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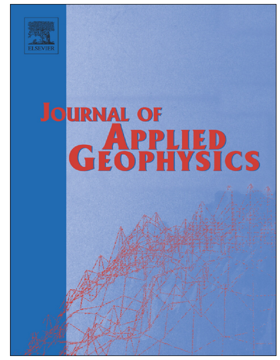

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Improvement of railway ballast maintenance approach, incorporating ballast geometry and fouling conditions

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Abstract: Ballast plays an important role in the stability of railway track systems. The effectiveness of the ballast in maintaining the track stability is very much dependent on its mechanical conditions. The available ballast maintenance approaches are mainly based on only track geometry conditions (such as track profile) which do not sufficiently reflect the ballast mechanical behaviors. That is, the ballast potential of degradation (i.e., ballast long term behaviors) has been omitted. This makes the effectiveness of the current ballast maintenance approach questionable, indicating a need for a more comprehensive and effective ballast conditions assessment technique. In response to this need, two ballast condition indices based on ballast geometry degradation (BGI) and the level of ballast fouling (BFI) as the main indicators of ballast mechanical behavior were developed. The BGI is a function of the standard deviations of track alignment, unevenness and twist. The BFI was developed based on the data obtained from the ground penetration radar (GPR). Making use of the new indices, a more reliable maintenance algorithm was developed. Through illustrations of the applicability of the new maintenance algorithm in a railway line, it was shown that the new algorithm causes a considerable improvement in the maintenance effectiveness and an increase in the life cycle of railway tracks by making more effective allocation of resources and more accurate maintenance planning.

Keywords: Railway, Assessment technique, Quality index, GPR, Railway Ballast, Maintenance planning

1. Introduction

A conventional double-track line contains 3000 to 5000 m^3 of ballast per kilometer, depending on the type of the track and the spacing of the lines. The economical handling and maintenance management of these huge quantities of material is one of the main concerns of railway industries. Ballast transfers train loads to the sub-ballast layer and plays significant roles in the lateral and longitudinal stability of railway track systems. The ballast has to have minimum required mechanical and geometry conditions in order to perform its role. As the track strength and stability are greatly dependent on appropriate functioning of the ballast (Misar, 2002), the ballast is considered as the main component in any railway track maintenance. The effectiveness of a ballast maintenance approach is dependent on the accuracy of the recording and assessment of ballast conditions (Anderson, Cunningham, & Barry, 2002; Caetano & Teixeira, 2015; Navikas, Bulevičius, & Sivilevičius, 2016; Nederlof & Dings, 2010).