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MODERN METHOD FOR OPTIMIZING TECHNOLOGICAL FLOW FOR MANUFACTURING METAL PARTS BY USING LASER CUTTING EQUIPMENT

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Abstract: Numerically controlled laser cutting (CNC) tools have been developed as an alternative to conventional cutting equipment and bring a considerable benefit due to the increased accuracy, contactless processing, higher productivity and lower energy consumption. Given the desirable need to streamline the technological flow of manufacturing to optimize production costs and minimize losses of raw materials, the use of numerically controlled equipment (CNC) for cutting metal parts is a goal of real interest. The paper presents in stages a manufacturing sequence of a metal part, with an explicit description of the necessary steps, which includes the design stage and realization of 3D and 2D models of the part, loading in the command computer and control of laser cutting equipment, positioning material on the work surface, parameterization and calibration of the equipment, proper cutting of the parts and dimensional verification of the part at the end of the process.
Keywords: optimize, CNC, process, production

INTRODUCTION

The production of laser cutting machines began fifty years ago. Progress has been rapid and laser cutting is one of the largest applications of lasers in the metalworking industry. Numerically controlled laser cutting (CNC) tools have been developed as an alternative to conventional cutting equipment and bring a considerable benefit due to the increased accuracy, contactless processing, higher productivity and lower energy consumption.

Common to all personal manufacturing tools (e.g., 3D printer, laser cutter, CNC machine) is the need for a virtual representation, diagram, drawing, or 2D / 3D model of the object to be produced. Another important aspect in the manufacture of metal parts using modern cutting equipment is the calibration and parameterization of the cutting machine. Laser cutting is a thermal process that begins by heating and focusing the laser beam (density varies around 104 Wmm-2) in combination with the gas (active or inert). The laser beam melts the metal that is being cut, and the gas with its current eliminates the liquefied metal (Ahn, D.G., et al., 2005).

MATERIALS AND METHODS

The process of laser cutting or laser cutting is done with the help of a laser beam. It is directed with a lens to the area to be cut or cut. The laser beam that passes through the lens and into the work area melts the material you want to cut or cut. In order for this activity to take place, a coaxial gas jet is pumped in order to remove the waste that occurs as a result of the melting process of the material you want to cut or cut (Barton, K.L et al., 2007).

RESULT

The necessary steps for cutting a metal part consist of a sequence of operations and parameterizations, such as: designing the part, loading into the computer the command and control of the laser cutting equipment, parameterization and calibration of the equipment, actual cutting of parts (Cheng, T. et., 2001).

— Part design

In order to cover the manufacturing flow, a side wall of a drum was selected, which was designed in the solidworks program according to predetermined dimensions (Davim, P. et al).

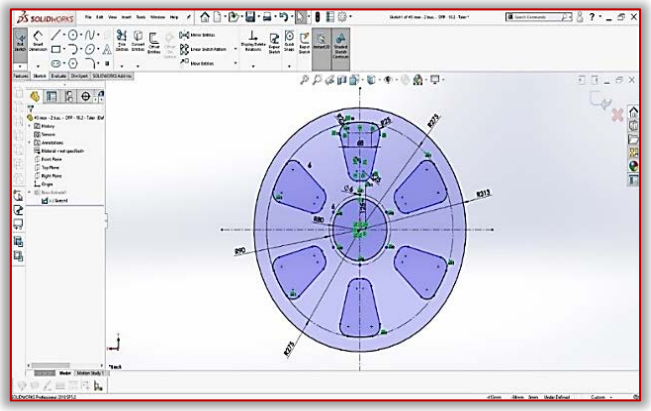

Figure 1. Design and dimensioning of the piece (Solidworks)

