109th ESGI

European Study Groups with Industry in Portugal

11th - 15th May 2015

Universidade do Minho
www.norg.uminho.pt/esgi/

PT MATHS IN
rede portuguesa de **matemática** para a **indústria** e **inovação**

109th
2015

working groups

CHALLENGE 1

Modelling and optimization of production scheduling

industry_ **Estamparia Têxtil Adalberto Pinto da Silva, S.A.**

sector_ **Textile**

It is aimed to model and optimize a company's productive system. The model to be developed is expected to determine the optimal planning subject to a set of production orders and deadlines, and also allowing the computation of new orders delivery time. Due to the high number of products and orders, the complexity of the production scheduling is expected to be a large-scale optimization problem, which may lead to the use of heuristics. The provided solution technique should enable the launch of new production orders in real time.

CHALLENGE 2

Physical model of MDF boards

industry_**Confidential**

sector_ **Retail**

Aims to provide a physical model of MDF boards used in the manufacture of kitchen furniture doors. The existence of a board physical model and handling process (smoothing, drilling, and painting/lacquering) will allow computing (numerically) the board behavior when subject to the multiple physical phenomena taking place. The ability to numerically simulate the occurrence of defects would allow the determination of optimum parameters to be used in the different processing phases (e.g. environment temperature and humidity), leading to the minimization of rejection doors due to manufacture defects.

CHALLENGE 3

Setting the Reserve Fleet

industry_**Transportes Urbanos de Braga**

sector_ **Transport**

An urban transportation company has a reserve fleet of buses, which allows replacement of the active fleet in case of breakdown or maintenance. Through the survey of the maintenance data and reliability of the fleet it is intended to determine the optimal reserve fleet (number of buses).

CHALLENGE 4

Surgical cases packages

industry_**Hospital de Braga S.A.**

sector_ **Healthcare**

The hospital holds currently more than 27,000 surgeries/year in operating room, involving a series of material and significant human resources. To achieve a high standard clinical quality a continuous and regular improvement in delivering operational efficiency is mandatory. A study on the composition of standard surgical packages, to optimize the grouping of surgical instruments that make up each box according to the surgical specialty, is to be made. The packages should be made according to a set of similar characteristics in different dimensions (e.g., surgical team and surgery), taking into consideration the type of materials used in a historical database.
The aim of this approach is to identify groups of materials to be included in surgical boxes, meeting minimum difference in usage profile (high internal consistency) and with significant differences between different groups of boxes (high external heterogeneity).

CHALLENGE 5

Prediction model to textile parameters

industry_**Continental**

sector_ **Transport**

The challenge consists in the use of a big quantity of available data to predict textile parameters, by developing a prediction model that considers different material conditions – greige and dipped. Mathematically, the problem can be described as given $x \in [(R,Z)]^n$ and $y \in [(R,Z)]^m$, $n>m$, related by an unknown function $f: R^n \rightarrow R^m$, an approximate function (prediction model) $F^{(-1)}$ of $f^{(-1)}$ is to be obtained. The available of a big quantity of data for x and y allows to obtain $F^{(-1)}$ (or F) by using approximation techniques (e.g., neural networks). The approximate function $F^{(-1)}$ is to be used to predict $\underline{x}$ values, obtained from $F^{(-1)}(\underline{y})$. Given $\underline{y}$, the possible non injectivity of f may result in several values for $\underline{x}$, which may require to solve the optimization problem $\{\min_x g(x), \text{s.t. } F(x) = \underline{y}\}$, so a unique solution is to be obtained. The objective function $g(x)$ is a performance measure, like, for example, the textile shrinkage.

CHALLENGE 6

Stock and production planning

industry_**Confidential**

sector_ **Footware**

Production planning of a production line with different rates in operations. The production line of study has (among others) an assembly operation with high rate with respect to the next treatment step, which in turn is followed by the finishing step with a higher rate. The existence of an intermediate stage of lower production rate leads to the need to have entry and exit stocks at the lowest rate step. The aim is to calculate the size of intermediate stocks and the development of a mathematical model that allowed the production planning.

sponsors

Universidade do Minho
Departamento Produção e Sistemas

Apdio

Centro Internacional de Matemática

EMMI EUROPEAN CONSORTIUM FOR MATHEMATICS IN INDUSTRY

CENTROALGORITMI

CMUC
Centre for Mathematics
University of Coimbra

⟨φ|μ⟩ Grupo de Física Matemática da Universidade de Lisboa

lema
LABORATÓRIO ENGENHARIA MATEMÁTICA
Instituto Superior de Engenharia do Porto