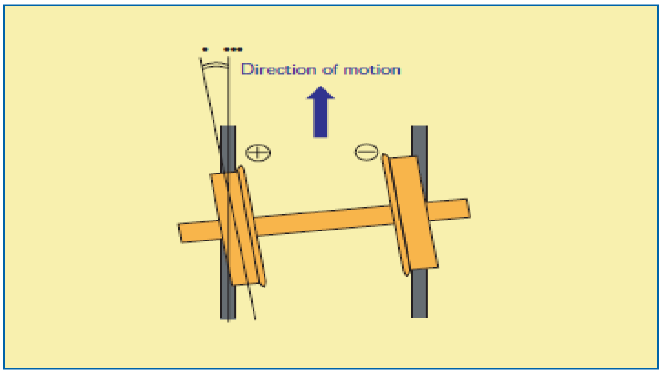


Fig. 1: Attack angle

(1) Wheel climb derailment accident in this type of derailment, the attack angle (formed by the wheel and rail, see Fig. 1) is positive (the wheel flange climbs up the rail in the direction of motion), and transversal force is produced between the wheel and rail, with the result that wheel climbs up the rail.

(2) Slide-up derailment

In this type of derailment, the attack angle is negative, and the wheel is faced in the direction away from the rail, where force in the lateral direction is greater than that is applied, whereby the wheel slides up the rail.

(3) Jump-up derailment In this type of derailment, abrupt force in the lateral direction is produced to cause the wheel to collide with the rail. Of these three types of derailment, the wheel climb derailment is most likely to occur. The aforementioned accident having occurred on the Hibiya line belongs to this type. In the wheel climb derailment, the flange of the wheel contacts the shoulder of the rail (gauge corner portion), as shown by a circle in Fig. 2 . Then the flange starts to climb up the rail. Then it climbs to reach the top position in the final step.

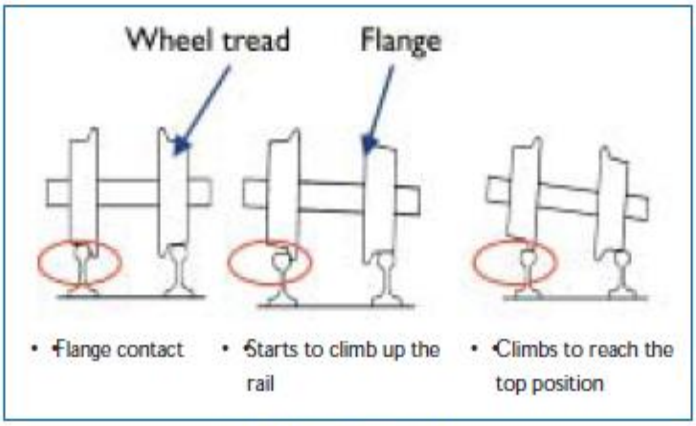


Fig. 2: Process of climbing

The accident scenario analysis can be used to provide a clear picture of accidents that arise from hazardous events and hazardous conditions [1]. Although much work has been done to apply scenario analysis to accident, there is still no systematic and formal methodology which identifies generates, analyzes, and verifies accident scenarios, in our view. The absence of such a methodology raises questions regarding accuracy and objectivity; i.e [2]. the systematic reflection of the interaction between hazardous events and hazardous conditions is not employed. Since the validity of the accident scenario can be subjective because of its dependence on the analysts' personal experiences, this method is not widely used in accident analyses. Therefore, a new method which is more systematic as well as objective is needed to better identify and give a clearer picture of the accidents arising from the interaction between hazardous events and hazardous conditions [3].