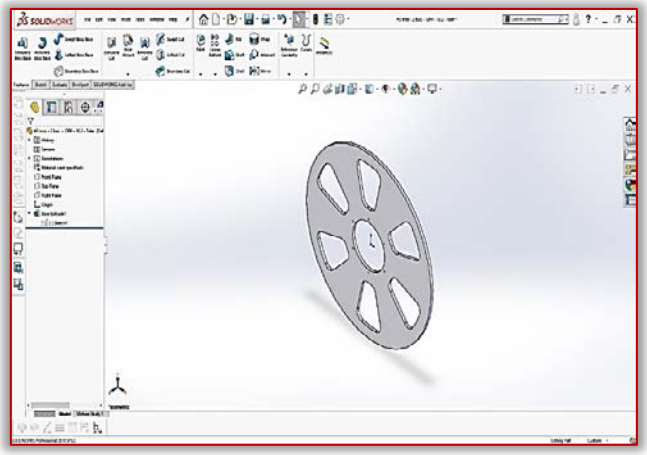

Figure 2. Previewing the piece in 3D format (Solidworks)

— Loading into the computer the command and control of the laser cutting equipment

The project designed in solidworks has been saved in a .dxf file so that it can be loaded into the laser cutting machine program (Felix Huppert et al., 2019).

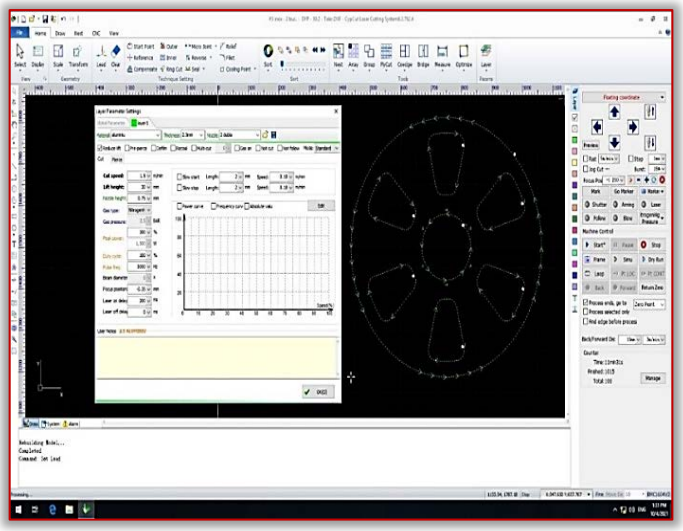

Figure 3. Loading and parameterization in the control computer of the cutting machine

— Equipment parameterization and calibration

Depending on the material to be cut and its thickness, we choose a cutting nozzle. The size of the nozzle holes has a great influence on the quality of cutting and drilling. When the diameter of the nozzle holes is larger, its proper protection for the focusing mirror is weaker because the chances of the flying melting sparks reaching the mirror are higher (Davim, P., et al.).

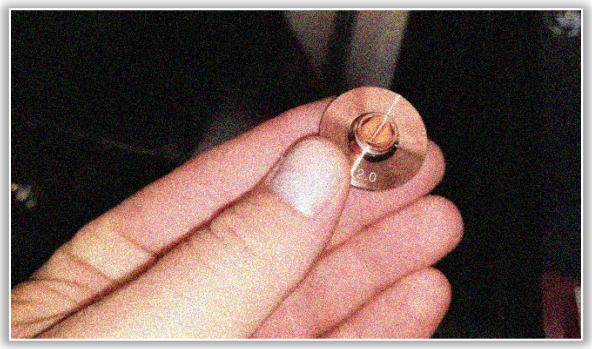

Figure 4. Cutting nozzle

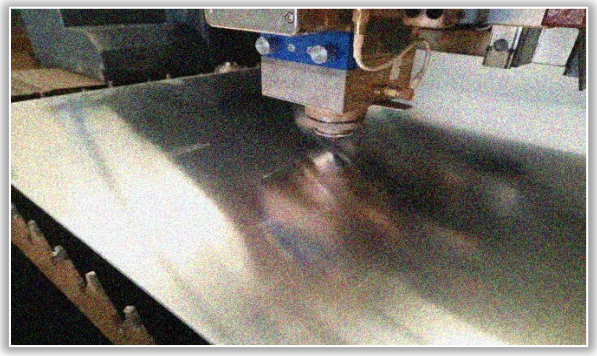

Figure 5. Calibration of sheet thickness

The calibration of the cutting machine according to the thickness of the material to be cut is done automatically, the machine having capacitive sensors.

