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Analysis of longitudinal vibration in M/T vehicle using characteristics of complete vehicle system

Yoshihiro Wakabayashi / ESTECH CORP.

<e-mail : yoshihiro.wakabayashi@estech.co.jp>

Hajime Igami / HONDA R&D CO.,LTD

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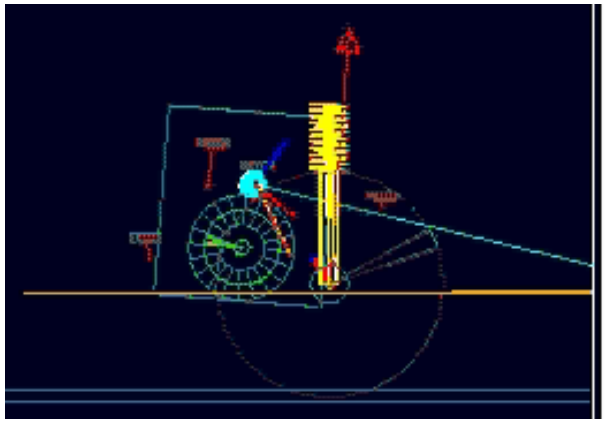
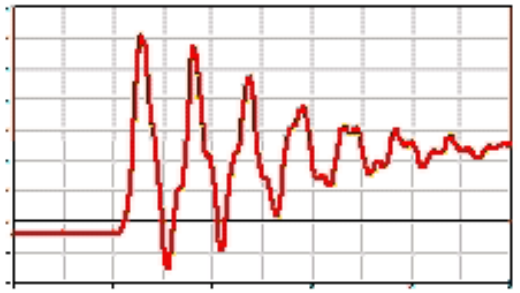
A simple and accurate ADAMS model using characteristics of complete vehicle system is developed for simulating longitudinal vibration which is observed during acceleration of a vehicle with manual transmission.





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1. Introduction

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In developing the model, we directed our attention to:

- **Creating a model as simple as possible based on drawings and design values,**
- **Taking notice of low frequency vibration below 10 Hz,**
- **Making it easy to utilize measured system characteristics in the model.**

The following characteristics are especially taken into account:

- **Engine torque input**
- **Drivetrain torsional stiffness**
- **Engine mounting system characteristics**

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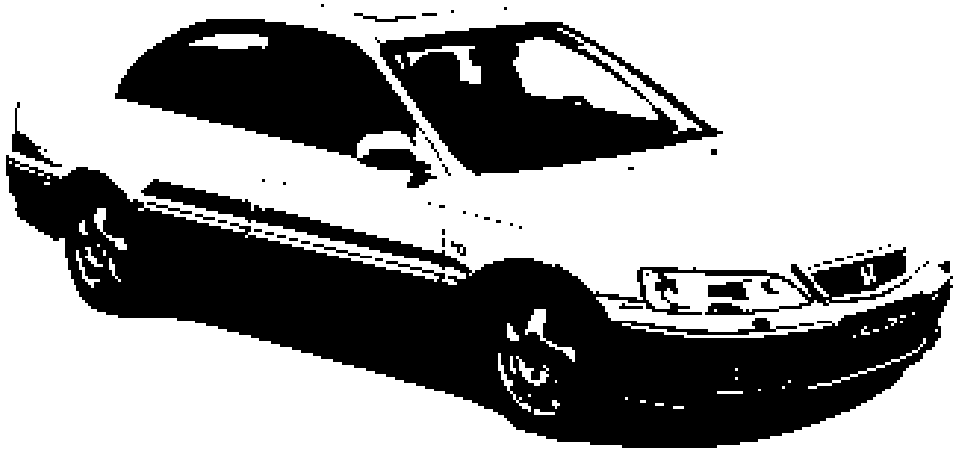

- **Engine : 4 Cylinders, 1800cc, Spark Ignition**
- **Transmission : 5-Speed Manual Transmission**
- **Drivetrain Type : Front Engine, Front Drive**
- **Destination : Europe**

