NDSU UPPER GREAT PLAINS TRANSPORTATION INSTITUTE

RAILS

Railway Autonomous Inspection Localization System

Smart cities rely on well-maintained multimodal infrastructures to support mobility, safety, and environmental health. More frequent rail line inspections have become critical because railroads now move heavier loads, at higher speeds, in longer trains, more frequently across the same tracks. However, agencies cannot afford to use existing methods of non-destructive evaluations on all railroad tracks or to monitor important routes more often.

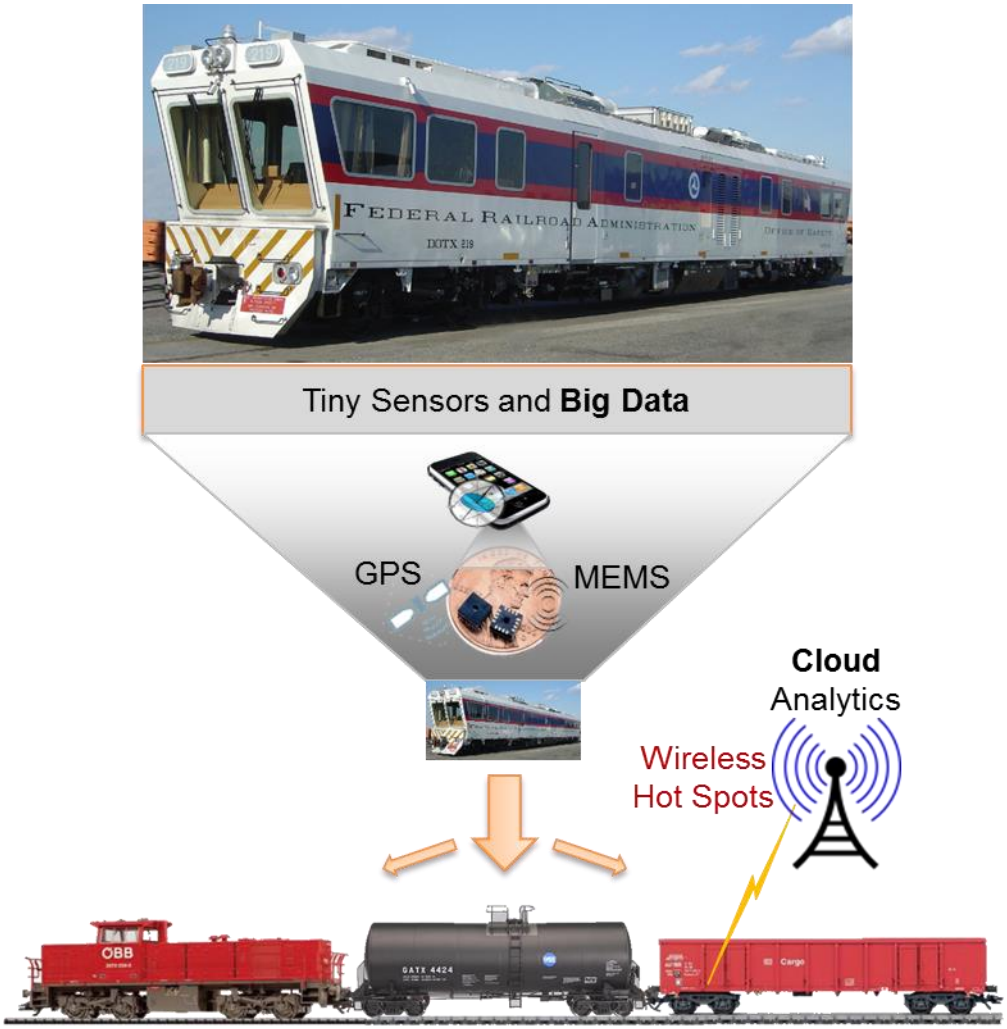

Fig 1. Railway performance evaluations using connected cars.

Most railroads use foot patrol to inspect sections of railroad tracks. Alternatively, inspection cars contain a myriad of specialized equipment to assess the condition of tracks. Such complex

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technologies force relatively slow inspection speeds. Consequently, both foot patrol and instrumented vehicles reduce line capacity.

Proposed Method

We developed a scalable and affordable method to characterize the condition of railroad tracks by using highly integrated sensors. Microchips embed global positioning system (GPS) receivers, accelerometers, and tiny gyroscopes. Such devices also integrate several forms of wireless communications that may include RFID, Wi-Fi, and Bluetooth. All smartphones now embed such devices and they can provide all of the functionality needed to identify and locate potential track and equipment faults. The maturity of smartphones and a proliferation of the Internet-of-Things (IoT) has commoditized low-cost sensors. Figure 1 illustrates the **concept** of the research, which is to migrate much of the existing functionality of inspection cars to highly integrated sensors that manufacturers can deploy onto *every* revenue service car.

Technology Status

We developed a series of algorithms to transform inertial, orientation, velocity, and geospatial position data from many cars to identify the position and classify the type of a potential fault (Figure 2) for further scrutiny. This method does not replace track inspectors or inspection vehicles but rather improves their efficiency by localizing track sections that may have a problem. Maintenance decision-support systems can use the technology to prioritize detailed inspections of detected problems based on their reported severity and type, rather than scanning for potential faults manually or by using inspection cars. We tested the data collection method successfully in the field and compared results with simulations. We are now inviting industry partners to collaborate in the further development, refinement, and testing of the method to:

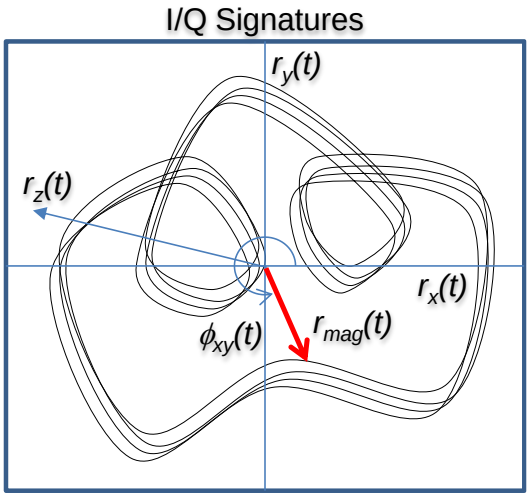

Fig 2. Fault Signature Classification

- Integrate the algorithms into existing maintenance decision-support platforms.
- Begin the standardization process for data exchanges and data processing.
- Develop application extensions such as track deterioration forecasting.

Research Services and Capabilities

Our team has dozens of years of railroad experience and expertise. They are ready to work with clients on technology refinement, customization, and standardization. The team has the signal processing, data mining, and software development skills needed for **smart city** implementations. Our clients will have access to our exceptional private and public sector liaison capabilities that are highly regarded by many state and federal agencies, and an extensive framework for future research and development.