Testing and Improving the Detection Capability of Portal Monitoring Systems at High Transit Speeds

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ABSTRACT

The aim was to validate the sensitivity of a typical portal monitoring system at high transit speed up to 44 m/s (160 km/h) and to enhance the detection capability of a prototype system by improvement of the signal processing. It has been demonstrated that speed dependent signal processing can enhance the detection capability of portal monitoring at higher speeds.

SIGNAL SHAPE

The detector efficiency, depending on the position of the object, has been the basis for all calculations. It has been measured for different minimum source-detector distances (offset) and used to calculate the signal shape for different geometries depending on the speed. The signal shape has been used to calculate the minimum detectable activity (MDA) depending on the integration time. The minimum of the MDA, depending on the speed, has been used to apply the optimum integration time.

Source transport system for testing of portal monitors.

INTRODUCTION

Detection-capability of portal monitoring systems is affected by the count-rate statistics, it increases at lower speeds. Therefore, the typical transit speed for scanning vehicles is app. 8 km/h. Most monitoring systems have been developed and optimized for slow speed and are not suitable for scanning of fast objects. If a higher or varying transit speed is required, for technical or economical reasons, more advanced signal processing is needed to reach the theoretical limit for sensitivity, as set by the measurement statistics.

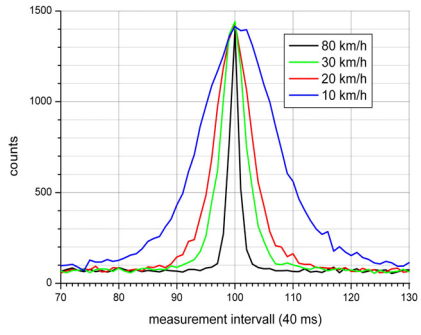
Monitoring system near Vienna consisting of six chained portals.

SPEED DEPENDENT SIGNAL PROCESSING – FIELD APPLICATION

For field-testing, a set of six portals was installed at a railroad track near Vienna. The speed of the train was measured by wheel sensors and used to determine the optimum integration time. The signals from the portals were delayed and synchronized according to the transit speed of the train. The sum signal was analyzed by scanning based on the speed dependent integration time.

LABORATORY TESTING

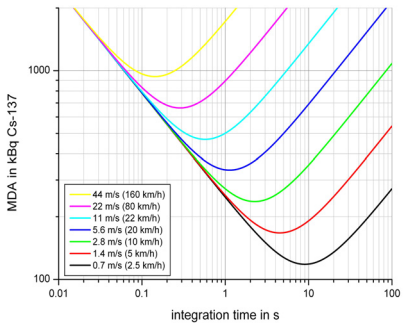
For laboratory performance-verification a pneumatically driven point source has been used to simulate the signal of a passing train.
This source transport system allowed flexible operation using different sources at various speeds in the range of 1 m/s to 50 m/s. The measured data has been used for the development and optimization of the algorithm and for testing its implementation before deployment in the field test.



Count-rate signals at various speeds.

CONCLUSIONS

It has been demonstrated that speed dependent signal processing can improve the detection capability of portal monitoring at higher speeds. At 50 km/h, the MDA could be improved by a factor of two and at 90 km/h by a factor of three, compared to a conventional system, set at a fixed integration time of one second. The best possible improvement of the sensitivity is dependent on the source position and also affected by the self shielding of the vehicle.



MDA depending on the integration time.

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ACKNOWLEGDEMENTS

The work was supported by the department for research and development of the Austrian National Railways "Österreichische Bundesbahn, Infrastruktur-Bau-AG, Stab Forschung und Entwicklung".

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