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2. Test Vehicle

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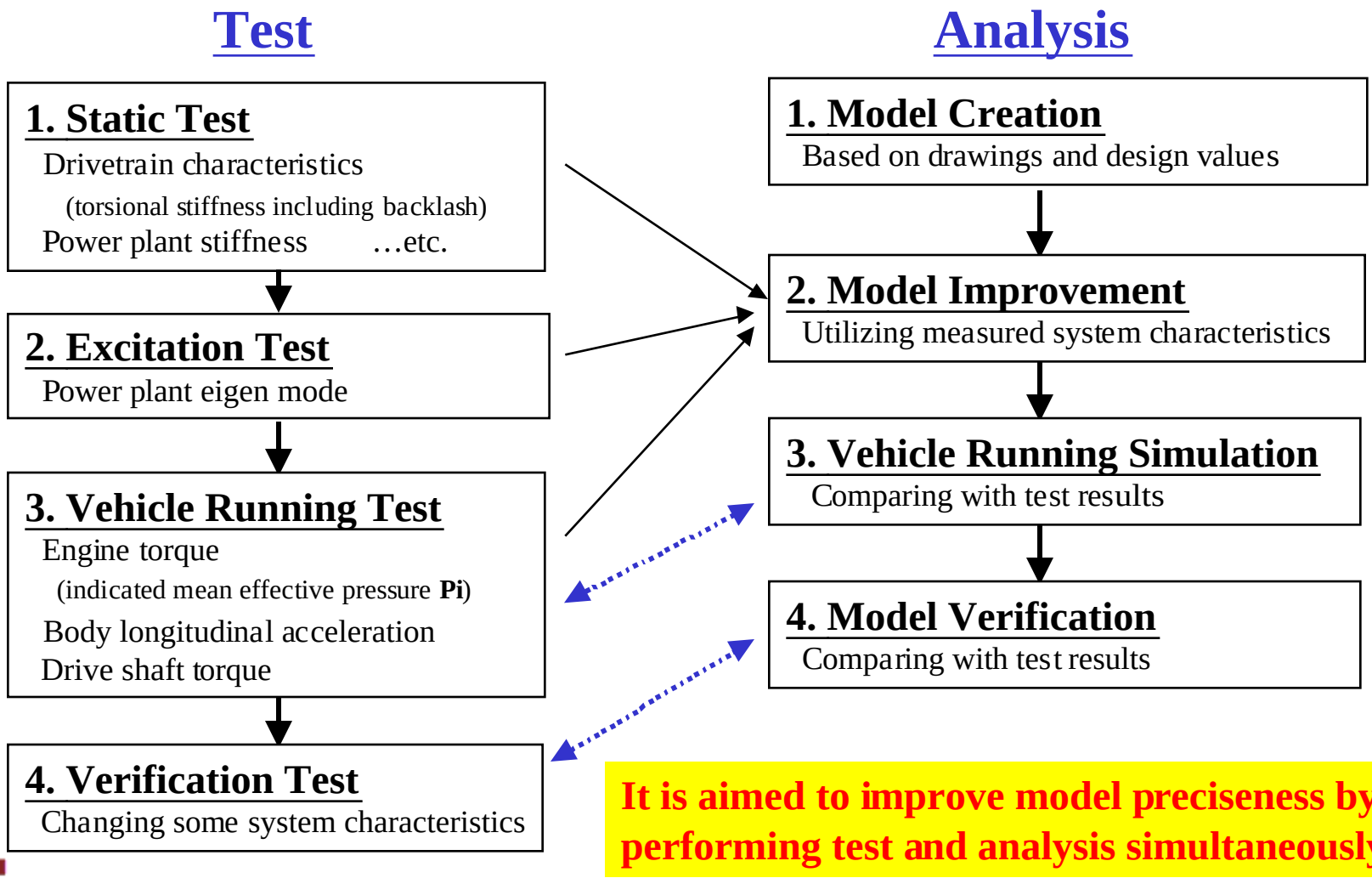

It is aimed to improve model preciseness by performing test and analysis simultaneously.