Figure 6. Calibrarea din soft

Figure 7. The results displayed on the display after calibration

The auxiliary gas used for cutting can be connected to the O2 and N2 sources at the same time. The gas can be selected as needed during cutting and the system can automatically switch the gas supply (Frederick Struckmeier et al).

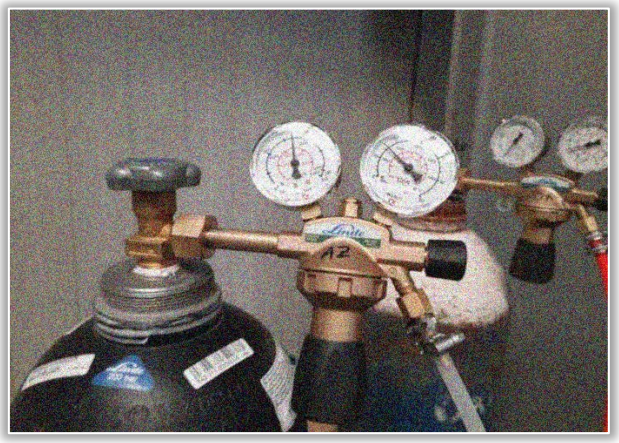

Figure 8. Gas pressure adjustment

— The actual cutting of the parts

Each workpiece has different profiles, some are easy to cut, but some are difficult to cut, such as small holes, sharp corners, etc. To ensure the cutting quality and cutting efficiency of the whole part, we will adopt the layered cutting method.

In this way, we could adopt different technological parameters to control the cutting of different profiles, thus ensuring not only the cutting quality of the hard-to-cut

profiles but also the improvement of the cutting efficiency of the easy-to-cut profiles (Miroslav Radovanovic et al., 2002).

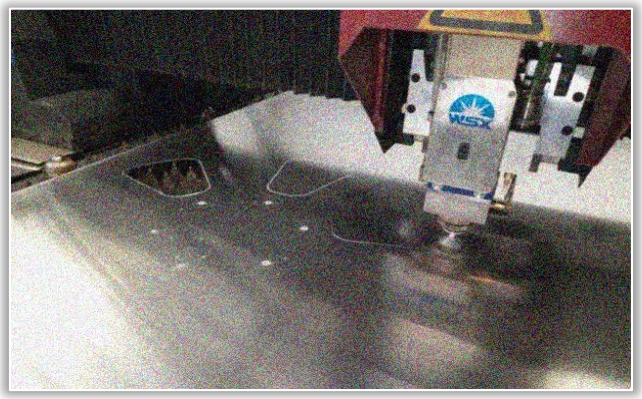

Figure 9. The debit process

After completing the above steps, the part being cut, we can measure it with the help of measuring instruments (subler) to verify compliance with the quotas in the execution drawing (Paolo Bison et al.).

Figure 10. Checking the final part

CONCLUSIONS

- Prototyping, an activity which normally costs a car manufacturer thousands of hours per year (the parts to be produced range from single pieces to a few dozen for experimental preproduction runs).
- Production in small batches, luxury or special cars, trucks and buses or parts for the aerospace industry.
- Production of spare parts where the robot flexibility is especially suited to following the diversified demand.
- For cutting and drawing dies. The process of development that precedes the die forming reaps a major advantage when laser robots are used.
- Cutting of large turbine blade ving contours for rotors and stators. Flexibility of the systems is often the most important reason for its purchase since in the case of production start-up or small batch production, frequent modifications will be necessary

Acknowledgement

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