Laser Cutting Tool Empowers the Maker Movement

Written by Robert Boyes
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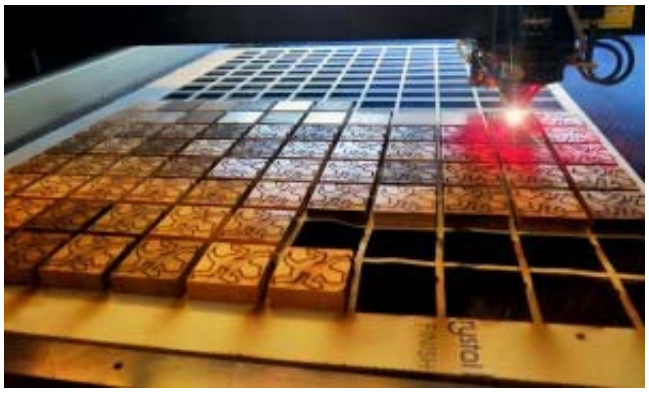

Over the past decade, the so-called "Maker Culture" has emerged as a significant movement of individuals who take the DIY (do it yourself) approach to an amazing extreme, creating everything from fine art pieces to aerial drones. Three technological developments have been key in facilitating the rise of the Maker Space movement:

The internet, which allows makers all over the world to share their ideas, methods and designs.

Powerful (and sometimes free) software that permits individuals to rapidly develop complex designs.

Fabrication methods which enable the production of physical items directly from digital design files, without the need to possess in-depth expertise in traditional manufacturing methods, such as machining or welding. 3D printing has been one of the most important

of these tools, but this technology is limited in terms of the materials that it can work with, and the maximum size of parts that it can produce.

Now, a new generation of laser cutting tools is emerging as an important resource for makers, enabling rapid, high precision fabrication of parts from metals, plastics and many other materials. This article reviews the laser technology behind these tools, and shows how an artist at the Autodesk Workshop at Pier 9, the company's facility for digital fabrication and traditional manufacturing on the San Francisco, California (US) waterfront, used a Coherent laser cutting tool in his maker project.

Mid-range laser cutting tools

Laser cutting tools have been around for decades, but traditionally, they fell into two distinct classes. The first are large machines, based on multi-kilowatt, flowing gas CO2 lasers. These powerful systems are characterized by fairly high consumables and maintenance costs (and frequent downtime), and are targeted exclusively at metal cutting applications. They are widely employed in job shops, metal service centers, and in the automotive and appliance industries.

The second type of laser machine tools are smaller systems that employ sealed, waveguide CO2 lasers with output powers of less than 150W. This is too low for processing metals, but well suited to cutting and engraving a wide range of organic materials, including plastics, fabrics, leather, wood, paper and thin films. Typical applications for these systems are making signs, nameplates, rubber stamps and stencils, and engraving stone. The small size of these tools, coupled with their low operating costs and quiet operation, make them ideal for use in "mom-and-pop" operations and small job shops.

The development of sealed, slab discharge CO2 lasers with output powers in the 150W to 1 kW range has dramatically altered this landscape. In many ways, these mid-range lasers combine the best features of high power flowing gas and low power waveguide lasers. For example, like waveguide lasers, slab discharge lasers are physically compact, and have low operating and consumables costs, combined with high reliability and uptime. But, they output much more power, in a high-quality Gaussian beam that can be tightly focused, and deliver

nearly square wave shaped pulses having very rapid rise and fall times. All this enables them to cut metal in a way that rivals much more powerful flowing gas lasers. Using this technology, manufacturers like Coherent have developed a new breed of laser cutting machines that rapidly process metals and organics, yet are physically compact and economically accessible to smaller companies.

Autodesk workshop at Pier 9

The Workshop is an extensively equipped facility located in San Francisco, California. Created by Autodesk, a leader in engineering, entertainment and architectural software, the facility is available to their employees as a space where the relationship between design software and fabrication equipment can be explored in detail. The Workshop is also open to a select group of Artists in Residence (AiRs) who can use the resources for a variety of projects. And, with everything from 3D printers, CNC routers, laser cutting machines, woodworking equipment, a metal shop and an electronics lab, to a sewing center, and even a test kitchen, those projects can cover a tremendous range.

Autodesk recently added a Coherent METAbeam 400 (based on a 400 W CO2 laser) laser cutting system. According to J. Sassaman, the Pier 9 Shop Manager, "Our goal is to provide our users with the broadest range of options in order to deliver unlimited creative potential. The METAbeam 400 helps us towards that because it offers much greater flexibility than the smaller laser systems we already possessed. These have a smaller cutting bed, can only cut materials up to ⅜ inch thick, and can't process metals. In contrast, the Coherent system can rapidly cut everything from ¾ inch plywood and acrylics to sheet metal, which our users have employed to make everything from armatures to tree house parts. And, while the METAbeam has a 4 foot x 4 foot cutting area, it is still relatively compact and light weight."

The Coherent METAbeam 400 is a compact laser cutting system capable of processing metals, plastics, wood and many other materials at high speeds.

Tessellated pattern cutting board

A tessellated pattern cutting board, produced by Pier 9 AiR Will Buchanan, demonstrates the capabilities of this system well. This piece is based on MC Escher's famous lizard tessellation and is made from maple, cherry and walnut to produce good color contrasts in the pattern. Because the board is made from wood, it couldn't be 3D printed, and a CNC router would be unable to produce the sharp corners that occur throughout the pattern.

The tessellated cutting board based on a MC Escher lizard pattern.

According to Buchanan, "Getting the fit right was the key challenge for the cutting process. Interlocking tessellated patterns are inherently difficult to work with. Making the pieces too small will cause the assembly to be loose. Alternately, if they're too large, it will lock up on you during assembly. The speed of this laser system was a definite advantage because I had to determine the best cutting parameters through iterative trial and error. Since each wood type has a different flashpoint, the cutting parameters for each are different."

Buchanan quickly determined that all the pieces from a given wood type couldn't be cut in from a single board. Even the narrow kerf width of the laser cutter would have caused the pieces to be too small for proper assembly. Instead, he cut each lizard shape from an individual 2 inch square. These were arranged on the bed of the laser cutter in a jig he fabricated from acrylic.

The pattern pieces were separated from their square substrates and then assembled like a jigsaw puzzle.

"When I looked at all the fabrication technologies available to me at Pier 9 for making the cutting board, only the Coherent METAbeam 400W would cut it (pun intended)," notes Buchanan. "The system is far more powerful, accessible and easy to use than any laser system I've seen before. With this tool added to Pier 9's capabilities, I feel like the only limit to what can be produced is the maker's imagination."

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