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3. Approach

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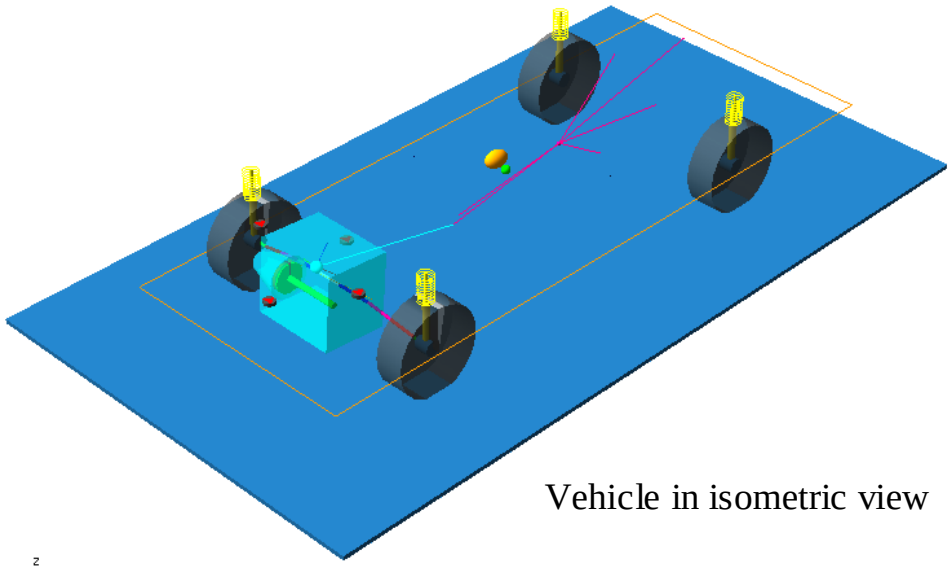
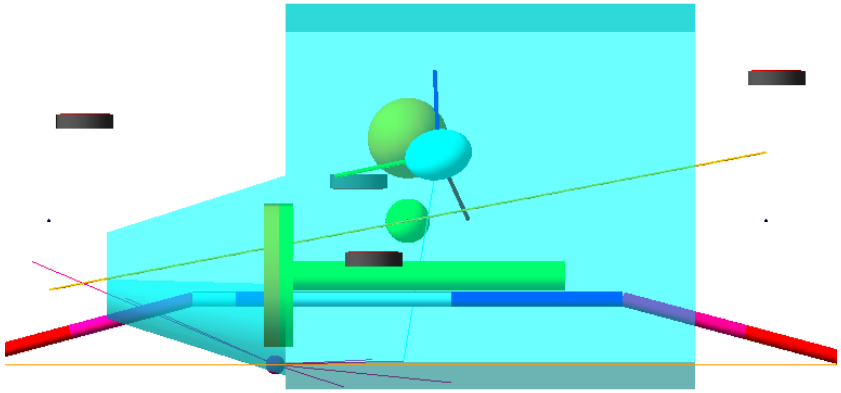


Vehicle in isometric view



Power plant in front view

- Using simple or conventional elements and functions
- Modeling important system characteristics
  - Engine torque input
  - Drivetrain torsional stiffness
  - Engine mounting system characteristics
- Neglecting or simplifying unimportant characteristics

