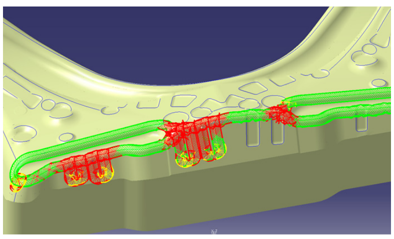
LASER HARDENING OF TOOLS

Laser hardening is a means of increasing the service life of molding and cutting tools. The fine-tuned programming solution FASTTRIM makes laser hardening the right choice for many industrial applications.

When processing convex radii and edges, punching and blanking die tools are subject to particularly high wear and abrasion. Laser hardening is a means of increasing the service life of these and other tools. Some time ago, the toolmaking division of the BMW plant in Dingolfing acquired a 6-axis machine equipped with a series of processing heads for treating tool surfaces. The laser hardening technology is contained within a 6-axis portal device operated via a special control system. To treat the tools, the laser beam is fanned out into a rectangular form; the orientation of this rectangular laser beam along the machining contours is controlled via the 6th axis.

At the time, no fully automated offline programming solution was available for the laser hardening process. But BMW was already aware of CENIT's existing solution FASTTRIM, as well as CENIT's associated know-how in the field of CAA and 6-axis programming and its experience in developing sophisticated software. All these factors convinced BMW to assign CENIT AG with developing the required system. The goal was to develop an intuitive, highly automated offline programming solution for laser hardening of tools.



Visualisierung: Mehrfach überfahrende Bereiche

First off, the project team meticulously took stock of BMW's requirements and held detailed discussions with the machine manufacturer. A line of approach was then developed in close coordination with the tooling department of BMW's Dingolfing plant. Since a high-performance offline programming system (OLP) was already available in FASTTRIM, the project participants decided to build on the standard functionalities of this system. Using V5-based geometries, even the standard version of FASTTRIM can work very comfortably and quickly on surfaces, curves and points.

The machine was integrated into the CATIA V5-based OLP system via a Process Implementation Kit (PIK). The PIK contains a kinematic machine model, the postprocessor and controller emulator, as well as process-specific customizations of the user interface. A VisualBasic link to the Microsoft Access process database was implemented to ensure optimal technological realization.

Near-surface tool hardening is achieved by guiding a prismatic laser beam along the sections that require hardening. To exploit the full potential of laser beam hardening, the following considerations must be observed:

- The rectangular focus must be aligned along the contour.
- Sections must not be treated repeatedly because repeat hardening has an annealing effect.
- For the same reason, the laser beam must not linger on the hardening sections.

The contour selection function was expanded to include the so-called feature technology. The tool paths for the laser hardening process are created on the basis of geometric and technology parameters. For radial sections, for example, such technology parameters include the area exposed to the laser, the clearance distance between adjacent sweeps, information on recognition of radial surfaces, focusing range, as well as look-ahead definitions.

In accordance with these parameters, the system automatically generates guide curves along the constant and variable radii. Where the laser exposure field cannot cover the entire width of the radius, one or more additional paths are generated to cover any adjacent areas. Manual corrections are only required when dealing

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with complex "case corners" and surfaces outside tolerance limits. But since the OPL system offers a wide range of interactive management tools, this in no way interferes with efficient programming.

The hardening of cutter edges is a further contour type within FASTTRIM and is likewise handled via the feature technology. For this contour type, additional parameters such as the lateral dimensions of the treatment area must be set. As soon as the cutter edge that will be subjected to laser treatment has been selected, the sweep curve – a specially corrected program tool path – can be generated.

It should also be mentioned that all these operations, while created fully automatically, can of course be edited as comfortably as with the standard version of FASTTRIM. Geometries can be deleted or modified; starting and end points can be selected freely along the sweep curve and are freely configurable with respect to approach and disengagement movements of the processing heads. At any time, the user can additionally control the NC output by distributing events along the tool path.

Path sections that have been laser-treated repeatedly and/or sections that need to be corrected are highlighted in red by the simulation. This supports the user in making path corrections, which prevents unwanted annealing of the hardened areas and thus increases process security. Further safeguards come from the highly realistic movement simulation, based on the CENIT Controller Emulator (CCE) for a customer-specific customization of the Siemens 840D 6-axis control unit. This offers clear advantages when making collision analyses for the processing head and the laser beam.

Another important add-on is the look-ahead function for presetting the axes to tight and/or concave contour geometries, so as to achieve minimal offset movements. This gives the axes more time for reorientation and thus avoids or minimizes any drop in feed rates. Additionally, the system conducts a Z-directional angle adjustment whenever it recognizes a collision threat.

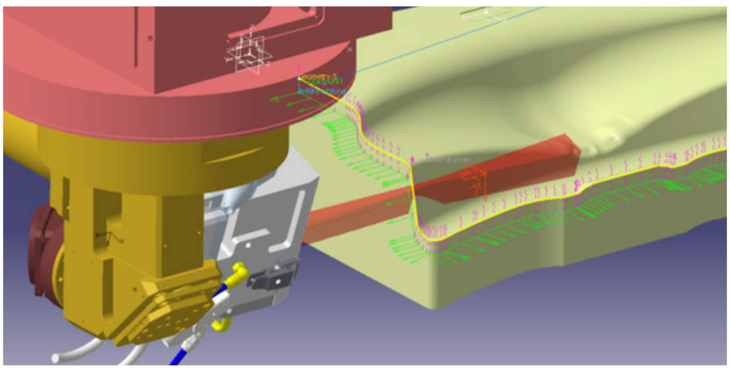
The progress of the project and the fulfillment of all targets were exhaustively approval-tested during the project and again at its conclusion. A total of eight defined milestones had to be attained, leading to a fully automated laser hardening solution that boasts the following benefits:

- High degree of automation in offline programming of laser hardening
- Reduced need for modeling thanks to radius recognition and generation of guide curves
- Efficient programming thanks to automated tool path generation
- Tool protection thanks to simulation-based overlap recognition
- Machine simulation to prevent tool collisions
- Integrated look-ahead function to reduce accelerations of and stress on mechanical components and drive trains

► PROFILE CENIT AG

CENIT AG has been a consultancy and software specialist for the optimization of business processes in Product Lifecycle Management, Enterprise Information Management, Application Management Services and Business Optimization & Analytics since 1988. CENIT currently has over 720 employees world-wide and its customers include Allianz, BMW, Daimler, EADS Airbus, LBS, Metro, AXA and VW. A large number of customers are medium-sized enterprises, particularly in the financial services, automotive and mechanical engineering sectors, such as Dürr, ISE and Emil Bucher.

CENIT is headquartered in Germany (Stuttgart), where it is present in all the major cities. It also has a branch near Detroit to cater for the American market. CENIT is also represented in Switzerland and since 2006 in Romania. With the foundation of another subsidiary in Toulouse CENIT stresses its reputation in the aerospace industry. The internationality of CENIT's business gains more importance with a further consistent expansion of these subsidiaries..



Zu härtende Bereiche: Radien- und Schneidkanten

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