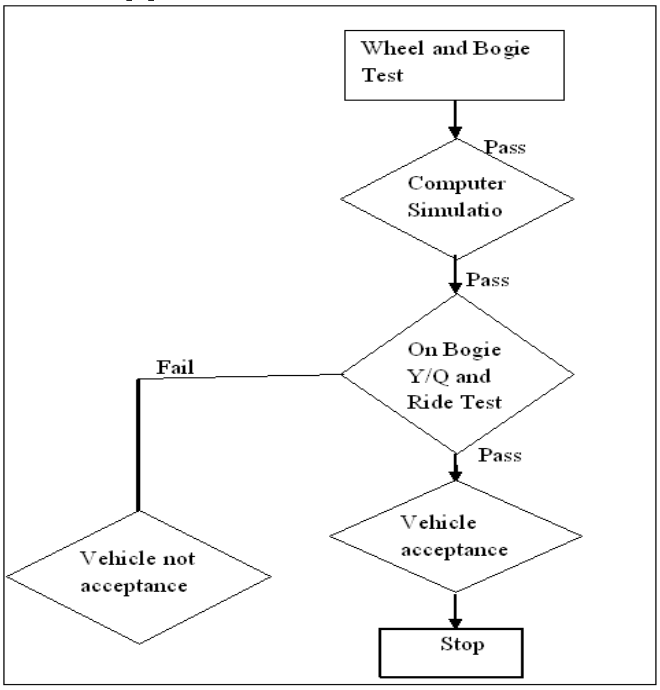


Fig3: Work Flow diagram

. Conducting new studies for every single countermeasure of specific interest in resolving specific local problems is impractical. The challenge posed by Melcher is "not to throw these estimates out, but rather to systematically and objectively integrate relevant findings from different sources to provide a comprehensive appreciation of countermeasure effects applied to different transportation safety problems and locations [4]. In summary, regardless of the model adopted a significant degree of bias in the estimates of countermeasure effects can be introduced. This is due to a number of reasons, including:

• Rarity and randomness of collisions.
• Lack of adequate statistical controls or misspecification of factors.
• Complex co-linearity issues among variables.
• Treatment selection biases (e.g. the RTM problem).
• Data aggregation.
• Data reporting biases.

In light of these biases, in this paper we have taken the view that countermeasure effects can best be treated as random variables and their distributions should be obtained formally by integrating prior distributions with location-specific data [5]. Railway vehicles provide a range of more comfortable facilities compared to the other means of passenger transportation in respect to the ability of performing sedentary activities like reading, writing, eating, etc. Facilities that are commonly seen in railway passenger cabins are tables, spacious seats, special compartments, etc. As a consequence, many passengers choose the railway to be able to work while travelling.

2. RELATED WORK

(A) Bayesian Data Fusion

This study proposes a Bayesian data fusion method for combining countermeasure effects from different independent sources with estimates obtained from a formal analysis of the grade crossing data. The proposed approach is similar to that suggested by El Faouzi (2006), Melcher et al. (2001) and Washington and Oh (2006), but different in how prior knowledge and data likelihood functions are developed. In this paper, our aim is to obtain "posterior" estimates of the probability of the effect induced by a given countermeasure applied to a specific crossing *i* with a given mix of attributes.The posterior expression is of the form (Migon and Gamerman, 1999; Lee, 2004): $Pi(\theta|x)$. $Pi(\theta)Pi(x|\theta)$ (1) where θ is the countermeasure effect (CMF) for a specific crossing;x the estimate from Canadian collision prediction models; $Pi(\theta)$ the prior probabilities of θ from past studies; $Pi(x|\theta)$ the probability of observing the sample data given that a statement about the value of a parameter is true (i.e. objective or current best knowledge); $Pi(\theta|x)$ the posterior probability of θ give x. Eq. (1) assumes that the effect of a given countermeasure is best treated as a random variable with a unique probability distribution[5]. Since these estimates are obtained from independent sources and are commonly empirical in nature, we assume that for a given crossing they are normally distributed with a given mean and a variance. As noted by Lee (2004), the observations which have a built-in estimation error are likely to reflect a normal distribution according to the central limit theorem. If the distributions of multiple source estimates on the priors and data likelihoods are normal the posterior estimates are also normal. Note that this normal distribution assumption is purely for computational convenience and other distributions are equally applicable with the proposed data fusion method. The use of other distributions may require more computationally intensive procedures such as, Markov Chains Monte Carlo (MCMC) techniques. Similar to Washington and Oh (2006),more flexible beta distribution, which can explain the non symmetric nature of countermeasure effects, is also considered in this study in obtaining the posterior probability distribution for a given countermeasure effect[6].

