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M.S. Seminar Talk

Title: **Enhancing Railway Track Integrity through the Strategic Deployment of Autonomous Inspection Systems.**

Speaker: **Mr. Kaushik (ME23S403)**

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Date and Time: **10-03-2026 @ 3:30 PM**

Venue: <https://meet.google.com/hyz-ktsu-gtw>

Abstract

As rail operation standards advance to meet societal needs in the railroad market, these incredible demands lead to increase rail track damage, due to the large forces from powerful locomotives, increasing frequency of high-speed passenger trains, and larger loading forces from increased freight limits. Maintaining railway tracks is essential for safety and efficiency, but traditional inspection methods are often workforce-intensive and prone to human error also require blocking of trains. These methods can overlook critical flaws, leading to potential safety hazards and costly maintenance issues. The global market for track inspection vehicles, valued at USD 0.75 billion in 2023, is projected to grow to USD 1.03 billion by 2032, with a CAGR of 3.15% over the forecast period. To overcome these challenges, the proposed system presents an advanced Autonomous Track Inspection Vehicle (AIV) platform integrating multiple non-destructive testing (NDT) technologies for comprehensive, high-speed inspection. The system incorporates roller probe ultrasonic testing, laser profiling, and vision-based inspection to ensure accurate and continuous monitoring of rail integrity. The ultrasonic subsystem employs wheel-embedded probes with multiple angled transceivers, detects internal defects. Complementing this, laser profiling systems uses high-resolution scanners to capture transverse and longitudinal rail geometries. AI and ML algorithms enable automated detection of surface wear, cracks, and gauge anomalies. The vision-based subsystem utilises high-speed cameras and advanced image processing techniques to detect surface defects and missing track components in real time. All subsystems are synchronised, which enables real-time defect flagging and data archiving for predictive maintenance. AIV redundant system design boost's reliability, making it a state-of-the-art solution for modern railway maintenance.