4. Simulation Model

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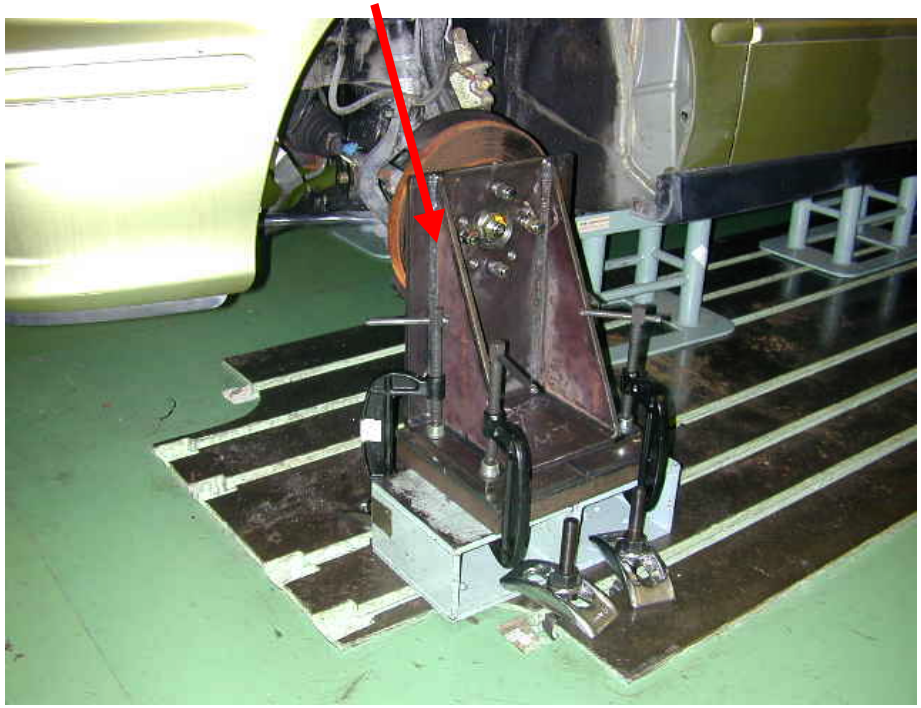
Rig for fixing the wheel

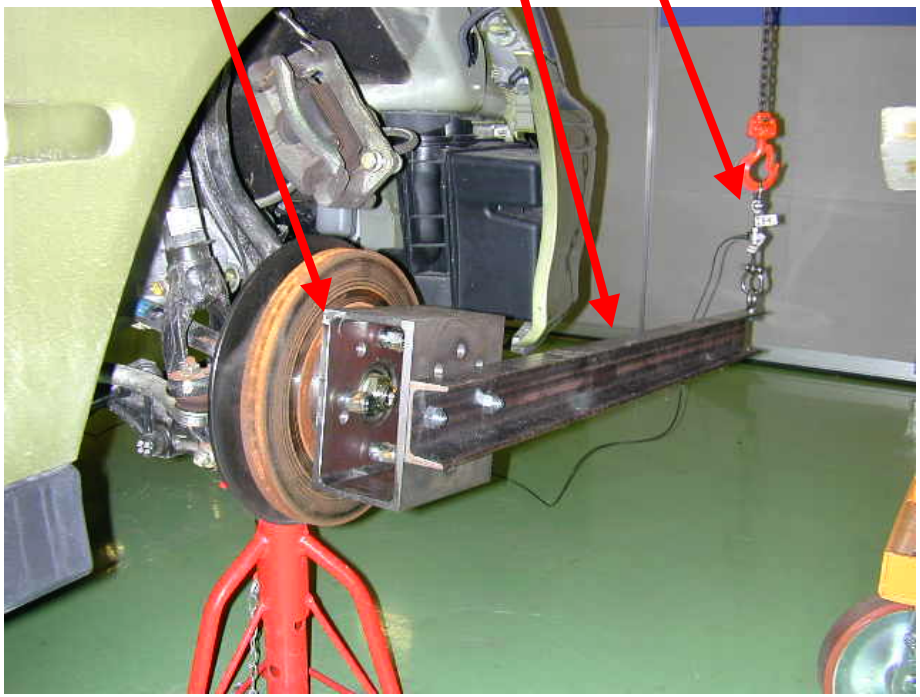


Front left wheel

Torque bar

Wheel hub attachment

Load sensor



Front right wheel

Measurement of the torsional stiffness of drivetrain system and power plant system by torque input.

