Optimization of Inventory Usage

Minimizing Production Cost of Ready to Press Powder at Sandvik Coromant

Summary

Sandvik Coromant currently uses a bought black-box optimization program to minimize the production cost of Ready to Press Powder (RTPP), used for manufacturing inserts. Alongside evaluating the black-box, we attempt to replicate and improve it in order to make the program more controllable. The improved program appears to be more accurate and result in a lower total production cost of the RTPP.

Figure 1. Inserts

Introduction

Sandvik Coromant is one of the world leaders in the production of metal cutting tools, especially inserts, Figure 1.

At the main production site in Gimo, outside of Uppsala, RTPP is mixed and undergoes a series of processes before becoming an insert. The insert can be used for turning and milling applications ranging from manufacturing airplane parts to cellphone parts.

Figure 3. Turning in action

Aim

Having little insight, and no access to make changes, in the current program optimizing the production cost of the RTPP, this project aims to evaluate, replicate and, if possible, improve the program.

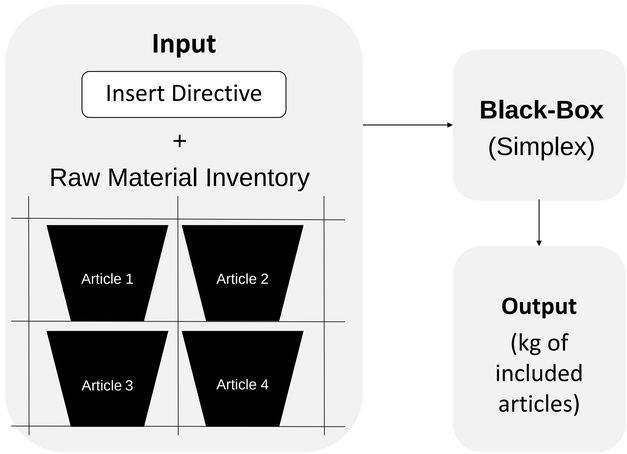

Figure 2. Input to the algorithm is the insert directive and the raw material inventory.

Problem Description

The objective of the optimization is to minimize the production cost of the RTPP used for producing inserts. Each insert comes with a directive, i.e. a recipe, specifying the amount of each element, for example copper, wolfram and aluminum, present in the RTPP. The amount of each element in the RTPP is often flexible, i.e. the amount of each element lie in the interval [min% max%].

Articles, a powder mix consisting of many different elements, in the raw material inventory should be mixed in such a way that the directive is satisfied.

Linear optimization

This optimization problem can be solved using a well known linear programming algorithm; the Simplex method. The problem is formulated as follows

$$\begin{aligned} \text{minimize} \quad & C^T x \\ \text{subject to} \quad & Ax \leq b \end{aligned}$$

where C is the cost in kr/kg of each article and x is the unknown weight of each article to include in the powder mix. A is a matrix with *m* elements and *n* articles, where $A_{i,j}$ is the percentage amount of element *i* in article *j*. b_i is the directive specifying the max/min amount of element *i* in the final powder mix.

Results & Conclusions

When analyzing the output from the black-box, the insert directive is violated. The percentage of some elements are outside the tolerance. However, when analyzing the finished product in the lab the chemical composition is approved.

The new program yields a similar output as the black-box, with the differences that the directive is not violated and the production cost is somewhat lower. This output will be used to produce some inserts with the purpose of analyzing them in the lab to conclude that the inserts, indeed, have the correct properties.

A system to optimize multiple orders at the same time was also developed.

If you have any questions, don't hesitate to ask us.

Project in Scientific Computing

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