Optimal schedule for repair a double-track railroad

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We consider a particular case of railway problems, namely, the optimal scheduling of the train operation by a double-track railroad when one of the segments is under repair works. It is necessary for a set of trains available at the stations to determine time-scheduling and destination routing by railways in order to minimize one of the regular objective function [1,2]. Application of the dynamic programming is effective to solve this problem. In this paper we suggest an exact algorithm. A double railway track lies between points A and B with a set of signal posts on it. In Fig.1 they are marked by points. Let call the subpathes between them the segments. Then to take: k – the number of semaphores between points A and B; n – the number of segments, $n = k - 1$; p – transit time of a train on each segment.

All the segments are numbered from left to right. The upper railway gauge is directed to running from the left to the right, and the lower one - to the oncoming traffic. The trains can not move back and make passages to the neighboaring branch line at the signal posts if the segment is not closed for a repair.

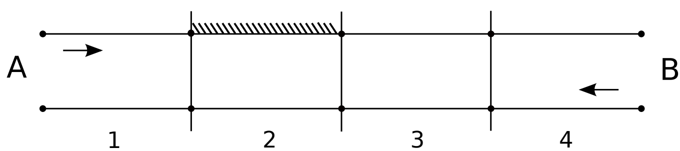

Fig.1

Let us assume that there exist a schedulling π ordering all the trains running to the receiving station to pass each signal post according to the schedule. Because of peculiarities of the railway schedule there exist the time moments when one of the gauge of the segment may be closed. The shaded area in the pictures is the segments where movement is inaccessible. That hereinafter is referred to as a bottleneck. It is neccessary to create a new scheduling $\pi^{'}$ considering the task with one of the following objective function:

$$\min \sum (C^{'} - C);$$

$$\min \max (C^{'} - C),$$

where $C^{'}$ – value of the aim function for the scheduling $\pi^{'}$; C – value of the aim function for the scheduling π. Moreover, any regular function can be used for this.

Generally, the generation of the states is based only on the information from the previous state. This feature represents wide opportunities for the correlation of the algorithm and it is launching to the multicore architecture of cluster. The idea suggested may be used for the solution of the task of the segment repair planning minimizing the value of any regular objective function and chosing the time period when it is economically profitable. In addition, we suppose that it will not change the complexity of the algorithm dramatically. In this paper we suggested in getting of exact algorithm for the task of the segment repair scheduling.

References

1. *Lazarev A.A., Musatova E.G., Gafarov E.R., Kvaratskheliya A.G.* Theory of Scheduling. The tasks of railway planning. – M.: ICS RAS, 2012. – p.92
2. *Lazarev A.A., Musatova E.G., Gafarov E.R., Kvaratskheliya A.G.* Theory of Scheduling. The tasks of transport systems management. – M.: Physics Department of M.V.Lomonosov Moscow State University, 2012. – p.160