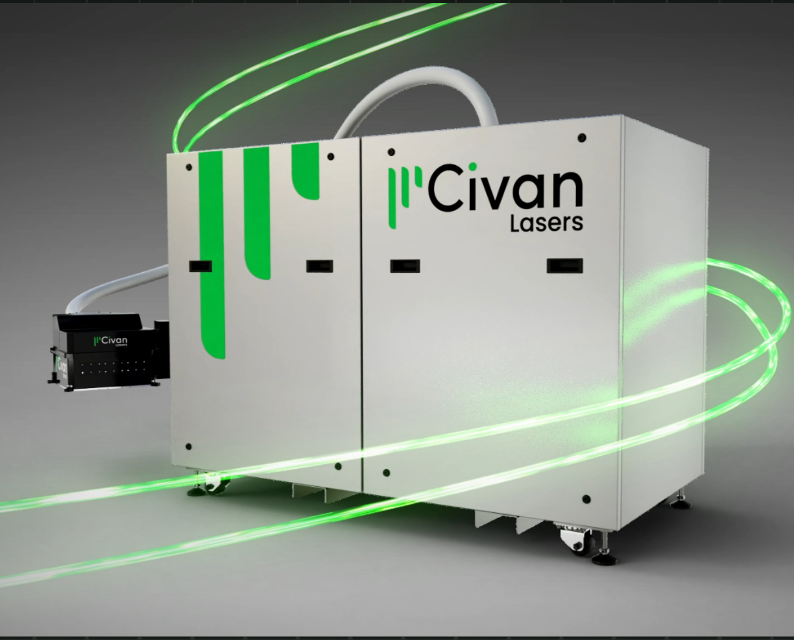
Next-Generation Laser

Dynamic Beam Laser Explained.



Civan Lasers

Intro

The introduction of lasers revolutionized the nature of materials processing (MP) in the automotive and aerospace industries. Lasers have replaced traditional tools and have brought new levels of quality, reliability, and efficiency to the field. **The industry, however, has continued to evolve with new materials and faster processes and it is important for the lasers to keep up.**

At the moment, it seems as if materials processing needs may be changing faster than new laser capabilities can be developed. **For example, auto parts are now made from an assortment of alloys and often require the welding of asymmetric parts or dissimilar metals.**

This creates challenges, and it is particularly difficult to overcome issues of cracking and porosity when welding at high speeds. **One of the ways to improve results is by tailoring the beam shape for the process.**

While there are a number of solutions that exist for beam shaping, they offer a partially solution, rendering it impossible to maximize the use of lasers both in terms of cost and productivity. For example, you can use Diffractive Optical Elements (DOE) to change beam shapes, but **once a new shape is designed and implemented, it can't be changed on the fly.** Or, mechanical scanners can solve keyhole instability issues, but they are limited by the maximum speed at which they can operate, which is often not fast enough.

The reality is that laser technology must evolve alongside the materials processing industry. Standard lasers do not offer the flexibility needed in order for lasers to be optimized and used to their full potential in MP. **This flexibility can be found in Dynamic Beam Lasers (DBL), which allow you to customize any beam element property quickly.** Read on to discover how Dynamic Beam Lasers will take materials processing to the next level.

Civan's Dynamic Beam Lasers Allow You to Customize Any Beam Element Property Quickly.

01

Revolutionizing Material Processing with Flexibility

Since the problem is inflexibility, the most effective solution is **Optical-Phased Array (OPA).**

OPA is one of the possible methods to do coherent beam combining (CBC) that combines many single-mode laser beams into one larger beam.

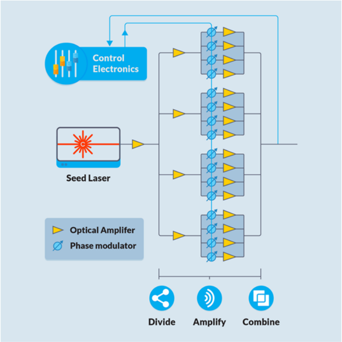
As each laser emits its own light, there is an overlap in the far field, creating a diffraction pattern. In simple terms, this process unlocks the flexibility to easily manipulate the beam shape in real-time. Basically, you use the laser like a pencil and draw whatever beam shape you want.

It's not just the shape of the beam that is flexible. There are 4 main features in which the high flexibility of DBL comes in handy:

1. Beam shaping
2. Shape frequency
3. Beam sequencing
4. Focus steering

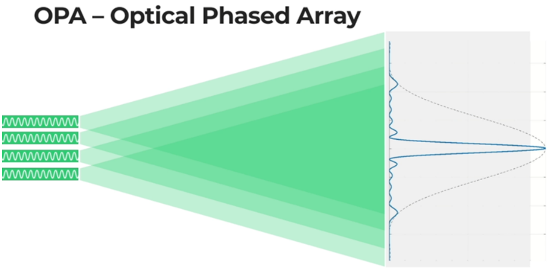
Let's look at how flexibility in each of these areas impacts the quality of a weld.

Coherent Beam Combining



+

Optical Phased Array



02

Beam Shaping

The shape of the laser beam has a direct effect on the material being processed, with each different shape resulting in a specific weld geometry and micro-structure. The exact shape that you need depends on the result you are trying to achieve, and sometimes a small adjustment might make a big difference.

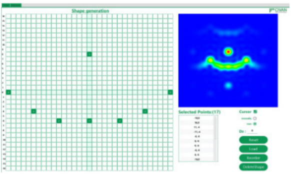
Existing solutions do not give you the flexibility of choosing such a wide range of different shapes, let alone design the exact one that you need.

