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ROUGHNESS OF FERROUS AND NONFERROUS SURFACE FERROUS MATERIAL USING ANN FOR LASER BEAM MACHINING

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ABSTRACT

This influential paper discusses the research that has been done so far in the field of laser cutting process, as well as the experimental and theoretical studies on the influence of the process parameters, such as power, cutting speed, gas pressure, focus position, and so on, on surface roughness, kerf width, and heat affected zone (HAZ). The research that has been done so far in the field of laser cutting process includes both experimental and theoretical studies. Cutting using a laser is an advanced kind of machining that makes use of an energy-based process that is not often used in other contexts. The key objective of this piece is to provide a thorough analysis of the most recent advancements that have been made in the field of laser cutting technique. Now today ,Inadequate understanding of the laser method, along with a lack of both sufficiently trustworthy practical data and information about the factors that impact the forming process itself, may be the cause of some of the technical faults that are encountered in the area of laser machines' applications to contour sheet cutting. Other possible causes include a lack of information about the factors that impact the forming process itself. These mistakes may be the root cause of a number of the difficulties that are experienced. The more information that is made available regarding the process of laser cutting and its dependence on a range of criteria, the more it will be possible to improve the quality of the forming process while also reducing its susceptibility to being manufactured.

Keywords: *Nonferrous Material, Laser Beam, Machining Process*

INTRODUCTION

In the context of industrial production, the word "laser cutting" refers to a technique that, as the name suggests, cuts materials with the help of a laser. This technique is often used. When cutting with a laser, the output of a high-power laser is often directed via optics in order to simplify the process. This is done in order to ease the cutting process. In order to guide either the material that is being processed or the laser beam that is being created, laser optics and computer numerical control (CNC) are used. After aiming the focused laser beam at the material, which then either melts, burns, vaporises away, or is blasted away by a jet of gas, a surface finish of a high quality is generated on the edge of the product. This may be accomplished in a few different ways. Using industrial laser cutters makes it possible to precisely cut a variety of materials, including flat sheet material, structural material, and pipe material.

Companies that produce goods in nations with high wages face the problem of addressing the specific needs of individual customers as well as the constantly shifting requirements of the market, all while maintaining a competitive price point. Providing a production that is not only reliable but also effective leads to an increase in the complexity of the production processes.

Both the planning and scheduling of production need a significant amount of information processing and decision making on the part of humans. When making decisions, particularly in the realm of manufacturing pro to this, the human mind can only handle so much complexity at one time becess planning, it is important to take into account the impact that multidimensional characteristics will have on the criteria that will be used to evaluate the manufacturing process. For example, one of the most frequent challenges involves selecting an acceptable machine parameter set that would produce desirable process outcomes (e.g. high output quality or minimal energy consumption). Because of the great dimensionality of the domain space, establishing a link between interdependent characteristics and criteria can be an extremely challenging task. In addition for being overwhelmed. In order to solve these issues, process designers implement cutting edge computational methods for the purposes of modelling and simulating industrial processes.

The traditional methods include running a large number of simulations on the process, with each simulation being distinguished from the others by a high-dimensional set of parameters and a range of criteria. This is done in order to find the optimal solution. The issue is that in order to illustrate the whole behaviour of the process, it is essential to carry out a very large number of labor-intensive tests. This is a problem since it takes a lot of time and effort to do experiments. This entails a substantial obstacle to overcome. It is not possible to carry out exhaustive numerical simulations that cover the whole parameter space at a cost of computation that is within an acceptable range. This is because such an endeavour is computationally prohibitive. This is due to the fact that such an endeavour requiring such a large amount of time and money would be impossible. As a direct result of this, experimental simulation runs are performed by making use of the proper Design of Experiment (DoE) techniques in addition to other procedures that are based on experience. Since they are based on discrete sets of process parameters, simulations can only cover particular areas of the process and cannot give insights into the process as a whole. This limits their usefulness. Because of this, their usefulness is reduced.