(B)Vehicle/Train Collisions

Under Indian conditions, approximately 70% of collisions occur during daylight and 30% Occur at night. Daytime collisions also predominate, but the difference between Daytime and night-time crash occurrence is less marked. Approximately 65% of crashes involve trains running into road vehicles and 35% Involve road vehicles running into the side of trains.
Seven contributing factors related to the driver of the road vehicle have been identified:

- Not detecting the crossing
- Stalling
- Not detecting the train
- Being distracted
- Inaccurate expectancies
- Deliberate risk taking
- Misjudging train speed.

There are very few cases of stalled vehicles on the tracks, and deliberate risk taking is not possible unless the driver has already seen the train. The important contributing factors are, on the one hand, not detecting the train, to which distraction and inaccurate expectancies Regarding the presence of a train may contribute; and on the other hand, misjudging the speed of the train. It is not known to what extent each of these factors contributes to collisions at railway level crossings [7]. It seems inherently unlikely that adding more lights to the train would result in more accurate (or at least more cautious) perceptions of train speed [8]. This leaves cases which involve not detecting the train, distraction and expectations that a train will not be present as events where adverse outcomes could be avoided by better train conspicuity. Unfortunately, it is not possible to say what proportion of cases this involves, or by how much increased conspicuity (assuming effective increases in conspicuity were possible) is likely to reduce this.

3. PROBLEM IDENTIFICATION

As it is known that Railways are the second fastest means of transport in the country and therefore it demands great security and safety. The main aim or objective is to prevent all the passengers from any sudden accidents due to rail crack that can leads to derailment. On the basis of information, the frequency of vibrations can be analyzed and efforts can be made to cease any sort of accidents.

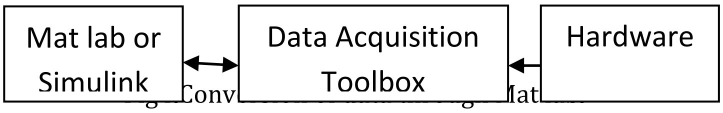
4. PROPOSED APPROACH

You can execute Data Acquisition Toolbox functions from the MATLAB command line, through MATLAB applications, or in Simulink models using dialog boxes.

The toolbox provides functions for creating device objects that are directly associated with your hardware. These objects include base properties that apply to all supported hardware, such as sample rate, trigger settings, and channel properties. They also include device-specific properties that let you access the specific features and capabilities of your hardware [9].

Using Device Object

Device objects provide a gateway to the hardware's functionality and enable you to control the behavior of your acquisition. For example, you can execute any supported analog input task via an analog input object created in MATLAB or Simulink.



The toolbox supports three device objects: analog input, analog output, and digital I/O. Data Acquisition Toolbox automatically perform A/D and D/A data conversions for receiving or sending data[10].

Basically the sensor that has been used to sense the vibrations of Railway track depends on the level of frequencies. The working method that is applied to implement derailment is totally depends on the lateral (horizontal) and vertical forces i.e. (L/V values). In this report, the combination of Nadal' s theory and Sperling's Ride index theory is used to prove that the derailment may happen if both the forces are not balanced , and if it is not balanced then automatically the passenger's ride comfort zone will be disturbed[11]. The major factors by which the derailment can be assessed and it depends on:

1. Dynamic frequency.
2. Static frequency.
3. Acceleration of a vehicle.
4. Ride comfort value in both the lateral and vertical directions.
5. The cone angle of a force i.e. λ value.
6. Coefficient of friction i.e. μ value.

