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Fiber Laser Applications Video- January 2007
Transcript Part I

This particular piece….is a multimode laser. Anything above 2 kilowatts, in our case, is a multimode laser. So we've got direct from the laser a 50 micron fiber which is delivering the energy. The issue with it is, and you can see by the robot here, these are deployed by automotive companies, shipbuilders and so forth, and what happens is with robots these are moving at very high speeds. I'll give you an example. I'll show you one of the parts. This is what's called a hydroformed part.

(0:33) So in the old days when you build a vehicle you'd have a chassis, you'd put the body on top of and so forth, and what they've gone to is they'll take a piece of sheet metal and form it under great pressure, hydraulic pressure, they'll weld the parts and it'll actually make these complex shapes, which'll give you a much more rigid structure. Think about the new Ford trucks and Nissans; they need to have this towing capacity, so they need this box frame to do it.

But what happens is once they've got this one hydroform part, they need to join the different materials. They need to pass through either lightening holes or brake lines, gas lines, and so forth. They need to stamp these parts out traditionally. What they've done is they've gone to this new material so that it's easier.

(1:15) The first thing you can see is the color difference. The big difference between the two materials is this is high carbon steel. It crinkles under extreme pressure or force, say a vehicle crash, and this is the new high strength steel coming out of Detroit. The issue with it is, one, it's very strong. We've actually taken out blanks of it and struck it with a ten pound sledge and it doesn't deflect at all or it goes right back to its original shape.

The issue is if you go back to the standard process normally done in Detroit to produce these shapes, they're wearing out a set of dies every two days. So they've got to take them off, either use a laser or another process to recondition the die, machine it back to its capabilities, test it, qualify it, and put it back on the production lines. So they're constantly breaking down the lines. To look at it, if you believe what they say, companies like Ford and Chrysler, they rate their time being somewhere between $5 million and $15 million an hour for every hour they're down. So they look at using lasers.

What we've found is using a 3.5 kilowatt laser, using a 6 kilowatt dialed down, we can cut this material at a rate of about 18 meters per minute with good quality of cut. So it's equal to the speed they're doing with the stamping, but it also allows them with a five or six axis system to actually follow the contour of the part. So now instead of having a series of dyes, they can create lightening holes, brake passage holes at a very high rate of speed. By either changing the optic or changing the focal plane they can use the same laser to join two pieces of metal or dissimilar metals together. So now they can use one tool for stamping as well as welding….Well the thing about stamping is besides cutting the hole that it's cutting or the stamp that it's creating, it's actually putting a series of stress lines on the part, whereas with the laser it's a non-contact process. There's no force being required so there's no stress lines.

There's a little bit of stress put in from the heat, but what we do is we use shielding gases like oxygen or nitrogen. If it's a welding process, we might use nitrogen as a shielding gas to remove oxygen because you don't want to impart that in the weld. And if we're trying to do high-speed cutting what you usually do is use high pressure oxygen, similar to an oxy-acetylene weld. It facilitates the burning process. In some cases it'll start to create a fine ash. The ash then creates an iron oxide that burns at a higher rate. So they've gone from stamping to cutting and they've gone from from low strength steel to high strength steel. This is just one example.

(3:50) What I want to get at is besides having a very versatile tool, there are a few financial reasons for having this equipment. If you look at what a United Auto Workers gets with overhead, 401K and everything else, it's about $28 an hour. A robot takes about 30 cents an hour. So they can be more cost competitive with Japan, Asia, Mexico and so forth. But they can also have the flexibility of just programming in something versus needing a die which is something you have to manufacture.

But the biggest issue that I was trying to get at from a laser standpoint is if I go direct fiber to a laser unit, that's all well and good, you get good beam quality and so forth, but now you're stuck with one tool for one laser. The other issue is because this is moving around, programming, hardware and so forth, limit switches... they do fail at some point, operator interventions happen and so forth. So you have the ability to damage the fiber. You can impinge it. I've actually had units come back where they've driven over the fibers with a fork truck at their facility. They don't have good cable management going on. So what we do is we offer a beam switch which you see over here in this box. What that allows us to do.......

If you look at this here, it's an optomechanical switch, electrically operated. We'll bring one fiber in, in this case the direct 50 micron fiber. You can air launch it internally, into…. typically the ratio is 1.5, so if it's a 50 micron you'll want to go with a 75 micron or larger diameter, just because of the divergence of the beam. So we can take a 50 micron, and this happens to be a three position beam switch; I can go to a 100 micron, 200 micron, 400 micron beam switch.

What that allows me to do is – say 100 micron I can do cutting applications, 200 microns I can do welding, and 400 or 600 micron I can do heat treating or cladding. So cladding would be in the case that they wanted to repair that stamping tool, they could actually put metals down, get a near net form and then manufacture it down to where the tolerances need to be. Or on a die stamp they usually want to do selective heating of the part so they can actually increase the wear. So that's another thing that they can do with it. But what this allows them to do is they can switch it in the microsecond regime. Then say the standard is a 20 meter fiber. Now I can have one laser that's shared between four workstations or three workstations depending on the switch. You can always have parts moving in on a staggered sequence, so you're always using the laser so you're getting the most money out of your laser. But also, if I damage a fiber with these passive delivery cables – fork truck, impinging or so forth- it's a quick replacement. So that $5 million, $15 million an hour that the autoworkers are looking at- it's a quick replacement and it's easy to have fiber on hand versus having to send the laser back for repair or rework.

(6:27) So that's really the basic use of this laser from a robotics standpoint. Cutting, drilling, and welding. A robot isn't what I'd use for something like 3D selective laser sintering, producing large parts- I have some parts in the sample case I can show you. There you'd want to use a 12 or 14 inch very fine….. resolution. So choosing the motion control system with the right laser tool is more the integrator's responsibility, and what we do is help them select the right tool for the right job. So if you go to our Apps Labs here we've got a Haas Mini Mill, a standard workhorse you'd find in a lot of job shops, a robot which allows for a large format and a large traversing but it also allows us to really utilize the laser.

If you went back about 10 years ago, you'd find the laser couldn't keep up with the machine- the machine tool was always faster. But with these high speed, high power lasers now, what we're finding is the machine tools can't keep up. We have a video on our website where it shows remote welding applications with one of our robot arms, and the reason why they have that long standoff is to show a few things- the quality of the beam over long distances, it's a good collimated beam. And we're taking advantage of that collimated beam by standing off a slight movement at a distance of about 12 feet equals a very large movement at a distance away. So now I can actually maximize the speed of throughput and really take advantage of the speed of the laser in that case.

(7:53) The issue there is if you're a laser safety officer or facilities manager, it is an infrared beam, so you can't see the beam, there's no guide laser you can see through space and it's very easy to have human interaction, which could cause some damage. When you deal with 5 kilowatts, 50 kilowatts, that's an awful lot of power, an awful lot of energy in, say, a one millimeter spot seven millimeter spot. So you've really got to worry about eye safety and physical contact in that case.

So as you can see in this room, we've got ceramic coated panels and there's actually a honeycomb structure, which helps to diffuse the beam for specular reflection off the surfaces. In addition to that we've got laser curtains around it and that's really just for again operator safety from the specular reflection. Even though it's considered one bounce, two bounces, there's still an awful lot of energy there and even with glasses you want to maximize the safety if you can.