Rail Research UK
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Whole System Performance

A Computational Intelligence Approach to Railway Track Intervention Planning

Institution:

The University of Birmingham, CERCIA

Researchers:

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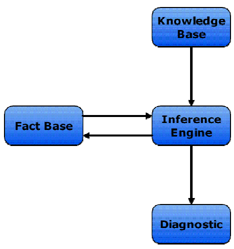
Background:

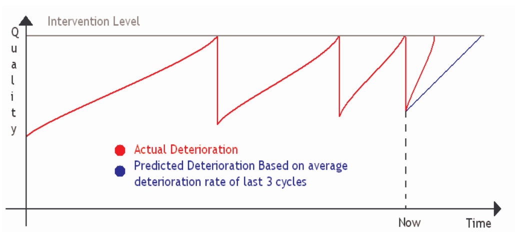
Railway track intervention planning is the processes of specifying the location and time of required maintenance and renewal. Planning is a complex process due to the wide variety of track components and materials. Each track component interacts with its surrounding environment causing highly complex deterioration patterns.

Decision support tools exist to aid the permanent way engineer in performing intervention planning. Existing systems typically use an expert system based approach.

The expert systems typically consist of a knowledge base containing track data such as geometry measurements, usage data, intervention history, a fact base of engineering knowledge, and an inference engine for applying the fact base to the knowledge base. The weakness of any expert system is the reliance on the quality of the fact base; two areas of weakness were found in a decision support system analysed;



- Due to the complexity of the domain, the likelihood of some errors (or non-optimal rules) is fairly high
- Deterioration models are simplistic, and typically result in work being scheduled late



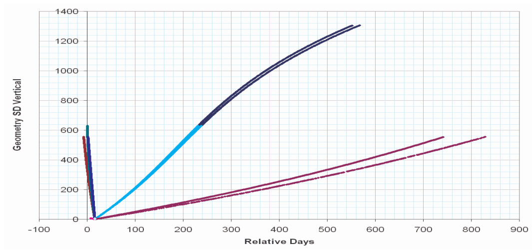
Methodology:

The proposed solution will use computational techniques to determine the various possible types of failure, and per failure type deriving deterioration models and determining the best intervention to perform. By repeating the training of the system as more data is acquired, the system will improve over time.

Failure Types Determination:

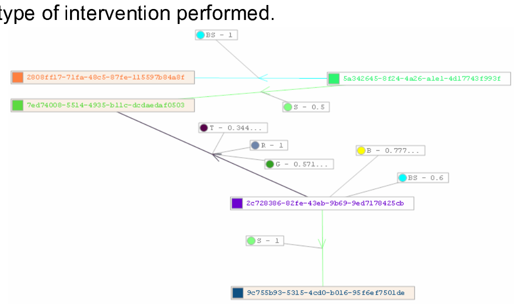
Using the clustering algorithm Rival Penalized Competitive Learning (RPCL) the various possible types of track fault are determined. Similar track faults upon different track material configurations are considered as separate failure types due to their differing deterioration patterns.

A result output of the RPCL algorithm is shown below; each failure type is indicated by a different colour. Typically the RPCL algorithm is performed on more than just one geometry measurement, with each measurement being assigned to a separate axis, however for clarity only one axis is shown.



Intervention Determination:

For each failure type an intervention is determined that best fixes the failure. A failure type linking graph is built showing the link between pre and post intervention failure type dependant upon the type of intervention performed.



For each failure type a tree of all possible futures is generated for a period of 150 years/ From the generated trees per failure type, the tree path with the best ratio of cost to length (time) is selected, and the first intervention in the tree path is used as the intervention to perform in all cases of that failure type.

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