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Design and Analysis of a Go-Kart

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***Abstract:** This research paper presents the structural design and analysis of a go-kart vehicle intended for competitive racing applications. The design integrates considerations for safety, ergonomics, cost-efficiency, and structural integrity. The chassis and critical components such as the knuckle, disc, and wheel hub were modeled using CAD software and analyzed via finite element analysis (FEA) in ANSYS. Various impact scenarios such as front, rear, side, torsional, and vibrational (modal) were simulated. The results validated the design's safety margins under the intended loads and conditions.*

I. INTRODUCTION

Go-karting represents a popular and accessible motorsport discipline. The objective of this study is to design a structurally sound, lightweight, and driver-friendly go-kart vehicle. The vehicle design focuses on optimum weight distribution, structural safety under different impact scenarios, thermal management in braking systems, and effective ergonomics for the driver. The design process followed a bottom-up approach, beginning with chassis modeling in SOLIDWORKS and subsequent simulation in ANSYS.

II. MATERIAL SELECTION

Selection of appropriate materials for each component is crucial for balancing weight and strength.

Table 1: Mechanical Properties of Selected Materials

Material	Yield Strength (MPa)	Ultimate Strength (MPa)	Density (Kg/m³)
AISI 4130	514.85	615	7850
Stainless Steel	620	860	8000
GSM Mild Steel 500	370	500	7850
Cast Iron	250	700	7200

AISI 4130 was selected for the chassis due to its high strength-to-weight ratio, toughness, and weldability.

III. METHODOLOGY

A. Chassis Analysis

The chassis was modeled as a space frame structure. Various impact scenarios were simulated:

- Front Impact
- Rear Impact
- Side Impact
- Torsional Impact
- Modal (Vibrational) Analysis

Mesh: 69856 nodes and 35004 elements
Material: AISI 4130
Component Analysis: Similar analysis was conducted for Knuckles (GSM Mild Steel), Brake Disc (Stainless Steel), and Wheel Hub (GSM Mild Steel).

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IV. RESULTS AND DISCUSSION

Table 2: Chassis Impact Analysis Summary

Impact Type	Impact Force (N)	Max Stress (MPa)	Deformation (mm)	FOS
Front	5689.8	174.76	67.483	2.11
Rear	| 4267.35	| 299.48	54.107	1.78
Side	2844.9	302.25	0.9001	6.12
Torsional	±2844.9	433.45	10.904	1.23

Knuckle Analysis: Maximum lateral force during turning was 7676.73 N. Max stress: 456.02 MPa
Brake Disc Thermal Analysis: Peak temperature of 315.70°C under braking. Max stress: 1.99 MPa. Wheel Hub Analysis: Max stress from 1535.34 Nm moment: 0.78 MPa with negligible deformation.

V. CONCLUSION

The designed go-kart chassis and components demonstrated safe operational limits under simulated impact, thermal, and mechanical loads. Finite element analysis provided valuable insights enabling design optimization. The final model is lighter, structurally sound, and ergonomically refined for competitive performance.

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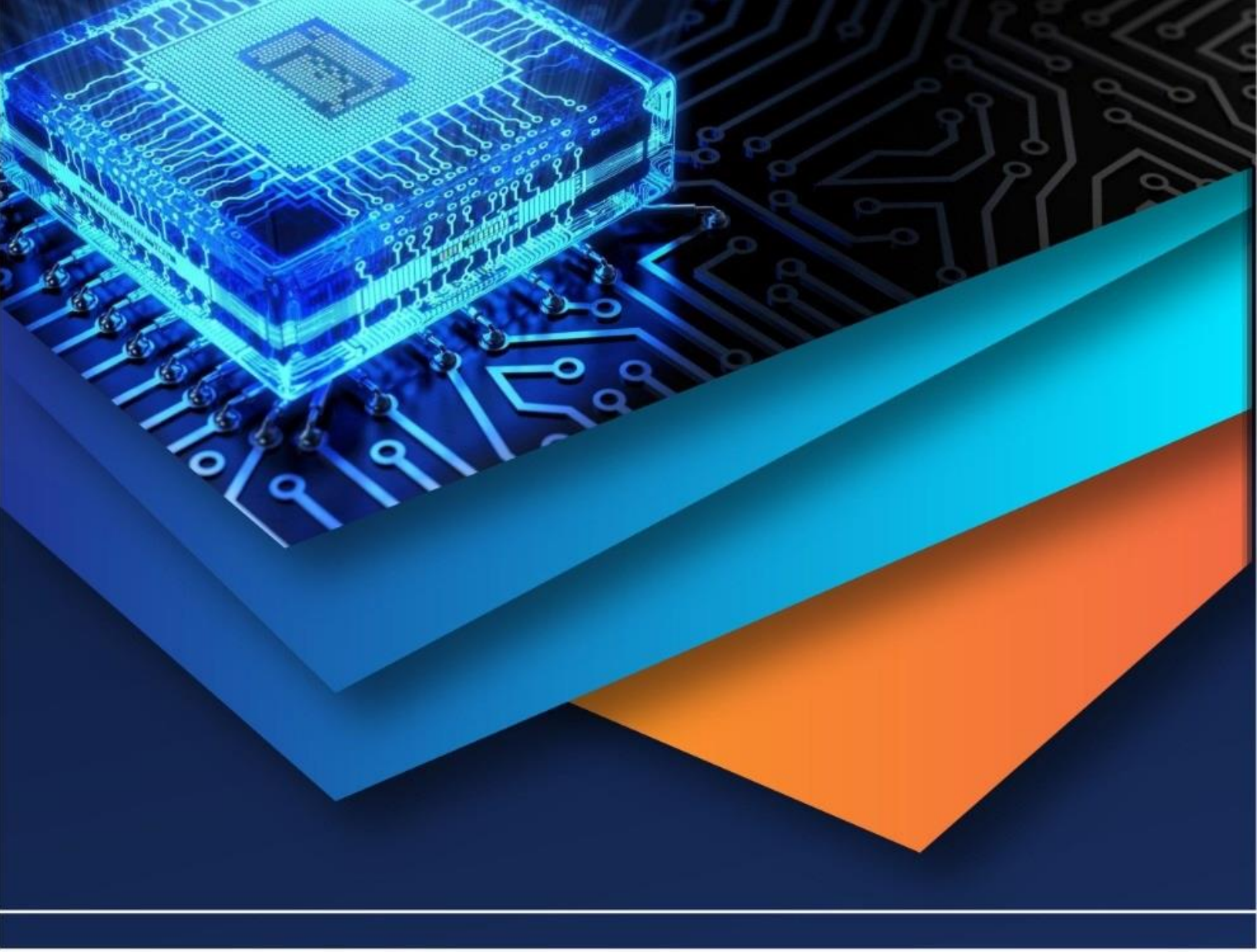

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