5. Static Test and Analysis

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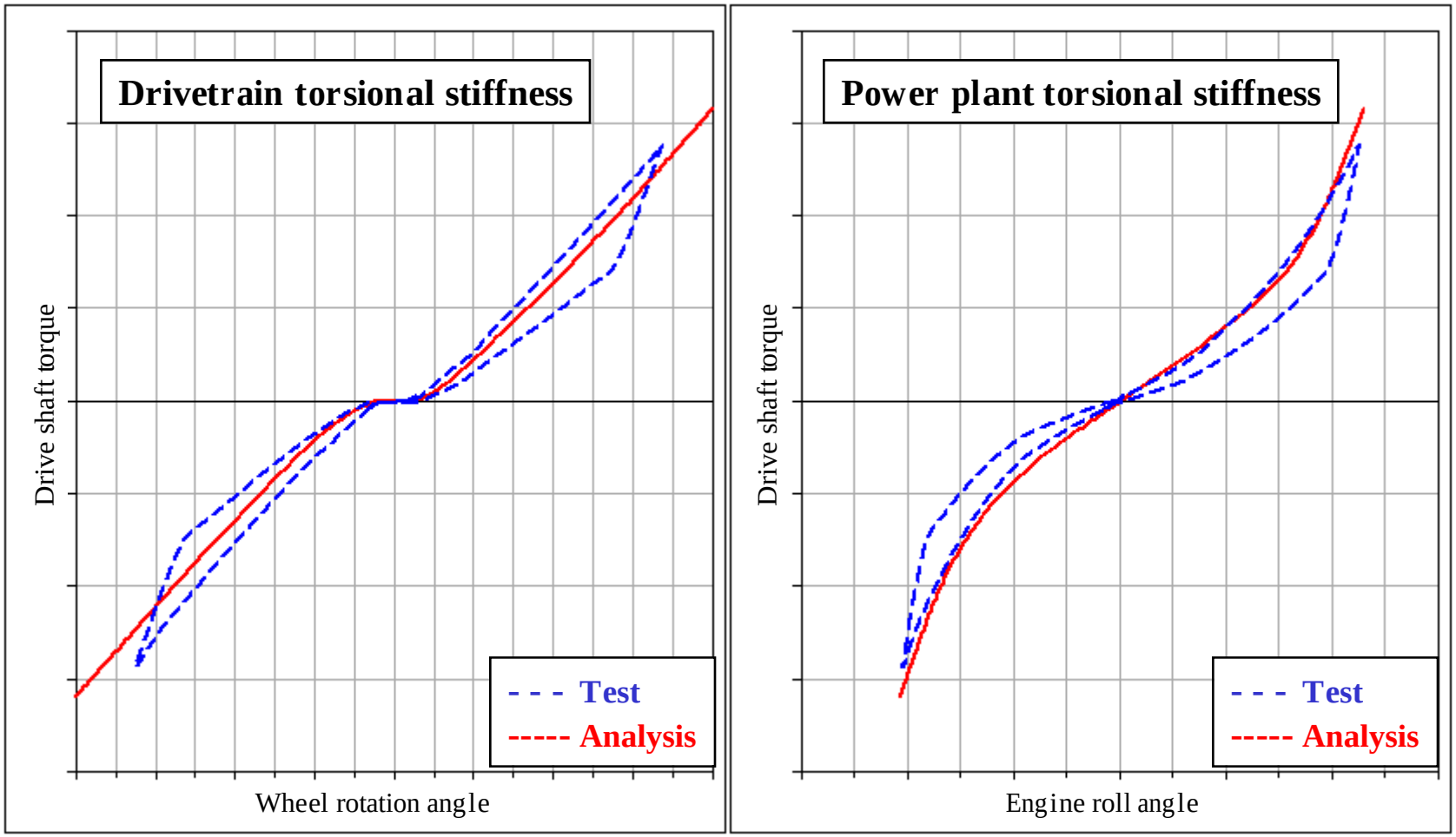

Analysis results were in good agreement with static test results.

5. Static Test and Analysis

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Driving Conditions

- **Gear position :**
  - **1) 1st gear**
  - **2) 2nd gear**
- **Throttle operation :**
  - **1) Wide open throttle from 1500rpm coasting**
  - **2) 1/8 open throttle from 1500rpm coasting**

Measured Values

- **Indicated mean effective pressure (Pi)**

  Using the **Pi** as engine torque in the simulation
- **Vehicle body longitudinal acceleration**
- **Drive shaft torque**
- **Acceleration at several points of the engine and body**

