Methodology for Multibody Dynamics of Light Motor Vehicle - A Review

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Abstract— This paper presents the methodology for multibody dynamics of light motor vehicle with the related search. The study specifies factors influencing the motion of light motor vehicle. These are based on a systematic study of dynamic forces acting on the vehicle body and analysis of stresses acting on it. For which we consider literatures reviews & some of them are explained.

Key words: Tata Sumo, light motor vehicle, modelling, dynamic analysis

I. INTRODUCTION

In the automotive industry, computer simulations of Light Motor Vehicle durability early on in the design process are becoming more and more important in order to decrease development cost and product time to market. Accurate calculations of force histories are of utmost importance for reliable fatigue life estimates. The forces are often calculated by use of multi-body software and used as input for stress analysis in a FEA package.

In Light Motor Vehicle development a challenge is the large number of variants generated by different transport missions. From a simulation point of view, this means that a large number of vehicle configurations needs to be analyzed which calls for effective analysis tools if the whole population is to be optimized.

Multi-body dynamic analysis is the dynamic analysis of mutually interconnected rigid bodies, whose relative motions are constrained by means of joints. The purpose of this analysis is to find out how these bodies move as system and what forces are generated in the process. The multi-body dynamic analysis is typically applied in automobile industry for the modelling and analysis of suspension system. The multi-body suspension models allow precise evaluation of the effect of suspension geometry and the mechanical characteristics of spring and damper on the ride comfort and vehicle handling performance.

One type of analysis that is growing in importance is the simulation of forces for durability assessment. However, all methods use multi-body simulation (MBS) codes to perform the calculation of the forces. Although very useful in many areas, MBS are quite slow for the integration of long time signals, such as the ones needed for fatigue analysis, especially if flexible bodies are included. For Light Motor Vehicle simulations it is vital to have a flexible representation of the frame.

To overcome this different method is proposed. In this method the force and/or stress histories are calculated directly in ANSYS software using complete vehicle models, where environment variables, such as road profile and curve radii, are used as input. This in combination with modal super element reduction will result in fast design studies.

The calculated forces are compared with measurements for different road inputs.

In a Flexible Multibody Analysis, components of a system that are likely to have large deformations are modelled as flexible and other components are assumed rigid. Mathematical modelling of vehicle dynamics helps engineers reduce the time it takes to achieve a design which will meet performance requirements for the consumer and for government regulations. A proposed design can be studied to determine if it can meet goals before any prototypes are built. The effects of design changes can be evaluated without building costly prototypes. Development engineers can use mathematical models to assist with the tuning of prototypes by identifying the changes which should be made to produce desired ride and handling characteristics.

As the project is being done in collaboration with TATA MOTORS, the Dynamic Analysis is carried on TATA SUMO.

II. CONCEPT

The concept of Multibody analysis is to find critical areas of a system to perform more detailed component-level structural analysis. Multibody analysis also gives insight into the system dynamics, forces experienced by segments of the structure and stresses generated in flexible components leading to failure due to large deformation or fatigue. A fundamental understanding on the stability of Light Motor vehicles is required in order to comprehend the effects of the various lay-outs and parameters.

III. LITERATURE REVIEW

A. F.Oijer [1]:

This paper gives information about accurate calculations of force histories for reliable fatigue life estimates. The forces are often calculated by use of multi-body software and used as input for stress analysis in a FE package. The calculated forces are compared with measurements for different road inputs. One type of analysis that is growing in importance is the simulation of forces for durability assessment. However, most (all) methods use multi-body simulation (MBS) codes to perform the calculation of the forces. For truck simulations it is vital to have a flexible representation of the frame. The objective of this study has been to find a more efficient method for the calculation of forces, which allows for fast analysis and easy implementation of flexible bodies.

B. M.F.J.Luijten [2]:

In this paper, electronic stability control functions are applied on trucks to enhance safety. The challenge of designing such functions is to guarantee robustness for all truck variations, such as lay-out, length, mass, number of axles and number of articulations. Therefore, fundamental understanding of the effect of these variations on the dynamic yaw behaviour of articulated vehicles is required. The results presented in this report pertain to optimal driving

conditions. It is recommended to investigate the effect of excitations of the truck other than the steering wheel input on the dynamic performance of truck combinations.

C. N.M.Shah [3]:

This paper describes a designing and analysis of earth mover – wheel loader vehicle using SolidWorks 2009 and MSC Visual Nastran Desktop 4D. Wheel loader vehicle is a multibody system and to design and analyze such system requires profound knowledge of highly challenging subjects like Computer Aided Design, Finite Element Analysis, machine design, reverse engineering and structural dynamics etc. This project work shows how to implement engineering fundaments into the real world application. In this project, designing has been done by implementing reverse engineering concept. Initially, the dimensions of wheel loader toy have been documented by vernier caliper and full scale ruler. These dimensions are vitally implemented in generating the 3D model of the wheel loader. Solid Works has been used for 3D model creation. In order to run the design to real time standards a few design modifications are taken into account. Design of lift arm cylinders, lift arms, tilt/bucket cylinder and connecting rod are modified to real time standards. Solid Works 2009 has been used for kinematic analysis of wheel loader. While MSC Visual Nastran Desktop 4D has been used for kinetics and structural analysis the model. To perform this analysis 3D model of wheel loader has been exported from Solid Works to MSC Visual Nastran Desktop 4D has been exported from Solid Works to MSC Visual Nastran Desktop 4D.

IV. RESEARCH METHODOLOGY

The research methodology will cover as follow –

- Obtaining input data regarding Light Motor Vehicle.
- Analyzing the detailed drawing considering critical parameter.
- Preparing modified design with the help of Pro-E software.
- Analysis of the major parts through ANSYS software.
- To compare analysis data of old component with new and reach to the final optimum solution.
- To show the results in terms of stress /deflection comparison.

V. CONCLUSION

The main conclusion will be to find out whether it is possible to reduce all the impact forces on the vehicle body. Also the future scope for developing design model for any profile can be identified.

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