TOP TEN

**Changrong Yang**
Newcastle University

Category: **Rail** | Country: **United Kingdom**

Research Area 3: **Efficient & Resilient Systems** | Idea Number: **50**

# Wheel-rail Contact Force Measurement Based on Wireless Inductor-Capacitor Resonance Sensing

Wheel-rail contact force measurement is significant to ensure high-speed railways' running safety and stability. Traditional strain gauges with slip rings rely on solid bonding with the wheel parts and complex signal transmission devices. From mechanics, electromagnetics, and materials, this research investigates non-contact wheel-rail contact force measurement methods by combining the change of material's electromagnetic properties under forces, geometrical change of strain gauges with inductor-capacitor (LC) resonance sensors, and wireless power transfer (WPT).

There are three phases taken into consideration. The first phase is the feasibility of LC resonance sensors on the force measurement in which the parameter selection of the sensor, the system, and the experimental set-up are studied to prove that LC resonance sensors have the potential to perform non-contact force measurement. The second phase is the measurement and separation of forces and lift-off effects (the varying distance between the sensor and the test samples) through the proposed orthogonal LC resonance sensor. The third phase is the measurement distance enhancement. A semiconductor strain gauge with high gauge factors is added to an LC tank receiver Rx. Through magnetic field coupling of wireless power transfer (WPT) and impedance change, an LC tank Tx senses the change in impedance caused by semiconductor strain gauges. Research methods contribute to the application of non-contact wheel-rail force measurement. The miniaturised and cost-effective measurement system enables IoT and real-time wheel-rail force monitoring, which provides more paths from the sensor's point of view to digital twins of running gears.