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Numerical and Experimental Modal Analysis of Go Kart Chassis

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Abstract: Structural analysis of GO KART chassis is significant in design and development stage. Since, it holds all the essential components, understanding the dynamic behavior is necessary to understand how vibrations are transferred to the end rows from any vibration sources. This project presents the modal properties of Go-Kart chassis calculated by means of finite element analysis (FEA) and experimental modal analysis (EMA). The purpose of this study is to find the modal properties like natural frequency and mode shapes. The correlation between experimental results and theoretical results was observed.
Keywords: Experimental modal analysis, natural frequency, chassis

I. INTRODUCTION

The chassis of Go-Kart is skeleton frame made up of hollow pipes and other material of different cross sections. The chassis of Go-Kart must be stable with high torsional rigidity, as well as it should have relatively high degree of flexibility as there is no suspension. So that it can give enough strength to withstand with curb load as well as with other accessories. Chassis is designed by taking ergonomics as main factor. The chassis is designed in such a way that it should ride safe and the load that applies does not change the structural strength of the chassis [1]. The chassis is back bone of the Go-Kart, as it has to be flexible as well as it must be equally tough for suspension. Chassis construction is normally of tubular construction, typically GI with different grades. In this kart, AISI1080 material is used. Chassis supports the power unit, power train, the running system etc.

A. Modelling of GO-KART Chassis

3D Model chassis of is made in CATIA V5 by measuring actual chassis dimensions.

B. Meshing 3D model of Chassis

3D Model in CATIA is imported in abacus as .CAT Part. After importing material properties like density, young's modulus, poissions ratio are defined. After defining properties meshing is done by using mesh tool function of abacus.
Type of element used for meshing: 2 dimensional beam element
Global meshing size: 0.005 m approximate
Natural frequencies and mode shapes are determined in abacus.
After meshing constrains are given in software. In visualization mode shapes having different frequencies are obtained.
Mode Shapes Are Obtained In Abaqus

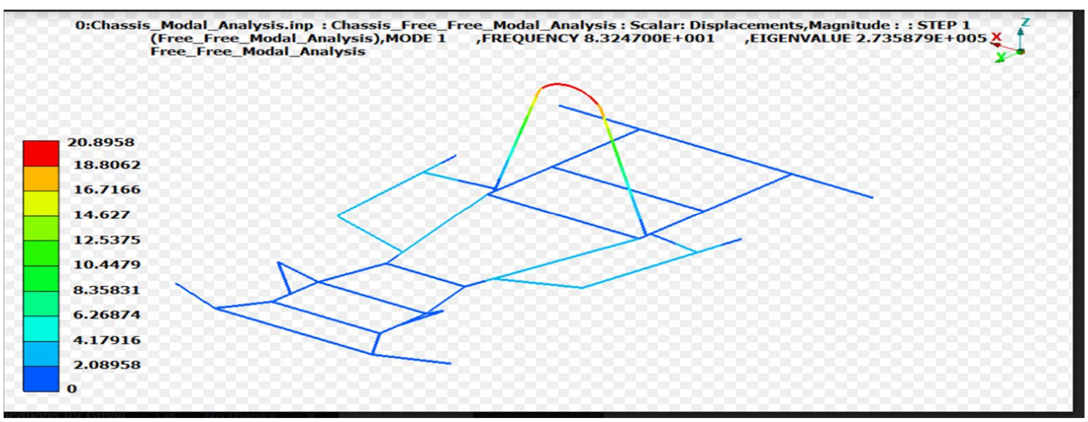

Fig 1: Mode Shape 1

This mode shape indicates higher stresses at upper part of the GO-KART Chassis.

