Fraunhofer IWS Dresden

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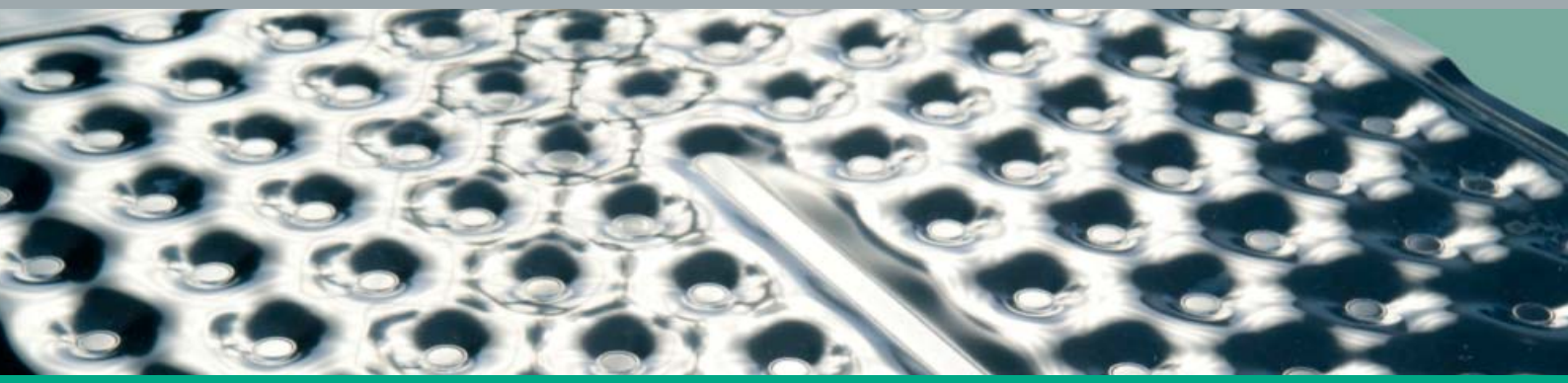

SUPERPOSED AXES SYSTEMS

System and control technology for highly dynamic laser material processing

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Task

Modern laser sources have considerably raised the limits of the process speed dependent on material strength and performance. In particular, the use of the most up-to-date solid state lasers (disc lasers, fiber lasers) make it possible to achieve considerably higher processing speeds at the same laser performance in comparison to traditional beam sources. The main reasons for this are to be found in the superior beam quality as well as in the higher absorption of this wavelength in metals. This gain can be used either for the reduction of laser power or for an increase in the productivity of the machine. However, an increase in productivity is possible only if the dynamic limits of the movement machines are also raised.

Solution

Solutions were developed for these purposes at the Fraunhofer IWS Dresden, in order to actively couple highly dynamic axes systems such as
- beam deflection optics lasertronic® SAO and
- form cutters HDFC

with conventional kinematics.
In this way, the acceleration capacity of the additional axes system is transferred to the whole working area of the laser machine. Technology-adapted path planning tools allow process time and energy optimization processing.

The interaction of process-specific system technology and technology development forms the basis for successful transfer into production.

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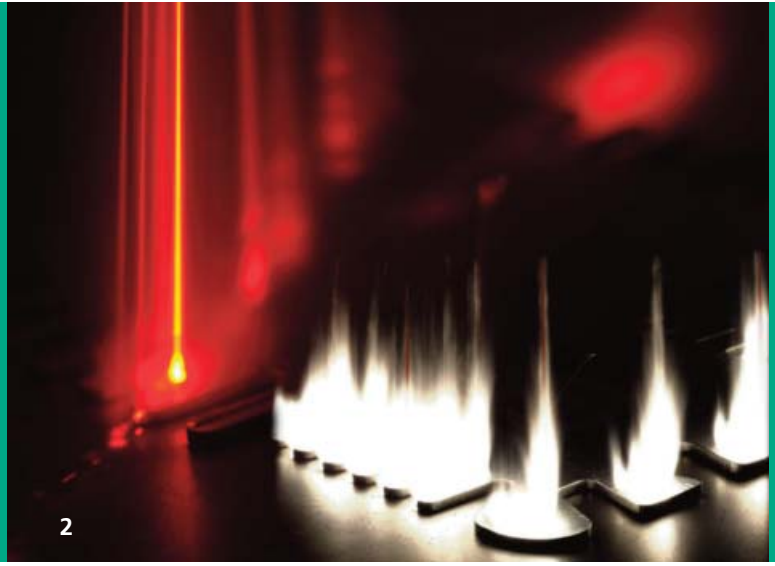
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Additional axes systems

The highest dynamics for laser beam movement are attained using galvanometer scanners and linear direct drives. Direct drives affect compact parallel kinematic axes structures to move the laser beam and cutting gas feed within fields < 100 mm. Small moved masses permit an increase in acceleration which is up to 10 times greater in comparison with conventional axes. The appropriate form cutters attain the technical boundary speeds even in the case of complex small geometries.

Even greater processing and positioning speeds can be realized using galvanometer scanners. In this way, for example, spot speeds of up to 250 m s^{-1} were realized for heat treatment processes. According to the optics design, the working fields can cover from 50 x 50 mm^2 up to 2 x 2 m^2.

The dynamic beam forming for the process-specific adaptation of the intensity distribution can occur e. g. for laser welding with frequencies up to 5 kHz.

Axes system coupling

By means of the coupling of additional axes systems with conventional laser processing machines, the technological possibilities of brilliant beam sources can be exploited. The combination is here carried out

- fixed (pursuing operation),
- »on the fly« (sequential operation) or
- active (simultaneous operation)

according to the specific application. Implementation of the coupling can be carried out as master-slave principle, integration into standard control mechanisms or as complete control unit.

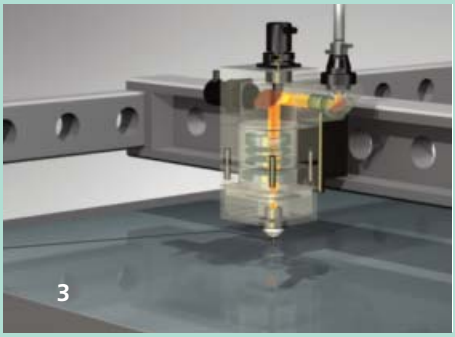
Path planning tools

Various path planning tools are available at the Fraunhofer IWS for axes coupling mechanisms:

- technology modules and postprocessors for CAD/CAM software
- offline movement planning for »on the fly« processes
- online path planning algorithms for superposed axes structures in the control core

The technological data (process parameters, operating types, processing strategies) are integrated on the basis of CAD data. Depending on the model of the complete system, which takes into account the dynamics of the individual axes, movement partitioning subsequently takes place. This is stored in data files (offline) or transferred directly to the machine control (online). In addition, simulation of movement processes and calculation of operating times are possible on the basis of the above-mentioned boundary conditions.

1 Beam deflection optics lasertronic® SAO
2 Laser beam remote welding
3 Active axes system coupling
4 »On the fly« processing
5 Online path planning tool RED_{Cut}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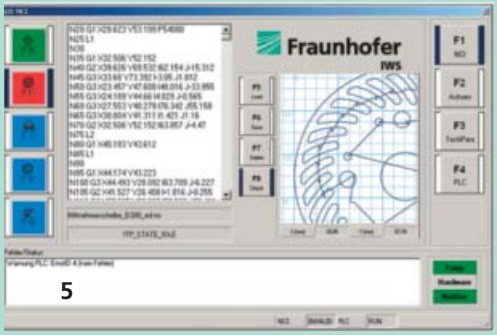

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