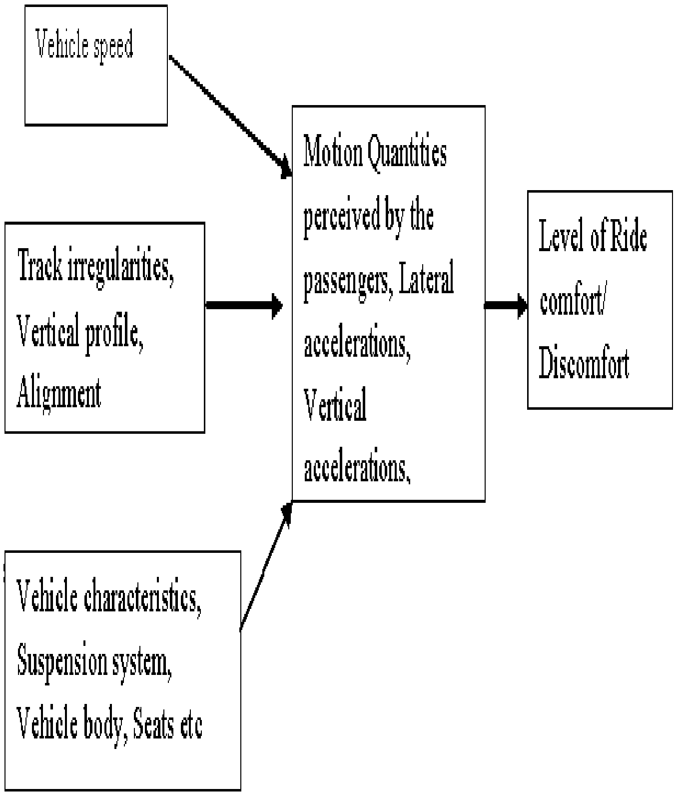


Fig 5: Significant track and vehicle parameters for Ride comfort that can cease derailment.

Analog Input

The analog input functions let you acquire signals from your hardware. You can create an analog input object, add channels to the object, acquire data to memory, read data into the workspace, and preview the most recently acquired data [12].

Analog Output

Analog output functions let you send signals out to your hardware. You can create an analog output object, add channels, queue data sets to be output, and generate analog signals.

Digital I/O

Digital I/O functions enable you to generate or read digital signals using your hardware. You can create digital I/O objects, add lines, send data to the hardware, and read data into the workspace.

Train conspicuity is but one of the issues to be addressed in improving safety at passive crossings. Government agencies and other funding bodies should consider the potential costs and benefits of further research into train conspicuity in the light of these other issues. At time of writing, a number of research providers have recently collaborated to produce a comprehensive program of research into improving safety at passive railway crossings which took into account the recommendations of the the views of rail operators and regulators[13]. The program has been developed through the Rail Co-operative Research Centre at the University of Central Queensland, and has involved Accident Research Centre;

program was presented to the Rail Safety Regulators for consideration. The regulators took the proposal to the SCOT Rail Group Meeting on but no decision to support the program was made at that time [14].

The research tasks proposed in the program are:

- Increasing the Conspicuity of Locomotives and Rolling Stock
- Adequacy of Warning Signals for Road/Rail Drivers with Color Vision Deficiency
- Ranking of the Safety of Passive Crossings
- The Effect of Road Surface on Approaches to Level Crossing on Drivers' Awareness of Trains
- Engineering Aspects of Safety at Level Crossings
- The Consequences of Increased Train Speed and the Leibowitz Illusion.

