Optimizing Laser Cutting

Optimizing Laser Cutting Machines

New cutting methods and utilizes help achieve increased material efficiency and throughput

By Mark Trager published by Industrial Laser Review, 1998

The leading advantages of owning and operating a laser cutting machine have always been improved part quality and flexibility, higher yield, increased throughput, reduced setup and elimination of secondary clean up operations when compared to other types of machine tools. Software technology, more commonly known as nesting software, helped to increase material yield and throughput by optimizing the layout of parts on a sheet of material. Customers not only wanted nesting solutions to their production problems, but wanted those nesting solutions to be automatic. In an effort to keep up with increased production requirements and programming consistency, automatic nesting systems became the only answer.

Until recently, laser cutting machines were supported by nesting software that was initially designed for other cutting applications. Greater demands for increased production placed pressure on nesting systems to improve part quality and increase throughput, while attempting to achieve the highest possible material efficiency. In addition, new laser cutting machines with highly advanced features were being manufactured which pushed the limits of the existing nesting systems. In effect, nesting software had become outdated for the laser cutting application.

End users in the laser cutting industry readily accepted the fact that nesting software optimized material yield, but they knew if the parts could not be cut efficiently, ensuring part quality and increased throughput, the savings gained in material efficiency would be lost. As a result of direct input from these users, a variety of laser cutting optimizers and utilities was developed in the last few years.

In one example, a problem relating to poor cycle time during the laser cutting process was presented by a customer who had been using a laser cutting machine for years to fabricate harvesting equipment. The customer realized cutting time was being lost by raising and lowering the cutting head between parts and internal shapes on a sheet of material. Studies indicating a significant improvement in cycle time justified the purchase of a second laser cutting application.

To satisfy this requirement, Feature Avoidance or Head Down Logic Software was developed. This cutting method minimizes the need to lift the cutting head when traversing between nested parts and their internal features, thus saving significant time and money. The technology automatically calculates the best location of lead-in and lead-outs, creating an optimized NC tool path which considers the need to avoid previously cut parts. This method has been documented to reduce linear tool paths and production times up to 40% (see diagram 1).

The following compilation of customer needs and their respective solutions represents recent efforts achieved by nesting software companies to save consumables, improve part quality, increase material yield and throughput on existing and new laser cutting machine tools.

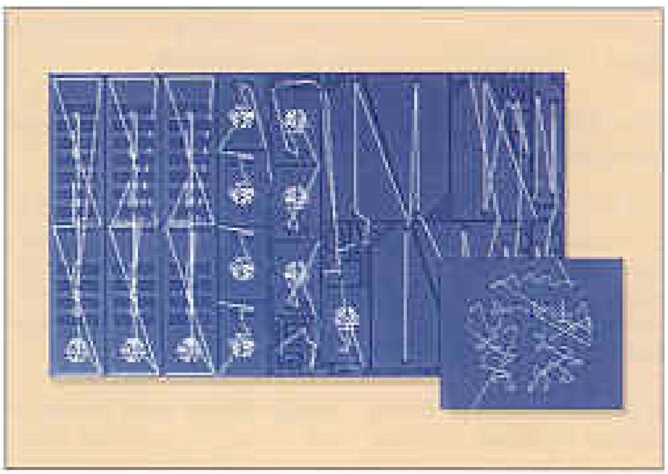

Figure 1. Nest before head down logic is applied. Note how tool path (white line) crosses over previously cut shapes in the nest and zoom view.

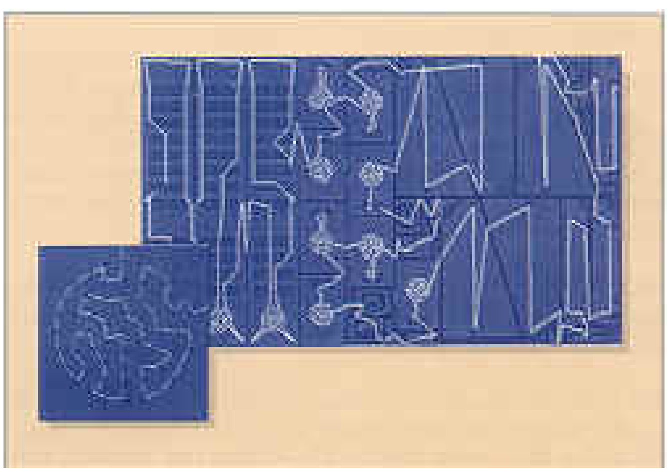

Figure 2. Nest after head down logic is applied. Note how tool path (white lines) avoids crossing over previously cut shapes in nest and zoom view. This resulted in a 40% reduction in the linear

cut path.

NEED: Eliminate duplicate tool paths in a nest for those parts that are nested close enough to share a common cutting edge when cut. Reduce the total linear inches in the tool path while cutting the same amount of parts.

SOLUTION: Shared edge or Common Line cutting was developed to automatically create a common tool path, where appropriate, between similar or dissimilar parts in a nest. Shared edge also automatically optimizes the cut sequence for the new tool path.

NEED: Minimize the traverse travel between irregular shaped parts in an effort to decrease pierce and pecking cycles necessary to cut the nest while reducing consumables during the cutting process.