Cutting, drilling, labelling, welding, sintering, and heat treatment are just some of the common applications for laser beams today. In most cases, it is put to use in applications ranging from weaponry used by the military to medical instruments, as well as in the cutting, welding, aerospace, and aviation industries. LBM can cut a variety of materials, including aluminium alloy, wood, ceramic, rubber, plastic, Brass, and Hardox.400, among others.

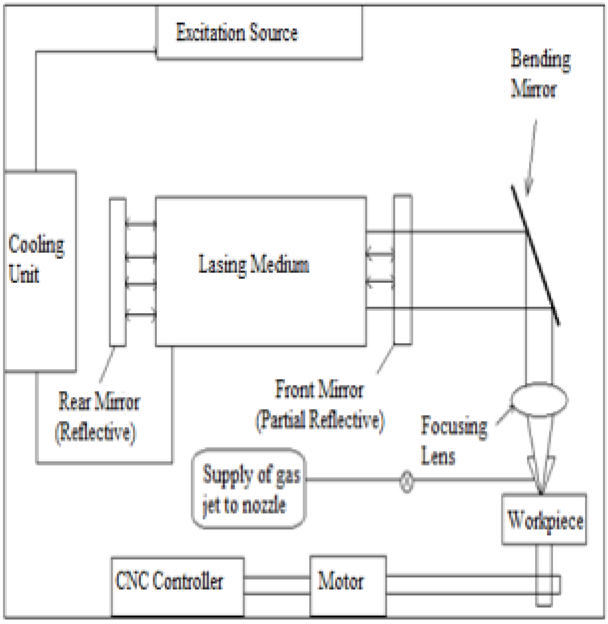


Figure 1 Diagram of a laser beam machine

The development of materials with intrinsic physical and mechanical properties that can be used in more advanced engineering applications. Machining, on the other hand, refers to the process of transforming these raw materials into finished goods. Researchers face a number of obstacles as a result of the machinability features, some of which include a greater cutting force, strict design requirements, a complex form, an infrequent size, a shorter tool life, an upper cutting temperature, and meagre surface integrity. As a direct consequence of this, the qualities of machinability have been deemed to be inefficient and difficult for the machining process. The machining of almost every conceivable variety of material can be accomplished with the help of LBM. Laser technology is put to significant use in the manufacturing sector of the economy. The word "laser ground processes" contains a broad number of subcategories, some of which include "machining," "shaping," "sintering," "coating," and "welding," amongst others. These subcategories can be found inside the larger umbrella term "laser ground processes."

LASERS

A laser beam is a kind of electromagnetic radiation, which is also the abbreviation for the term "light amplification by stimulated emission of radiation," which is abbreviated to "laser." It is from this sentence that we get the word "laser." These are the three fundamental components that make up a laser (John Powell 1998).

- Medium with energetic properties that helps to magnify light;
- The pumping source is what drives the active medium into an amplification condition.
- Optical resonator, which supplies optical feedback to the system.

OBJECTIVES

1. An analysis of the SLM literature to better comprehend laser melting and its many uses

2. In order to evaluate the surface finish enhancing post-processing techniques, in particular those that are already available.

APPLICATIONS OF LASER PROCESSING TECHNIQUES

When a target material is subjected to a laser processing technique that makes use of heat radiation, the surface texture of the material is altered. When a beam of light with a high energy lands on the surface of the target material, the temperature skyrockets, which causes the material to melt or evaporate and, as a consequence, changes the physical nature of the surface (target material). In 1958, the laser was first produced and put to use for commercial reasons in the fields of medicine, the military, and scientific research. The enormously high powers and coherency of the lasers are the primary attractions for the applications that centre on the laser systems. Machining the product without any kind of interaction from a mechanical source is one of the most significant advantages offered by laser action (non.contact method). The applications such as machining in a protective atmosphere (also known as remote machining), machining parts of the product that are difficult to access, and technological treatment of materials that cannot be affected by traditional methods are all examples of how this technology can be put to use. Drilling, annealing, laser welding, sputtering, and a few more procedures, along with a few others that are included in Figure 2, are among the numerous novel practises that are currently being conducted for engineering purposes. It falls under the headings of "removal," "joining," and "reformulation," while the methods of boring and cutting fall under the category of "removal," and general marking can be filed under either "removal" or "reformulation".