Study of new evaluation method

As described above, at present we evaluate the traveling safety according to the derailment coefficient. Evaluation of derailment, especially the evaluation of wheel climb derailment, cannot completely be explained by the derailment coefficient. shows the derailment coefficient and the amount of wheel riseas well as an example of waveform representing the lateral creep force (theoretical value) in the case of flange contact, when climbing has occurred in the car traveling test at the eighth point and crossing side track conducted by JR East. This shows that climbing starts if the derailment coefficient I large [15]. When climbing has started to occur no correlation can be observed between the amount of wheel rise and derailment coefficient. A high level of correlation can be observed between the amount of wheel rise and lateral creep force [16].

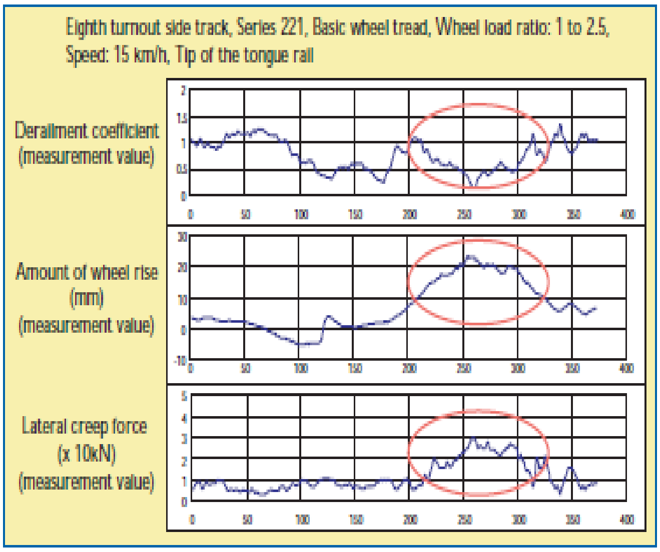


Fig.6: Example of waveform in derailment reproduction test

shows the computed values for Wzrq (the value of ride quality) and Wzrc (the value of ride comfort with the help of the value of previous computed values of B, Acceleration and standard parameters of Static frequency, and moreover keeping the standard value of λ and μ, we can calculate the Y/Q values and these values can relate with the ride quality and ride comfort.

5. RESULT

According to the report 1) by a committee for the survey and study of the derailment accident on the Hibiya subway line, when the car with unbalanced wheel load (assumed as being unbalanced by 20% or more) was traveling along a sharp curve at a low speed of about 15 km per hour, the wheel on the outer track was lifted to climb up the rail surface, with the result that the derailment accident occurred. To prevent this, the following five items are mentioned in this report:

- Management of the stationary wheel load ratio of the car (where

the target control value is 10%)

- Management of track distortion
- Optimization of rail grinding profile (For the sharp curve, the upper side of the gauge corner must not be ground at an oblique angle).
- Change of wheel flange angle (65 to 70 deg. to be studied)
- For the curve where the estimated derailment coefficient ratio is

A graphical user interface (GUI) is a pictorial interface to a program. A good GUI can make programs easier to use by providing them with a consistent appearance and with intuitive controls like pushbuttons, list boxes, sliders, menus, and so forth. The GUI should behave in an understandable and predictable manner, so that a user knows what to expect when he or she performs an action. For example, when a mouse click occurs on a pushbutton, the GUI should initiate the action described on the label of the button. MATLAB GUIs are created using a tool called guide, the GUI Development Environment. This *tool* allows a programmer to layout the GUI, selecting and aligning the GUI components to be placed in it. Once the components are in place, the programmer can edit their properties: name, color, size, font, text to display, and so forth. When guide saves the GUI, it creates working program including skeleton functions that the programmer can modify to implement the behavior of the GUI. When guide is executed, it creates the Layout Editor. The large white area with grid lines is the *layout area,* where a programmer can layout the GUI. The Layout Editor window has a palate of GUI components along the left side of the layout area. A user can create any number of GUI components by first clicking on the desired component, and then dragging its outline in the layout area. The top of the window has a toolbar with a series of useful *tools* that allow the user to distribute an align GUI components, modify the properties of GUI components, add menus to GUIs, and so on.