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II. NUMERICAL ANALYSIS RESULTS

Obtained natural frequencies and mode shapes of Go-Kart chassis by using Abaqus are as mentioned in Table 1

Mode	Natural Frequency (Hz)
1	83.24
2	115.07
3	121.32
4	140.81
5	147.86

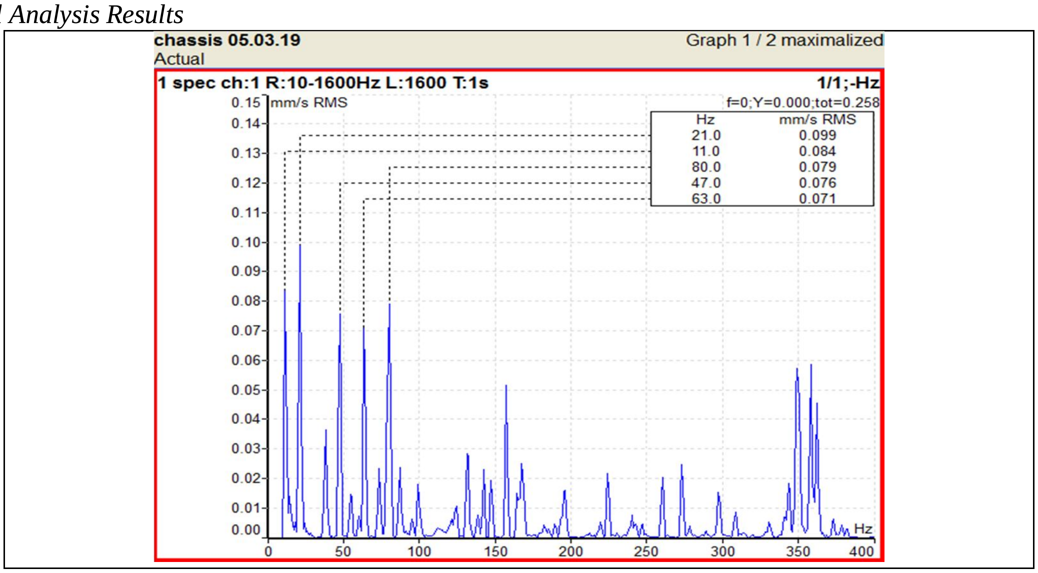
Table 1: Natural Frequencies

A. *Experimental Modal Analysis*

Test rig is used for suspending the actual go-kart chassis. Due to ropes, supports are provided at few points only and balancing is done. FFT impact hammer test is conducted and results were obtained by using accelerometer.

Picture 1 – Experimental Setup

B. *Experimental Analysis Results*



Graph No 1:FFT result

Graph No 1 shows the plot of frequency vs amplitude. 80Hz frequency shown in above graph approximately matches with mode shape1

III. COMPARISON OF RESULTS

It is observed that, the results of FEA have discrepancy with the experimental results. The process of comparing the data from FEA to EMA is known as Correlation. It is also used to assess how far that they are in agreement with each other. It is certain that discrepancies are unavoidable due to error possibilities in experimental data or finite element model structure. The results of FEA and EMA correlates to inconsistencies between both analyses. After correlating, percentage of error between them was calculated. Table No 2 provides the correlation of natural frequencies of the go-kart chassis structure extracted from both FEA and EMA.

Frequency No	Numerical Method	Experimental Method	Percentage Error
1	83.24	80	3.89
2	115.96	99	14.6
3	121.32	122	0.56
4	140.81	137	2.70
5	147.86	145	1.93

Table 2: Comparison of result

IV. CONCLUSION

In summary, this study has deals with two approaches to obtain modal parameters which are FEA and EMA. Modal parameters such as the natural frequencies, mode shapes were obtained through the FEA and EMA. Finite element models for the go- kart chassis structure was executed and percentage of errors between set of data was obtained [2]. The results of this study show that the total average percentage of errors was about 4.5%. The discrepancies between both results due to inaccuracies in parameter assumption and simplification in the process of modeling. However, this inconsistency between the prediction model and the actual structure can be improved by carrying out the model updating procedures. If the investigation is to be moved forward, a better understanding of model updating technique and parameterization needs to be developed.

