Relationship Between Track Geometry and Components Health Conditions

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Introduction

Railroad tracks have four main components: rail, ties, fastening systems, and ballast. The rail is the main component that supports the loads transmitted by the trains. The fastening system is responsible for fastening the rail to the ties and keeping the rail in a proper position. Fastening systems are made of spikes, tie plates, anchors, and sometimes clips. The ties are the interface between the rails and ballast. The two main materials used for ties in the United States are timber and concrete. The last layer on the railroad superstructure is the ballast. Its main functions are to spread the loads on the ground and to provide proper drainage for the track system.

These components are inspected using the LRAIL technology that combines 2D imagery and laser triangulation to assess the health and condition of each component. The collected data is processed through a DNN (Deep Convolutional Neural Network) model that identifies and classifies the components. This technology has been used under the scope of research led by the RailTEC group at UIUC, funded by the FRA-DOT with two Class I railroads in the US. The output of this technology, which will be used in this project, is described in an Excel file (filename: Datasets) attached to this proposal.

Track geometry can be defined as the relative position of the rails. The common measurements are related to horizontal and vertical irregularities, gage, and superelevation. CFR 213 establishes safety limits that must be kept in order to provide the trains with a safe ride. Railroads use laser-based contactless systems to measure track geometry. Recently these systems have been installed in boxcars and locomotives to provide autonomous measurements, reduce inspection costs, and collect more data. Geometry cars, as they are called, collect measurements of each foot of the track to calculate the deviations.

References