NetBrake Hybrid Dynamic Brake Testing System

1. Addressing a Critical Industry Challenge

Mining vehicles endure harsh conditions—heavy payloads, unpredictable terrain, and constant heavy braking. Traditional **dynamic brake tests** focus on overall deceleration, often missing subtle, axle-specific faults that can lead to unexpected brake failures. Static roller tests at set intervals catch some of these imbalances but fail to recreate the real-world stresses of active mining operations, causing unnecessary downtime and incomplete diagnostics.

A real-world case in South Africa highlighted these limitations: Vehicles that regularly "passed" dynamic tests still experienced brake failures due to hidden faults. This underscored the need for a **comprehensive solution** that integrates both **dynamic** and **wheel-level** testing.

2. The NetBrake Solution: Merging Dynamic and Axle-Level Insights

NetBrake combines the speed and realism of dynamic testing with the detail and precision of static-level analysis. By capturing the **vehicle's overall deceleration** and **individual axle performance**, NetBrake provides a complete, real-world view of brake health.

- **Real-World Dynamic Testing**
    - Measures deceleration under true operating conditions (terrain, load, driver behavior).
    - Monitors braking responsiveness and stopping distances to confirm overall functionality.
- **Individual Wheel Testing**
    - **Wireless sensors** on each wheel (MPU6050 accelerometers/gyroscopes) capture wheel speed, braking force, and efficiency.
    - Rapidly pinpoint imbalances or delayed responses that are invisible in typical dynamic tests.

This dual-approach system **increases safety** by detecting developing faults early and proactively guiding maintenance.

3. Technical Overview

Intrinsically Safe 8-Inch Decelerometer Tablet

- **Hazardous Environment–Ready**: Designed for mining conditions.
- **Suction Cup Bracket**: Installs in any vehicle for on-the-fly testing.
- **IP68 Trolley Hard Case**: Shields the device from dust, water, and impact.
- **Remote Software Updates**: Stay current with the latest features and improvements.
- **Fleet-Friendly**: Detach and move the same tablet between multiple vehicles.

ESP32 Logger & Wireless Wheel Sensors

- **High-Accuracy Wheel Sensors**: Measure rotational velocity, lateral/vertical forces.
- **Low-Latency Communication**: Uses **ESP-NOW** for secure, short-range data transmission.

- **Real-Time Data Consolidation**: The tablet synchronizes all wheel inputs for immediate analysis.

AI-Powered Analysis

- Processes raw sensor data (e.g., brake forces, delay times) with advanced algorithms.
- Delivers actionable prompts—**PASS/FAIL**, maintenance alerts, compliance checks—in line with recognized safety standards.

4. Standards and Compliance

NetBrake surpasses stringent global and local requirements:

- **SANS 3450 / ISO 3450**: Braking performance for off-road mining vehicles.
- **SANS 10047 & SANS 1589**: Detailed testing procedures for safety compliance.
- **Road Transport Regulations**: Ensures vehicles meet relevant on-highway legal standards.

Whether operating under local or international mandates, NetBrake's flexible design guarantees consistent, reliable, and compliant outcomes.

5. Implementation and Market Plan

- **Beta Testing & Proof of Concept**
    - Refined over 18 months across varied fleets—from light pickups to heavy haul trucks.
    - Validated sensor placements, data algorithms, and user interfaces in real-world scenarios.
- **Rollout Timeline**
    - **April 2025**: Early adoption with select NetBrake service partners.
    - **November 2025**: Official commercial release, incorporating feedback from initial users.
- **Cost-Effective**
    - Priced competitively against standard dynamic brake testers.
    - **Long-Term Savings**: Prevents downtime by detecting issues early, reducing expensive repairs.

6. AI-Powered Recommendations

NetBrake's onboard AI sifts through raw data and historical brake records to produce **precise maintenance advice**. A typical AI-driven report may include:

- **Inspection Summary**: PASS/FAIL status based on recognized criteria.
- **Brake Force Variation**: Left/right balance, pinpointing potential alignment issues.
- **Maintenance Suggestions**: Timely prompts (e.g., "Inspect rear-right brake pads in two weeks").
- **Standards Confirmation**: Verifies compliance with SANS 3450 or equivalent regulations.

7. Comprehensive Brake Test Reporting

NetBrake furnishes a robust, multilayered test report that maintenance teams, safety officers, and auditors can all rely on. Key data points include:

- **Braking Force (N/kg) per Axle (Left & Right)**
- **Axle-Level Force Differences in %**
- **Effective Braking Force (EBF) per Axle**
- **Average EBF for Service & Emergency Brakes**
- **Regulatory Compliance Check** (Road Transport regs, etc.)
- **Physical Inspection Checklist** (fluid levels, pad/hose integrity)
- **Wheel-Specific Graphs** (deceleration, vertical, lateral forces)
- **Combined Vehicle Deceleration** (max & average)
- **Overall Brake Efficiency**
- **Brake Delay, Vehicle Pull (L/R), Speed at Braking**
- **Stopping Time & Distance**
- **GPS-Based Test Location**
- **Brake Slope Capability**
- **Main Deceleration Graph (entire test run)**
- **AI Comments**: PASS/FAIL, maintenance reminders, notes on SANS 10047/1589/3450 compliance
- **Vehicle/Examiner Data**: Weight, ID, type, examiner name

8. Safety and Reporting Enhancements

- **Early Detection**: Catch axle-specific anomalies before they escalate into critical failures.
- **Real-World Accuracy**: Simulates genuine driving conditions, ensuring more representative results.
- **Reduced Accident Risk**: Identifies imbalances, wear, or mechanical lag swiftly.
- **Streamlined Maintenance**: Automated scheduling insights minimize unplanned downtime, optimizing fleet usage.
- **Granular Graphical Data**: Detailed visuals promote faster, more targeted repairs.

9. Conclusion: Elevating Brake Testing to the Next Level

NetBrake's **Hybrid Dynamic Brake Testing** redefines safety and efficiency for mining, transportation, and beyond. By integrating state-of-the-art sensors, an intrinsically safe tablet, AI-augmented analytics, and comprehensive reporting, NetBrake delivers:

1. **Comprehensive Diagnostics**: Zero in on both axle-level and overall performance.
2. **Operational Efficiency**: Portable hardware and remote updates slash vehicle downtime.
3. **Stringent Compliance**: Aligns with SANS 10047, SANS 1589, SANS 3450, ISO 3450, and more.
4. **Long-Term Cost Reduction**: Shift from reactive to preventive maintenance strategies.

For operators who demand the highest standards of **safety, reliability, and cost-effectiveness**, NetBrake stands at the forefront of modern brake testing solutions—empowering fleets to **drive productivity and operational excellence** with confidence.