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HIGHLY DYNAMIC FORM CUTTER HDFC$_{6060}$ FOR PROCESSING COMPLEX PARTS

THE TASK

At comparable power levels the new generation of highly brilliant solid-state lasers significantly improves cutting speeds in sheet metal applications compared to conventional CO_2 lasers. The utilization of these cutting speeds for higher productivities in industrial environments, however, requires extended dynamic limits of the associated machinery. In particular the high speed cutting of complex shapes with frequent directional changes leads to enormous requirements for the acceleration and jerking capabilities of the machine axes. Jerking refers to the change of acceleration with time and is therefore a significant parameter to increase the average processing time.

OUR SOLUTION

Currently there is a discrepancy between the technically possible, and practically achievable, contour cutting speed. Fraunhofer IWS engineers systematically analyzed cutting geometries and developed a quantitative measure to describe their complexity with respect to the laser cutting process. This measure is introduced as the "agility" of the geometry and captures the ratio of the directional change along the cutting edge to the cutting distance. Therefore the physical unit of the agility is degrees per millimeter.

A software package was developed to read NC codes of individual parts or entire cutting plans and determine the agility. The results make it possible to determine the optimal machine type for the NC program. It is also possible to relate the agility to an average cutting speed and thus estimate cutting and cycle times.

A highly dynamic form cutter HDFC$_{6060}$ was developed based on an entirely new concept to combine motions and beam guiding. This machine expands the traditional limitations of machine dynamics. A parallel kinematic axes structure reduces moving mass requirements and increases the three-dimensional dynamics of the system.

The HDFC$_{6060}$ was developed in cooperation with Held Systems and represents by itself a fully functional guiding machine. The integrated z-axis combination with a capacitive distance sensor is key for reliable process control in particular at high speeds. The consequent use of standard interfaces ensures the trouble free integration of HDFC systems into existing machine control systems.

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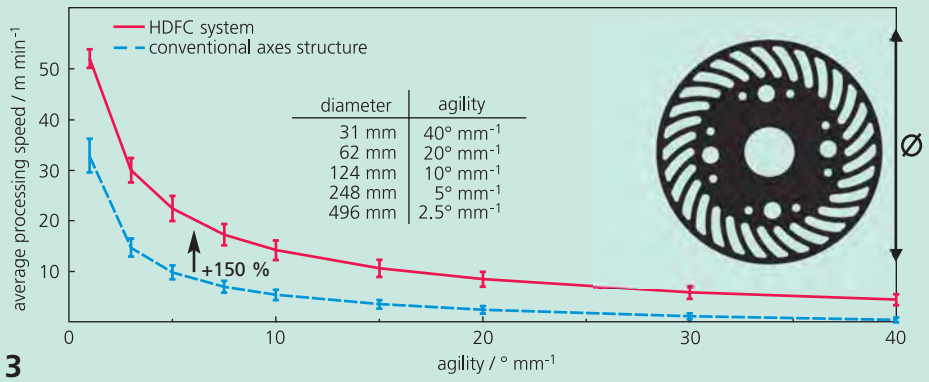
RESULTS

The main application field is highly productive cutting of complex workpiece shapes in high volume production. Sheet material rolling off a coil can be stepwise followed or processed on the fly. Productivity increases in the industrial environment is given by reduced cycle times and lower machine costs. Fig. 2 shows a workpiece (agility of 35° / mm) that can be fabricated in less than 16 seconds using the HDFC system. A conventional axes structure would require at least twice the time. There are additional advantages of the system including its compact form factor, flexibility and high level of integration capability. The use of highly brilliant beam sources and high value optical components leads to laser spot sizes of 15 µm, which can precisely process geometry details of 30 µm.

Correlation of agility and average processing speed



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1 *Process photo*
2 *Geometry generated using HDFC$_{6060}$*

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