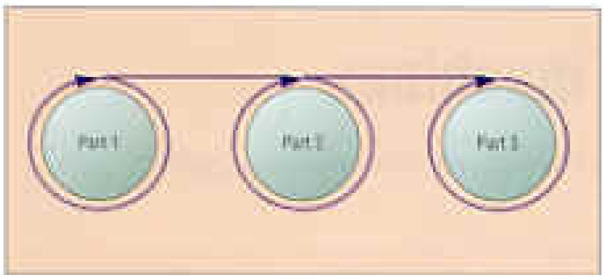

Figure 3. Simplified diagram of the chain cut tool path.

Three different cutting methods have been developed in the past several years to solve this need (see diagram 2):

SOLUTION 1: The Chain Cutting method was developed to automatically generate a continuous NC tool path where appropriate, weighing the use of a chain cut versus rapid traverse for certain groups of nested parts. This method will find the shortest path between parts and provide optimal placement of lead-ins, lead-outs and cutting directions.

SOLUTION 2: The Bridge Cutting method sorts groups of parts to be linked, bridging these groups of parts into single tool paths by combining their geometry. The bridge consists of coincident tool paths traveling in opposite directions resulting in a width equal to the value of the kerf. This method will also bridge parts that are nested inside the internals of other parts. The technology allows the parts to be nested closer together which improves the nesting yield and throughput.

SOLUTION 3: The Reduced Pierce or Minimum Pierce Cutting method was developed to utilize the kerf of a previously cut shape as the lead-in to the next shape. Unlike the chain and bridge cutting methods which cut from part to part, the Reduced Pierce Cutting method traverses to the optimal point to begin cutting from one shape to the next.

NEED: Provide for an automatic means of cutting the skeleton into pieces after the nest is cut. This would reduce the labor cost of manually removing and cutting the skeleton on the floor or the machine table.

SOLUTION: The Skeleton Cutting method was developed to cut the skeleton into user-defined sizes, improving cycles times and saving labor costs. Cutting the skeleton into smaller pieces can actually increase the value of the scrap itself. This method will work with probes and height sensors and characteristically avoids and dodges parts to decrease the amount of piercings.

NEED: Prevent part tipping and movement which in turn causes head crashes (down time) and poor part quality.

SOLUTION: The automatic tab cutting method was developed to join parts to the skeleton with a small tab to prevent part tipping. This method places tabs in user-defined locations, utilizing various tab sizes and shapes.

It important to understand that each method will satisfy customer specific needs. Part shapes, order requirements and material type being used will determine the appropriateness of one method over another. It may appear that several of these methods do the same thing, but the slight differences that exist will benefit only specific applications. In most cases, these methods are user definable and parameter driven. Variations will occur from company to company.

In addition to these methods that are specific to the cutting process, several other utilities have been developed to offer increased savings on the cutting floor.

NEED: Efficiently utilize existing punch presses to work in combination with laser cutting machines. The customer desired to utilize existing punching resources on small internals and cut larger contours with the laser.

SOLUTION: An NC output manager for combination punch/laser cutting tools was developed to utilize existing machine tools on the production floor. When the cycle times of the punch press and laser machine tool are linked, the customer can take advantage of the speed of the punch press to cut internal holes which in turn can feed multiple laser machine tools.

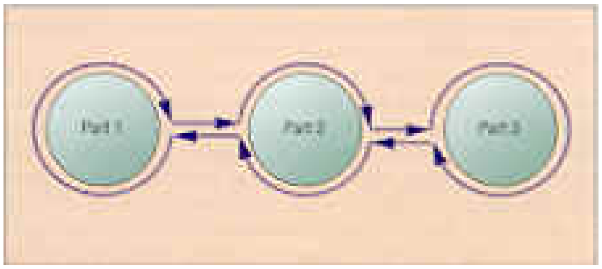

Figure 4. Simplified diagrams of the bridge cut tool path.

NEED: More efficient nests took longer to load into the laser machine tool and would often exceed the memory capacity of the machine controller. The ability to compress the MCD file was needed.

Solution: An MCD compression utility was developed to reduce the size of the longer MCD file that is produced when a more efficient nest is created. The use of an MCD compression utility has been documented to reduce by two thirds in size the actual post processed MCD file.

NEED: Automatically provide the ability to recover from machine shut down due to tool breakage, power outage or similar instance while cutting a large nest. This would prevent from having to retrace or search through large amounts of code to restart at the proper location.

SOLUTION: Part and Feature Tracking utilities were developed to allow the laser machine tool to be restarted automatically at the exact location in the nest where the head was stopped without retracing. One customer's use of this utility was during personnel shift change which prevented the need for significant overtime and machine down time.

Whether your laser cutting machine tool is a new installation or an older version, today's state of the art cutting methods and utilities developed by nesting software companies will help you achieve the increased material efficiency and throughput that is needed to compete successfully in the industry. The choices between methods and nesting software are sometimes subtle, but it is important to continue searching and bench marking until your specific needs are satisfied. Seek and ye shall find.

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Last modified: July 30, 2001

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