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ІНТЕЛЕКТУАЛЬНІ ТРАНСПОРТНІ ТЕХНОЛОГІЇ

V МІЖНАРОДНА НАУКОВО-ТЕХНІЧНА КОНФЕРЕНЦІЯ

ПРОГРАМА КОНФЕРЕНЦІЇ

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Збірник містить тези доповідей науковців вищих навчальних закладів України та інших країн, підприємств транспортної та машинобудівної галузей за чотирьма напрямками: розвиток інтелектуальних технологій при управлінні транспортними системами; транспортні системи та логістика; інтелектуальне проектування та сервіс на транспорті; функціональні матеріали та технології при виготовленні та відновленні деталей транспортного призначення.

Секція
РОЗВИТОК ІНТЕЛЕКТУАЛЬНИХ ТЕХНОЛОГІЙ ПРИ УПРАВЛІННІ ТРАНСПОРТНИМИ СИСТЕМАМИ

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НАСЛІДКИ ТИМЧАСОВОГО ОБМЕЖЕННЯ ШВИДКОСТІ НА ЗАЛІЗНИЦІ З ВИКОРИСТАННЯМ ІНТЕГРОВАНОГО ЦИКЛІЧНОГО РОЗКЛАДУ

EFFECTS OF TEMPORARY SPEED RESTRICTIONS ON RAILWAYS USING INTEGRATED CYCLIC TIMETABLES

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Maintenance of railway lines is an important factor in ensuring high-quality passenger and freight transport by train. Traditionally, railway maintenance was done by a large manual workforce, but more and more large machinery has been in use.

When conducting maintenance, several safe systems of work are available [6], for example the use of lookouts using warning signals, automatic track warning systems, other operational measures, or a complete blockage of the line. These measures depend on the kind of the necessary maintenance. On double-track lines, it can be necessary to also consider the other track than the track where maintenance takes place. For this purpose, rail track safety barriers might be built, or temporary speed reductions might be established.

From an operational perspective, some of the mentioned measures influence running times of the trains and their punctuality, especially in case of temporary speed restrictions. To compensate for that, recovery margins (also called buffer times or supplements) are used in the calculation of train schedules. For example, the International Union of Railways (UIC) recommends using a recovery margin of 1,5 min per 100 km and 5 % of the journey time for certain passenger trains ($m > 700$ t, $141 < V_{max} < 160$ km/h). Similar recommendations – 1 min per 100 km and 3 % of the journey time – are given for freight trains. [7] Some railway operators use higher values, e.g. 7 % on important main lines. While those values make sure that trains can recover smaller amounts of the time lost due

to speed restrictions and other factors, for larger amounts of time they might not be sufficient.

In Central European countries like Switzerland and Austria, it is a goal to have integrated cyclic (or clockface) timetables for all passenger trains (long-distance and regional trains). In Austria, the Mobility Master Plan [1] and the Target Network 2040 [2] state that further extension of railway lines should be compatible with the integrated cyclic timetable. Paths for freight trains are considered as well to ensure the railway network has enough capacity for them. [2] In integrated cyclic timetables, certain important stations serve as nodes, where trains to all directions meet at the same time and therefore short connections between trains are possible. The running time between two nodes needs to be a multiple of the half interval between trains [4] according to the equation:

$$t_{running} = n * \frac{t_{interval}}{2}, n \in \mathbb{N} \quad (1)$$

In case of maintenance the effects on the train schedules need to be considered carefully. If the loss of time is too large and cannot be absorbed by the recovery margins, the cyclic timetable might not be possible any longer. The same problem arises when track degradation or other external factors cause temporary speed restrictions. If the railway in one country adheres to an integrated cyclic timetable and the railway in a neighbouring country does not, intense coordination is necessary so that delays in one country do not propagate to the other country's railway network, especially if the threshold for trains to be considered punctual is different [3].

Possible operational solutions (each not without disadvantages) are including the recovery margin before a node station [5], temporarily using non-integrated cyclic timetables, using higher recovery margins than recommended in [7], temporarily accepting shorter transfer times in node stations, or (on double-track railways) building enough crossovers allowing medium to high speeds when using them. Another possible solution would be to undertake maintenance with high impact to the running in times of less demand (nights, weekends) [8]. More detailed analyses are possible using simulation software.

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