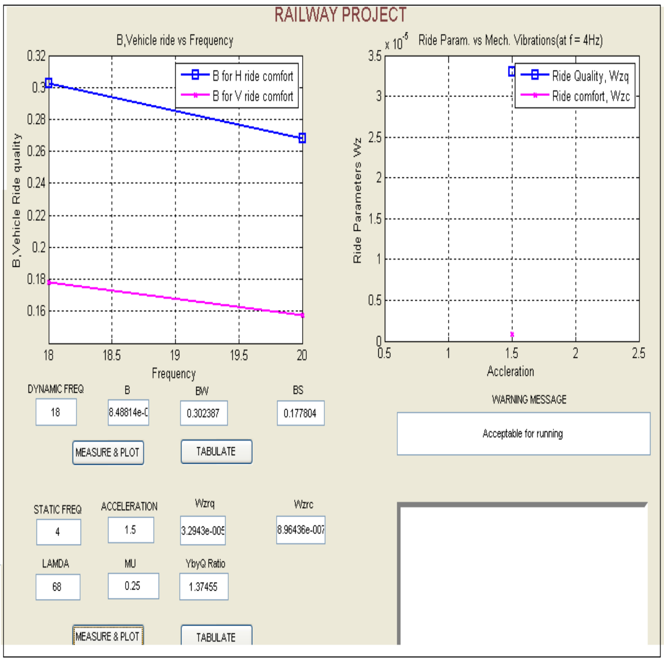


Fig 7: Complete GUI using MATLAB.

Result for Mathematical Analysis:
The simulation for both the graph shows some differences regarding the safe zone during derailment considering ride comfort and ride quality.

Table 1: Comparatives values with respect to f, B, Acceleration and Y/Q.

	F	B	Bw	Bs	Acceleration	Y/Q
Standard Graph	**15Hz**	**3.2**	**1.0**	**0.6**	**10**	**1.4**
After Simulating the Input data	**15Hz**	**2.42**	**0.4**	**0.2**	**10**	**1.3**

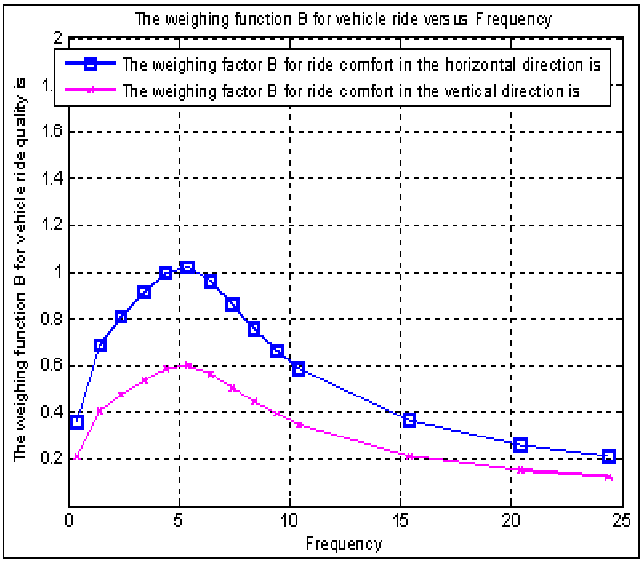


Fig 8: Complete GUI using MATLAB.

6. CONCLUSIONS

We have made the attempt to project the differences that occur due to the frequency variations and this causes vibrations inside the train that are totally based on the changes of the forces due to the speed of the train and that only leads to the conclusion that the value of lateral and vertical forces is somehow directly proportional to the Ride index value which represents the comfort zone of the passengers. We are able to perform the vibration sensing analysis based on some attacks or accidents that clearly depicts the differences in the GUI using MATLAB functions to display message box. Hence, we are to conclusion that is a scope of further improvement in monitoring the condition of the track that total depends on the lateral and vertical forces. We performed only for the condition of the track which shows the flow of vibrations in a graphical form based on the particular range of frequencies. There is a vast scope of improvement in both the theories that can be implemented for the safety of the passengers.

