Contributions to Balancing Problem Solving in Determinist Case

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ABSTRACT

Technical line balancing is a mean of economic efficiency increasing of some industrial activities.

Essentially, to balance a technical line means to organize the human operator's activity, to establish manufacture flux, to draw the line so to minimize breaking time of equipments and operators, through a charge of these, as better as possible.

In this work we'll present balancing problem for a technical line wherein an only model of a product is assembled, phase operating times are established and the operating rhythm of the line is fixed.

We'll also make some regards about the ways for solving the problem, contributing in this sense through the creation of a balancing method for this model of the problem, which method we named „*ballot method*".

Balancing problem in the case of an only model with established operating times and fixed rhythm, consists of finding a partition of phase manifold that non-operating time is minimum.

From dedicated literature, there is known that for solving balancing problem in the case of an only model with established operating times and fixed rhythm, there where used several kinds of approaching.

Used methods can be divided in two classes: exact methods and heuristic ones. The first warrant the optimality of given solutions but demand very large computing time and/or memory space. The others demand reasonable time and space resources (limited to o polynom of the length of problem instance) and generally give a solution of problem but without warrant its optimality [3, 4].

In the following we'll show a heuristic method for solving balancing problem for a model in determinist case. The method is author's searches fruit in the large and very complex domain of technical line balancing problematic and we entitled it „*ballot method*".

Method originality consists of the mixing of phases from starting list. Then, the list is run according to other heuristic methods used for solving this problem, well-known methods in specific literature, through searching of phases which can be assigned in stations and whose operating time, added to operating time from that station, not to overrun the rhythm.

If such an attempt fails, other attempt is made till reaching theoretical optimum or mentioned number of attempts. The more the number of attempts is bigger, the better the chances to gain optimum solution increase.

The mixing algorithm is the following:

Step 1. A zero *m*-component vector is built.
Step 2. $k = m$;
Step 3. We ballot a number between 0 and *k*-1. Let suppose it is *r*.
Step 4. We run the vector till we reach *r* zero components.
Zero component of r position takes the value 1 and its absolute position in vector represents the ballot number that we mark in a vector.
Step 5. We put $k = k - 1$.
For $k = 0$ STOP. Otherwise, go to step 3.

Mixing algorithm makes a random permutation of the manifold of technical process phases. This permutation is not necessary admissible in the sense that we haven't warranted the conformation of precedence relations between phases [2].

Starting from the permutation generated by mixing algorithm, there is built not only an admissible permutation but also a grouping of phases in workstations so that operating time in every station not to overrun the rhythm and to be near it, as better as possible, that is a solution of the problem.

In what concerns technical line balancing problem in determinist case, a comparative study of efficiency of used solving methods brought the conclusion that ballot method gives very good results, almost always offering optimum solution of balancing problem [1]. Even in difficult cases, when balancing indices is almost 1, some hundreds of thousands of attempts prove to be enough.

This method can be applied on every problem hard to be solved by other ways or wherefore no efficient

solving algorithm was found if the chances to give problem solution are good on this way, the case showed in this work being a particular one.

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