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Ph.D. SEMINAR TALK - 2

Title: **Suspension Performance and Dynamic Interaction of Multi-Axle Electric Trucks Considering Vehicle Configuration, Bridge Flexibility, and Longitudinal Effects.**

Speaker: **Mr. Mayank Khaparde (ME21D029)**

Biography of the Speaker:

Ph.D. Research Scholar for the Dept of Mechanical Engineering, IITM

Date and time: **30-01-2026 at 11:00 AM**

Venue: **Room No. 363, Conference Hall, New Academic Complex 2 (NAC-2), IIT Madras. (For hybrid mode, Google Meet Link:** https://meet.google.com/hyi-ueyw-aiz)

Abstract

With the rapid adoption of heavy-duty electric vehicles (EVs), understanding suspension dynamics in multi-axle configurations has become increasingly critical, particularly when such vehicles operate over flexible infrastructures and uneven terrains. This research investigates the ride comfort, road-holding, and dynamic interaction characteristics of multi-axle electric trucks by systematically analyzing vehicle-bridge interaction and cross-country operating conditions. A comprehensive modelling framework is developed, incorporating multi-axle electric trucks with non-linear suspension systems, in-wheel motor dynamics, driver-vehicle interaction, and external payload effects. Vehicle responses are numerically simulated using the Runge-Kutta method in MATLAB/Simulink. For bridge-crossing scenarios, the bridge is modelled as a simply supported Euler-Bernoulli beam, with the first five vibration modes considered to capture critical coupling effects between the vehicle and structure. The influence of vehicle velocity, bridge flexural rigidity, road roughness profiles, and suspension parameters on ride comfort and road-holding performance is systematically evaluated in accordance with ISO 2631 standards. Comparative assessments between multi-axle and dual-axle electric trucks reveal the advantages of multi-axle configurations in load distribution and road-holding performance under dynamic conditions. To extend the analysis beyond constant-speed assumptions, a modified half-vehicle model is formulated by incorporating longitudinal acceleration into the vertical and pitching dynamics. This enables the investigation of realistic acceleration and braking manoeuvres over cross-country terrain, capturing critical phenomena such as brake dive and squat that are typically neglected in conventional formulations. Sensitivity analyses further highlight the role of suspension stiffness, damping, and in-wheel motor mass in shaping vehicle response. Overall, the study emphasizes the importance of realistic operating conditions and coupled vehicle-bridge dynamics in the suspension design of future heavy-duty multi-axle electric trucks.