With Dynamic Beam Lasers, it is easy to design the relevant shape, upload to the laser software and then see the effect on the weld using cross-section analysis within a relatively short period of time. The simplicity and speed of this process makes it possible to test multiple shapes in order to optimize the best shape for the specific weld.

For example, when welding dissimilar metals, DBL would allow for the use of 2 laser spots moving at the same time (imagine the movement of a kitchen mixer) to provide the homogenous weld needed.

The above scenario is impossible with standard lasers and is just one example of how the accessibility of DBL will improve the capabilities of so many types of materials processing.

01

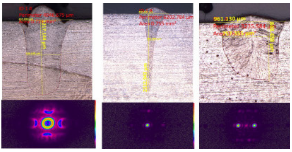


Design a Beam Shape

02

Upload Shape to the Laser

03



Optimize the Beam Shape

Modify Beam Shape for Optimal Process

03

Shape Frequency

Once you've designed the shape of the beam, you can set the laser to create the shape at different speeds - this is what's referred to as shape frequency. The speed impacts the characteristics of a weld, and a less than optimal speed can cause defects such as spatter. Fast frequencies, like 50MHz for example, is so fast that it behaves as a quasi-static shape and would produce a completely different result than a KHz or Hz frequency.

As with beam shaping, the frequency can be changed easily so that you would be able to test different speeds to determine which works best for the particular needs of the material being processed. **In some cases, it's just the difference in frequency that can be all the change needed to drastically improve a weld.**

Influence

0.4KHz

2KHz

20KHz

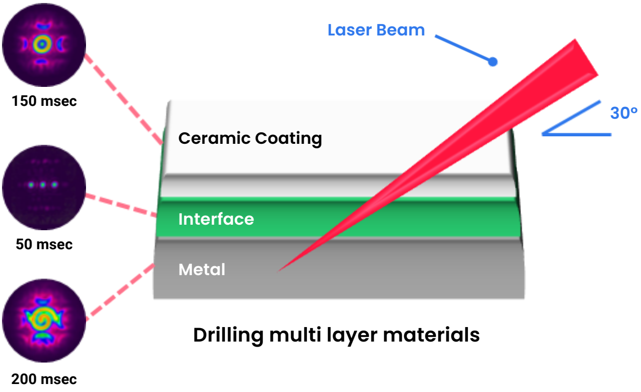
70KHz

04

Beam Sequencing

Beam sequencing adds another layer of flexibility, giving you the ability to switch between beam shapes in as fast as a microsecond. This means you can create a series of different shapes and program the laser to run through them in order, at different speeds, at intervals of your choice. The beam sequence you choose would, of course, depend on what you aim to achieve, but you will have the ultimate flexibility.

Current solutions would necessitate using the minimum properties required to suit all of the materials. This would be an inefficient use of resources as the process would not be optimized for **any** of the materials. With beam sequencing, you can easily program the laser to **change from one beam shape to the next as it moves through the different layers** and the material changes. In this way, the process is optimized at each layer.



Drilling multi layer materials

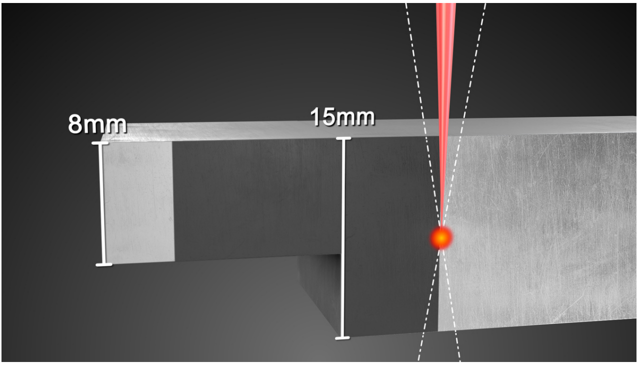
05

Focus Steering

Standard lasers have a short depth of focus that concentrates the vast majority of its heat on one point.

This causes all other areas of the beam to be significantly cooler. This results in an inconsistent weld throughout the depth of the material(s). Single mode lasers have a larger depth of focus, and Dynamic Beam lasers are single mode lasers that can also steer the focus. Meaning, you can change the focal position on the Z axis within the material at any time and any speed during the process.

Focus steering is especially beneficial when welding thicker materials, allowing for a smoother and more consistent weld. As well as in laser cutting where it causes less roughness and dross.



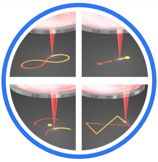
The Power of Flexibility

DBL takes a powerful tool like a laser and rids it of some of its inherent rigidities, resulting in an even more powerful and extremely flexible tool for materials processing.

The flexibility offered by DBL offers many benefits, including:

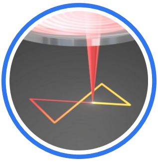
- **Strong welds of crack-sensitive materials** by generating different beam shapes with pre and post heating.
- **Reduced pores and spatter** via keyhole-stabilizing beam shapes.
- **Stabilized keyholes** even at very high speeds.
- **Controlling properties of dissimilar materials** using unlimited steering patterns.
- **Efficient welding of asymmetric materials** by accounting for the heat capacity of the different parts.

Overall, its ability to quickly adjust these laser properties that is a true game changer in materials processing. Dynamic Beam Lasers puts the power in your hands to test what has, until now, been accepted limitations.



Unlimited Beam Shapes

Customized beam spots

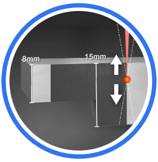


Shape Frequency

Beam Steering up to 50MHz

Shape Sequence

Switch beam shapes instantly



Focus Steering

Controlled depth of focal positions