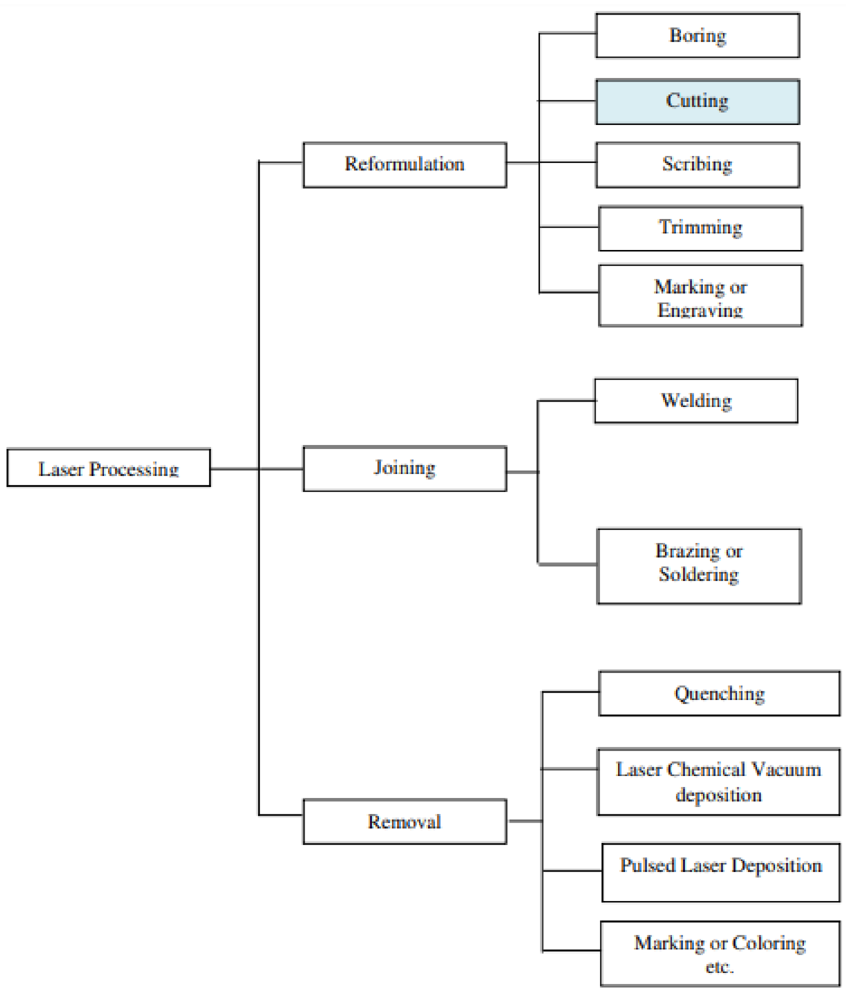


Figure 2 Techniques for Laser Based Material Processing

Laser cutting

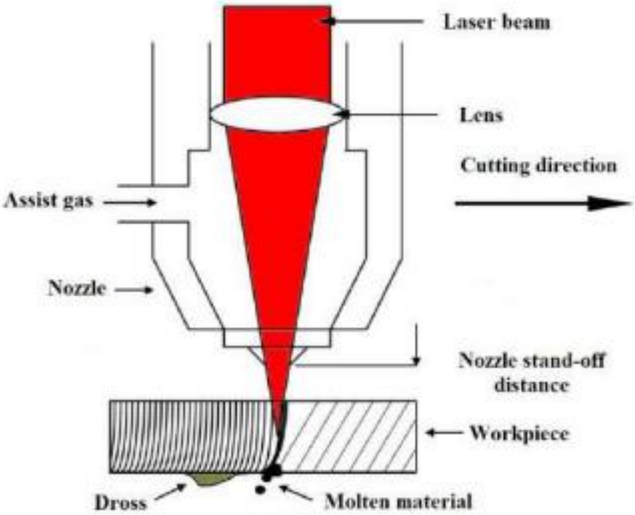
Cutting metal with lasers is by far the most popular usage of lasers in the industry of metal processing. This is due to the fact that laser cutting offers a number of competitive advantages over more conventional methods of cutting metal. These benefits consist of a decreased amount of material being thrown away, greater precision and surface quality, resistance to tool wear, and the capacity to be easily automated. The concentrated beam of the laser makes it possible to cut without using any tools while keeping high precision, a tiny kerf, and a minimal heat impacted zone. This is made feasible as a result of the fact that the laser may be used to perform cutting (HAZ). The process of laser cutting is a thermal one in which an intense laser beam is focused in a highly localised area on the surface of the material that is to be cut. This causes the surface of the material to heat up and cause the cutting to occur. The content will be cut as a result of this. This region is then moved all over the surface of the material in order to cut through it, and this continues until the material has been cut through. The substance is heated to the point that it either melts or evaporates uniformly throughout its thickness because of the material's capacity to take in the energy and transform it into heat. The migration of the molten material away from the incision is helped along by the assist gas in the interim. Since there are so many different factors involved in laser cutting, the interaction between them may be nonlinear and difficult to understand. This is owing to the large number of parameters. As a consequence of this, there is a continual effort being made to comprehend the process and model it in order to achieve the highest possible cut quality and the quickest cutting speed that is conceivable. In particular, this is done in order to achieve the highest possible levels of production.

INDUSTRIAL LASERS IN CUTTING

Excimer lasers, CO2 lasers, Nd. YAG lasers, and fibre lasers are the types of lasers that are utilised the most frequently in the fabrication industry. Cutting is done with CO2 lasers (gas lasers) and Nd. YAG lasers (fibre lasers) in industries the majority of the time because of the processing properties of these lasers. Because of the lower quantity of heat energy that is generated during the production process of CO2 laser beams, these beams are more effective than those produced by other lasing materials (Steen 1991). Aluminum and other highly reflective materials are within the scope of the laser's capabilities for processing. The laser cutting method is appropriate for usage when cutting various thicknesses of ferrous materials such as stainless steel and non-ferrous materials such as aluminium alloy. This is due to the laser's high productivity and precision.