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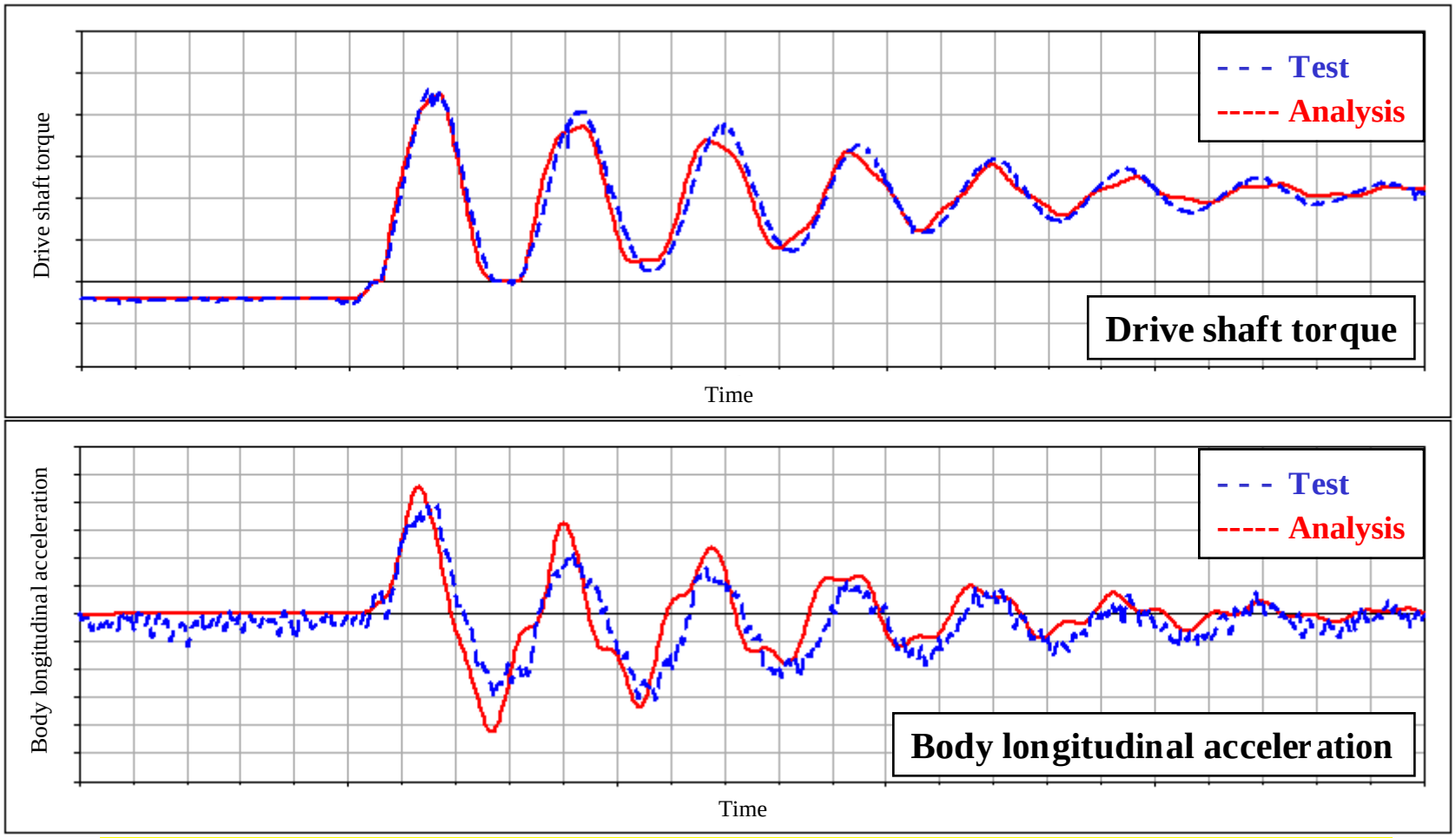
2nd gear in wide open throttle acceleration



Analysis results were also in good agreement with running test results.