7. FUTURE WORK

Further work can address the subjective experiments and prediction of accidents Online using the above salient measures identified. Another possible avenue is to combine various fundamental metrics for better performance prediction.

REFERENCES

[1].R.K.Yadav, The Investigation of Derailments, 3rd Ed, March 2007, Indian Railways Institute of Civil Engineering, Pune.

[2]. P. V. Krishna Kant, EVALUATION OF RIDE AND ACTIVITY COMFORT FOR THE PASSENGERS WHILE TRAVELLING BY RAIL VEHICLES, Mechanical & Industrial Engg. Deptt. Indian Institute of Technology, Roorkee (India), August 2007.

[3]. K. V. Gangadharan, Experimental and Analytical Ride Comfort Evaluation of a Railway Coach, Mechanical Engg. Deptt, National Institute of Technology Karnataka, Surathkal.

[4].Vivek Kumar, Vikas Rastogi, Investigation of vertical dynamic behaviour and modelling of a typical Indian rail road vehicle through bond graph, Deptt. Of Mechanical Engg. , Sangrur, Punjab, April 26 2009.

[5]. R. Illingworth, Resistance of Railway Vehicles to Derailment and Roll-Over, Railway group Std., London, and Feb 1998.

[6]. Kardas-Cinal E, Drozdziel J., Sowinski B.: *Simulation study of a relation between the derailment coefficient and the track condition*, Archives of Transport, vol. 21, issue 1-2, Warsaw 2009.

[7]. M. K. Bhiwapurkar, V. H. Saran, S. P. Harsha, V. K. Goel, *Influence of Mono-axis Random Vibration on Reading Activity,* Deptt. Of Mechanical & Industrial Engg. Indian Institute of Technology, *Roorkee,* Jun 30, 2010.

(8)Hariharan**, T.,** *Estimation of Ride Index of High Power Diesel Multiple Unit Rail* Coach*. M. Tech* thesis, *IIT Madras*, *India*, 2000.

(9)Sriram T. Vengalathur, *Low Cost Fault Detection System for Railcars and Tracks,* University of Bangalore, *India*, Aug 2003.

(10)Steven Bleakly and Steven Senini, *Autonomous time Frequency Analysis of Wagon Body Accelerations,* Faculty of Engineering and Physical Systems, *Central Queensland University, Rockhampton, Qld*, *Australia,* 2004.

(11)Mirjana Tomicic- Torlakovic, Svetislav Stefanovic, *Railway Noise Vibration- Current European Legislation And Research And Measurements On Serbian Railway,* University of Belgrade, The Faculty of Civil Engineering, *Serbia,* January 2010.

[12]. C. Madshus, B. Bessason and L. Harvik, *Vibrations From High Speed Railways On Soft Ground,* Norwegian Geotechnical Institute, *Norway,* Nov. 1995.

[13] S.K. Mittal, Sandeep Kalra, M.A. Shamshi and B. K. Sharma, *Micro-Controller based Oscillation Monitoring System for the safety of Railway Vehicles with high storage capacity and Real time warning facility,* Central Scientific Instruments Organization, *Chandigarh,* and June 2004.

[14] Khairul Anuar Abd Wahid, *Development of Tilt and Vibration Measurement and Detection System using MEMS Accelerometer as a Sensor, University Sains Malaysia,* July 2008.

[15]. Simon Wagner, *Derailment Risk Assessment,* James Goldston faculty of Engineering and Physical Systems, Central Queensland University, 2004.

[16]. Simon Wagner, *Derailment Risk Assessment,* James Goldston faculty of Engineering and Physical Systems, Central Queensland University, 2004.