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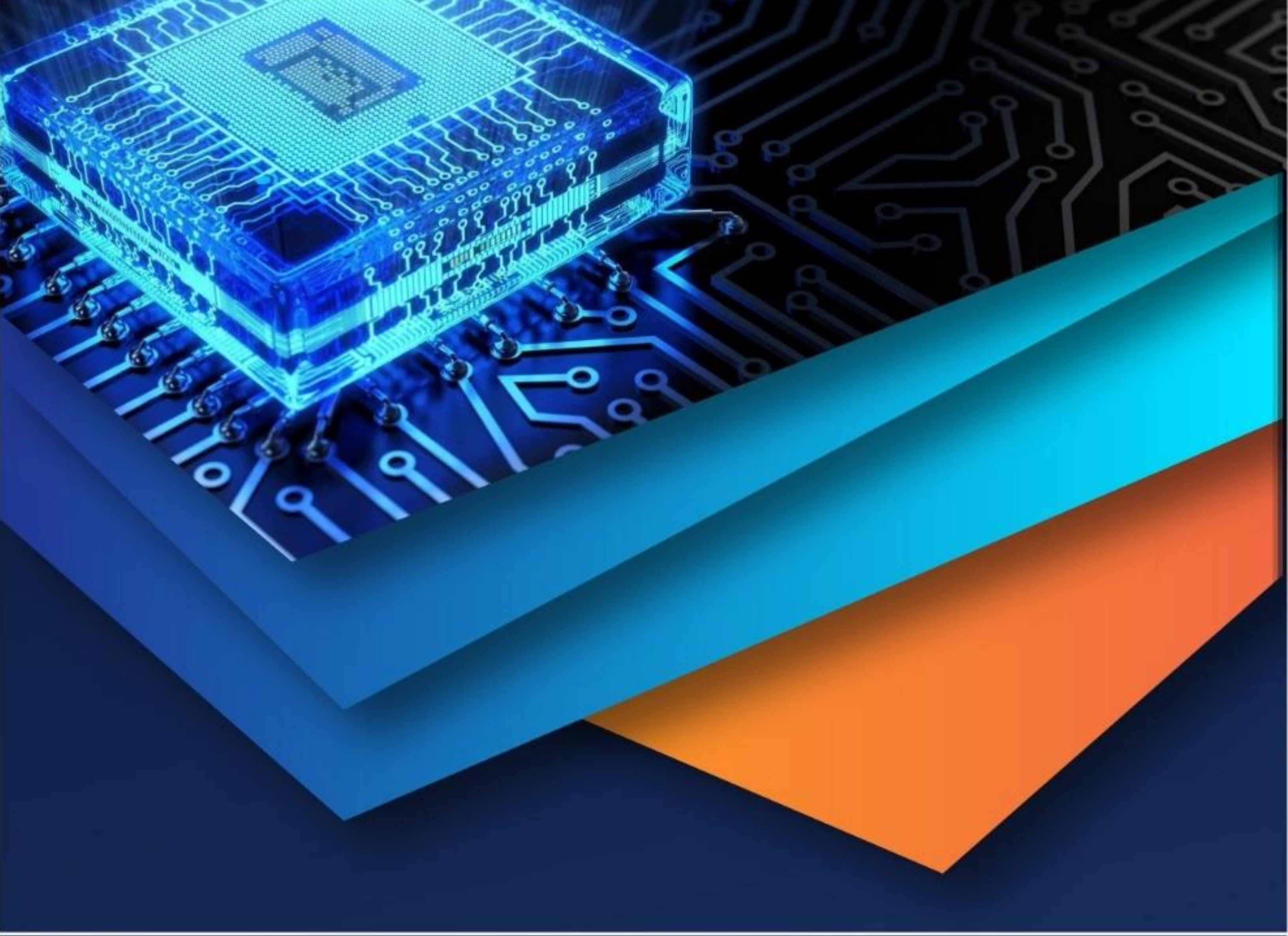

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