6. Vehicle Running Test and Analysis

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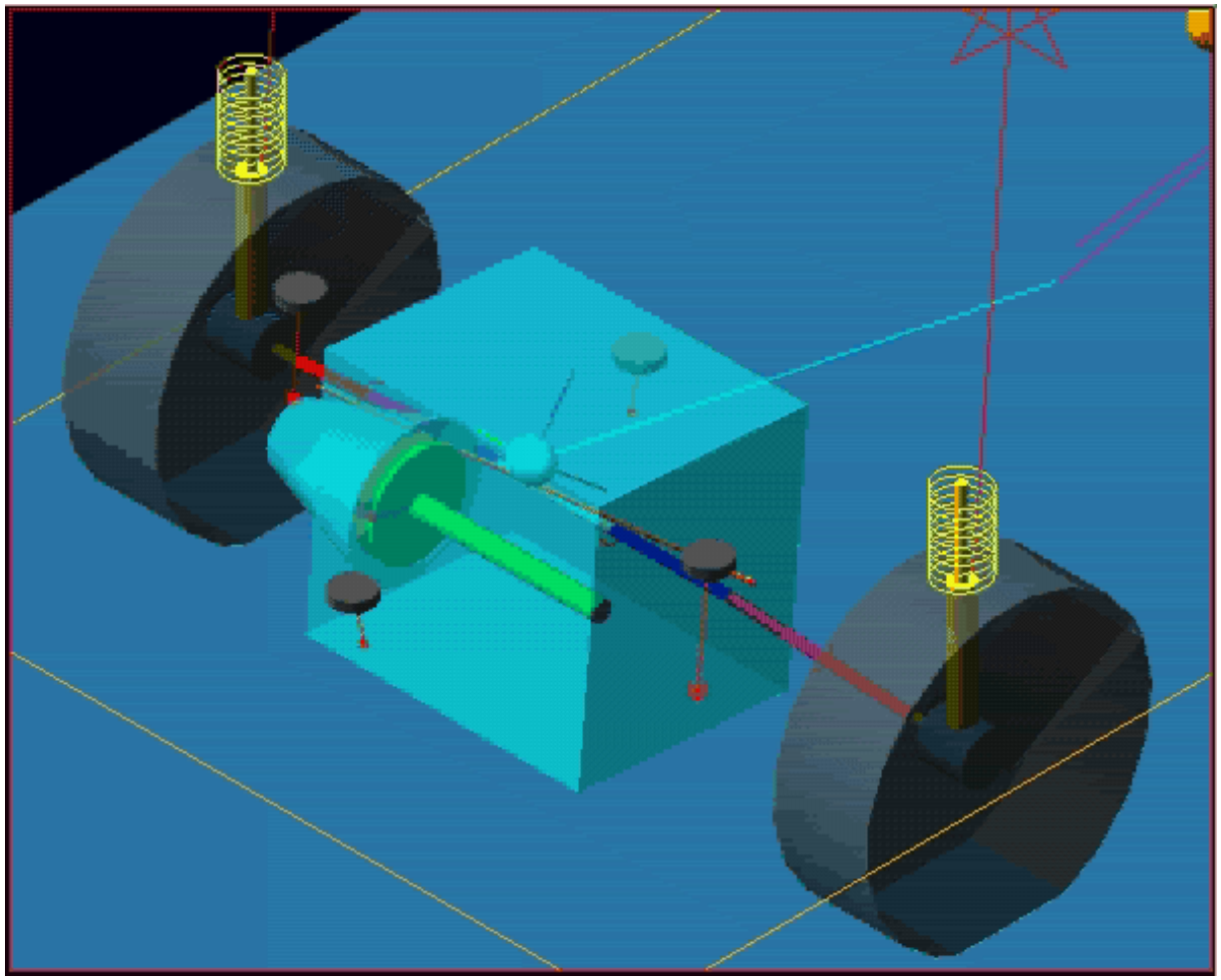

2nd gear in wide open throttle acceleration

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6. Vehicle Running Test and Analysis

