65th ESGI

European Study Groups with Industry in Portugal

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Universidade do Porto

http://cmup.fc.up.pt/cmup/esgi65/

PT MATHS IN

rede portuguesa
de **matemática**
para a **indústria**
e **inovação**

working groups

CHALLENGE 1

Warehouse storing and collecting of parts

industry_**Grohe**
sector_ **Retail and distribution**

The purpose of this problem is to optimize the time taken by fork-lifts to collect and store parts in a warehouse. The layout of the warehouse is shown in the figure. There are three fork-lifts collecting parts from the shelves and taking them to a fixed base point, per each corridor, denoted by B_i. At the same time, they take parts from B and store them in the shelves. At each point in time, a given fork-lift may carry only one type of parts which is to be either stored or collected. The storage place of a given part is predetermined. Denoting the parts to be collected and stored by $C_1,...,C_m$ and $S_1,...,S_m$, respectively, we want to produce a list with the optimal pairing of C_i's to S_j's (leaving $|m-n|$ items unpaired if necessary) which minimizes the total storage-collection time. Possible further questions include the optimization of the layout of the shelves, and also of the organization of the storage of parts depending on past history.

CHALLENGE 2

Electrostatic separation of rubber and textiles

industry_**Biosafe**
sector_ **Eco-innovation**

In the process of recycling rubber from tires, the end product should be as clear of foreign particles as possible. Of all the tire components, textiles prove to be the hardest to remove by the methods already being employed by Biosafe (vibration, magnetostatic, etc). Although for the larger grains the present process is satisfactory, for smaller particles (typically under 2mm) it is difficult to separate the textiles from the rubber. Because of this, the company is thinking of using electrostatic plates as a mean to eliminate the textiles in the final stage. However, existing methods of this type do not necessarily extend to the materials being used, and they would want to know if the method would prove to be feasible, efficient and safe.

CHALLENGE 3

Cooling of a rotor

industry_**Biosafe**
sector_ **Eco-innovation**

A steel rotor which is used to shred tires for recycling functions at 450 r.p.m. and has an allowable working temperature range. It is not known what the optimal temperature is, but it should not exceed 800°C. Very low temperatures, on the other hand, are not efficient – typically, the first half hour has a lower output than the stationary regime. In the present configurations, the temperature can easily become higher than what is acceptable (at least 1000°C-1500°C), and the company is considering the possibility of cooling the system by circulating a liquid (possibly water) inside the rotor. The company would like to know how the cooling should be made, and if it will be safe and efficient to have the cooling liquid inside the drum.

CHALLENGE 4

Optimization of task assignment in a factory

industry_**For Ever**
sector_ **Footware**

In order to carry out their orders of shoe soles, this company has a number of tasks $T_1,...,T_n$ of different lengths to be assigned to groups of machines. Each group is operated by one worker (two in one case), and an operation cycle corresponds to injection, cooling, and removal of the sole. The time taken at each step varies from one order to another, and when starting a new order a machine needs to be tuned, which takes some extra time. Machines are working in parallel. At the moment the assignment is carried out empirically, and the problem proposed is to optimize the procedure.

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