LASER BEAM CUTTING (LBC)

Laser Beam Cutting (LBA) is the most prevalent kind of unconventional two.dimensional machining that utilises heat energy. The required profile can be achieved by either changing the laser beam or the workpiece platform in response to commands from a CNC system. When compared to other unorthodox methods of cutting, this one has a multitude of benefits, including cheaper operating costs, higher cutting rates, the ability to generate complex geometries with exceptional quality, and many more (Ahn & Byun 2009; Chryssolouris 1991). The mechanism incorporates processes such as evaporation, melting, shearing, and ablation (Steen 1991). The process of laser cutting is an example of a thermally based advanced machining process. The workpiece undergoes melting or evaporation as a result of this procedure, which involves focusing a laser beam with a high power density on the workpiece. As can be seen in Figure 3, the molten material is eventually evacuated by the gas that is flowing out of the nozzle, and what is left behind is the cut zone, also known as the kerf. Vaporizing and sublimation are procedures that may be carried out on non-metal materials, such as leather, ceramics, wood, and plastics. Vaporizing can also be carried out on metals. When a circumstance arises in which the concentrated energy of the laser beam is used to raise the surface of the sheet metal to a boiling point in order to form a penetration hole, the laser fusion cutting mechanism is beneficial.



(Source. Milos Madic et al. 2016)

Figure 3 Laser cutting

CONCLUSION

Surface finish improvement is a crucial requirement for many applications of additive manufacturing, but it is still difficult to achieve using most traditional techniques. A vital element in getting the desired outcome is the appropriate implementation and selection of postprocessing. Due to the ability to generate complicated shapes with sufficient dimensional precision, the SLM process may produce fully functional parts with a number of advantages. SLM products' poor surface roughness and persistent porosity, however, are thought to be two of the technology's biggest flaws. Because each surface finishing technique has a unique impact on the components' physical and chemical properties, it is crucial to research them.

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