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Time-to-Failure Models for Health Monitoring of Railway Track Failures

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Squats are punctual material failures at railway tracks which can lead to critical effects when not detected or removed in time. Investigations in the last years (c.f., e.g., [1], [2], [3], [4]) pointed out the severity of this problem, although relevant questions about root causes remain open. A main reason for this situation may be the challenging detectability of squat genesis as well as the broad palette of potential root causes, such as track characteristics, traffic patterns and loads as well as maintenance. A comprehensive study of these effects requires high effort of data preparation since many different sources of different owners, quality and quantity have to be merged adequately. As an extension of the risk modelling work done so far ([5], [6]), this paper presents time-to-failure models which do not only show under which circumstances the risk for observing a squat is high but indicate additionally a time of failure occurrence. This allows to determine a health indicator along the track and supports the planning of preventive maintenance actions. Data from the Swiss railway were applied for model development and provide corresponding examples.

- [1] Kerr, M., Wilson, A., Marich, S.: The epidemiology of squats and related rail defects, Conference on railway engineering, 2008.
- [2] Luther M., Heyder R., Mädler K.: Prevention of multiple squats and rail maintenance measures, 11th international conference on contact mechanics and wear of rail/wheel systems (CM2018) Delft, the Netherlands, September 24-27, 2018.
- [3] Muhamedsalih Y., Hawksbee S., Tucker G., Stow J., Burstow M.: Squats on the Great Britain rail network: Possible root causes and research recommendations, International Journal of Fatigue, Volume 149, 2021. doi.org/10.1016/j.ijfatigue.2021.106267.
- [4] Schamberger S.: Der Squat aus Sicht der OEBB, OEVG: Squats, University of Technology Graz, 2021/09/13.
- [5] Nerlich, I.: Netzweite statistische Analyse von Squat-Rollkontaktermüdungsfehlern unter Berücksichtigung von Kontaktgeometrie und Zusammensetzung der Traktionsmittel in einem Bahnsystem mit Mischverkehr. Submitted Dissertation, TU Berlin, 2024.
- [6] Haselgruber, N., Nerlich, I.: Statistical models for health monitoring of rare events in railway tracks. Submitted paper to the SIS 2024, the 52nd Scientific Meeting of the Italian Statistical Society, Bari.

Type of presentation

Talk

Classification

Mainly application

Keywords

squats, time-to-failure model, health monitoring

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Track Classification: Reliability and Safety