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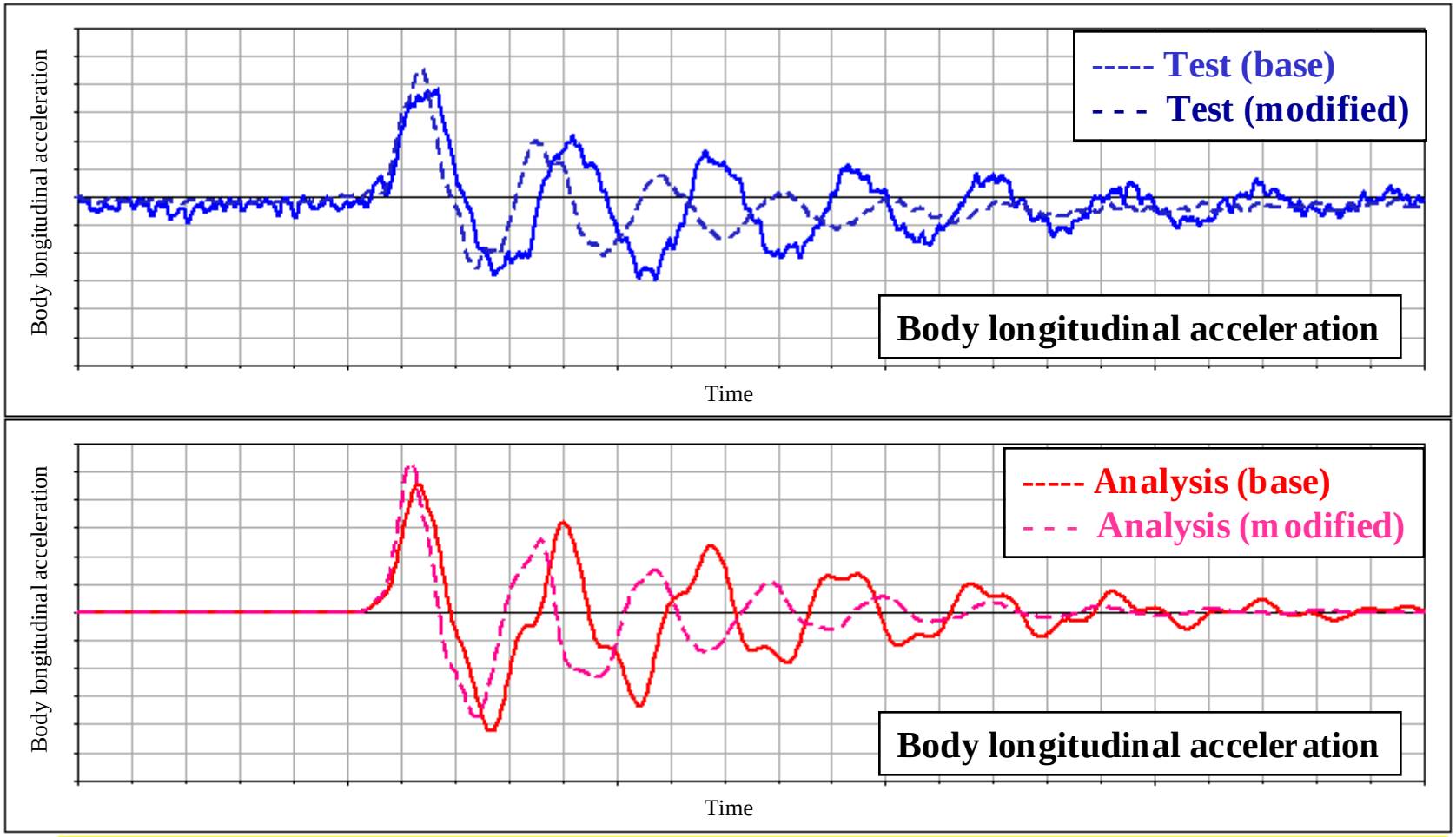
Drive shaft and engine mounting rubber were modified in high stiffness type



Eigen frequency increase by stiffened drivetrain and power plant is well represented.

7. Verification

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Quick and satisfactory results can be obtained in the simulation of the phenomena in question using conventional elements and functions provided in ADAMS through a good selection of parameters without generating a complex model.

Evaluation and study of the phenomenon for various systems are possible with using this model.

8. Summary

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