Using Genetic Algorithms To Optimise Guillotine Cutting Operations

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Abstract

This study presents an application to optimise the use of an L- cut guillotine machine. The application has two distinct parts to it; first, a number of rectangular shapes are placed on as few metal sheets as possible by using Genetic Algorithms. Secondly, the sequence for cutting these pieces has to be generated. The guillotine's numeric control then uses this sequence to make the cuts.

1 INTRODUCTION

The application that was designed focuses in particular on optimising the use of the L-type guillotine that the company owns. In contrast to traditional guillotines, which can only cut vertically or horizontally, the L-type guillotine can cut in both these directions simultaneously, which lends greater flexibility to cutting and also leads to more efficient use of the steel sheets.

The programme to be implemented must situate the different pieces that the client has ordered on the metal sheet, bearing in mind that orders are generally made for more than one unit of a particularly dimensioned piece, and that more than one metal sheet is generally required to complete any given order. Positioning should be such as make the maximum use of the sheet material, which is tantamount to minimising the number of metal sheets that are used.

Once positioned, the programme provides the guillotine's numeric control with the cutting sequence of the sheets (the order the pieces are to be cut in). The guillotine begins cutting in the top, right-hand corner of the metal sheet, and successive cuts leave the pieces and the leftover material. To do this, an algorithm was designed based on positioning the pieces within the base surface and generating the corresponding cutting sequence for numeric control.

2 THE SOLUTION PROPOSED FOR CUTTING

The genetic algorithm designed to minimise the number of steel sheets that were used. The steps that were followed to do this will next be described. The codification used in the algorithm is based on integer numbers; each piece to be placed on the metal sheet is assigned a number, and that individual is formed with a string of numbers (a string of parts), The order in which the numbers appear in the string represents the positions on the metal sheet of the pieces.

3 CUTTING THE PIECES

A second algorithm had to be applied in order to instruct the guillotine's numeric control on how to cut the metal sheets in order to obtain the pieces. The algorithm responsible for carrying out this task acquires the distribution of the pieces in the metal sheet from the Genetic Algorithm, and generates an output file that tells the guillotine's numeric control what order to cut the pieces in.

4 RESULTS

To check the quality of the solutions provided by the algorithm, a set of examples have been applied, and it has been shown that the quality of the solutions provided by our algorithm is better in most cases, and only obtains similar results when the number of rectangles to be placed is small, in which cases exact methods can be used anyway.

References

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