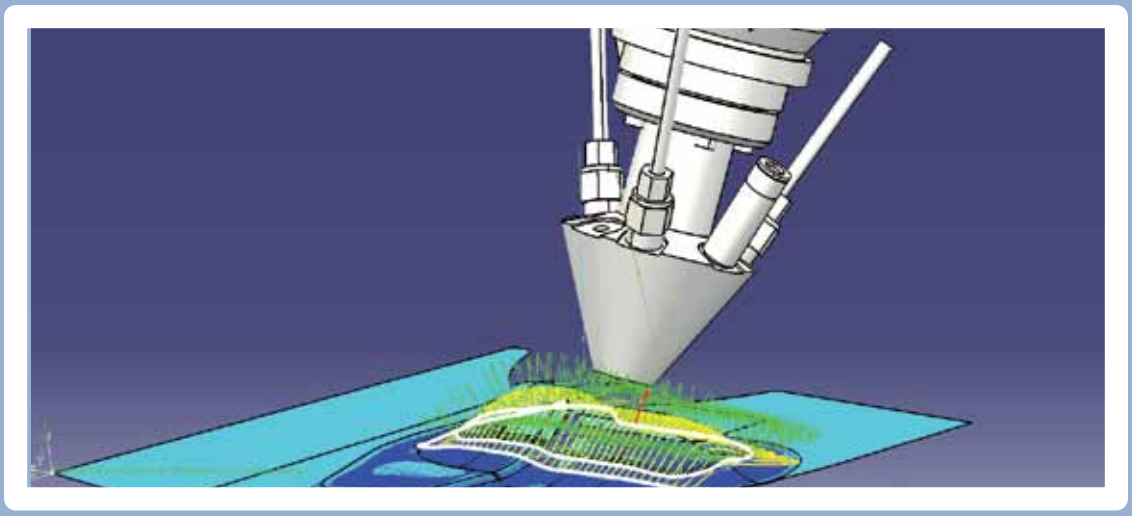


OFFLINE PROGRAMMING FOR LASER DEPOSIT WELDING ON TOOLS

CENIT AG has developed a groundbreaking offline programming solution for laser cladding. Featuring an extremely high level of automation, the solution is based on the tried and proven programming system FASTTRIM, a component of CENIT's FASTSUITE.

When a tool shows signs of localized wear, it doesn't always mean that it has to be replaced. By means of laser cladding, flaws such as cavities that have been created by tool wear can be filled layer by layer and then milled to specification. But laser deposit welding isn't just a solution for remedying the effects of tool wear and manufacturing errors: it's also suitable for applying anti-wear and anti-corrosion layers and provides a means for responding flexibly to shape or contour changes.

During the laser cladding process, a filler material is usually applied in powdered form via a feeder device. The filler, the base material and the laser come into contact on the tool surface; the laser beam fuses the base with the filler. The action of the processing unit, composed of the laser beamer and the feeder device, generates a caterpillar-shaped deposit layer. During the process, a diffusion zone develops at the transition between the base material and the filler, ensuring a firm, long-lasting bond. Using the appropriate application strategy, single or multi-layer deposits can thus be applied to locally defined sections.

The state of the art shows that laser cladding achieves best results when the application surface is divided into subsections, called cladding cells. Within these cells, the filler is applied in varying directions so as to minimize cooling of the welding agent. Subsequent weld tracks must be oriented at an adjustable angle (0° or 90°) to the subjacent track. When dealing with small welding areas, curve-parallel application is sufficient.

The height of the cladding layer is determined by calculating the difference between the actual value and the target value. Geometry data is available for both: the actual value is usually derived from scan data, the target value from a 3D CAD model. The target contour defines the limit up to which the filler will be applied. An additional machining allowance can be set to compensate for subsequent machining. The distance between the laser head and the tool surface is also adjustable.

In the toolmaking project for BMW's Dingolfing plant, the technology was realized by way of a 6-axis portal with 3 rotating axes within the processing head. The orientation of the application unit is controlled via the 6th axis. A special kinematic feature is that two axes are mounted eccentrically. The 6-axis portal is equipped with a customized Siemens 840D control unit.

„For us, CENIT's FASTTRIM-based solution opened the door to laser cladding. Without this system, we couldn't have realized the process efficiently."

Herr Ambros
Head of Mechanical Manufacturing

Technology arguments speak unequivocally in favor of laser cladding. Thus far, the only thing preventing the breakthrough and acceptance of the technology was the lack of a suitable offline programming system. The problem has been that additive deposition of layers on 3D surfaces differs radically from subtractive volume processing, e.g. milling, and is a great deal more complex. New approaches and algorithms had to be developed, e.g. for managing offset calculations and the cells derived from them. In terms of economy, a purely manual approach to generating machining paths is viable only for very simple application work.

Offline-Programmierung für das Laserauftragsschweissen von Werkzeugen

For more complex tasks, the level of programming effort quickly becomes unmanageable.

At the project's inception, no fully automated offline programming solution for laser deposit welding was available. What did exist was the extremely high-performing solution FASTTRIM and CENIT's associated know-how in CAA and 6-axis programming, as well as in developing sophisticated industrial software. These strengths convinced BMW to assign CENIT AG with developing the system they were after: an expansion of FASTTRIM for laser claddingof molding tools. The basic software already permits highly comfortable and rapid work on surfaces, curves and points of V5-based component geometries. The idea was to use virtual machine integration to let the customer reap the full benefits of laser deposit welding. Special software supplements, such as automated generation of tool paths for likewise automatically generated offset surfaces, were to be developed to radically accelerate the programming of layer application.

The machine is integrated into the FASTTRIM system by means of a Process Implementation Kit (PIK). The PIK encompasses a kinematic machine model, the postprocessor and the controller emulator, as well as various process-specific customizations of the user interface. To ensure optimal realization, CENIT also implemented Visual Basic connectivity with a Microsoft Access process database.

Contour selection was expanded by way of special ,,feature technology''. Based on geometric and technological parameters, the system creates tool paths for the entire deposit welding process. The feature-based contour programming is integrated into FASTTRIM as a ,,new contour type''.

Programming begins as soon as the current and target geometries become available to the system. The approach is heavily oriented on the tried and proven FASTTRIM procedure, i.e. instead of running contour searches, the contours for laser cladding are selected as a new contour type. Within this selection mode, the user more closely specifies the application task, i.e. setting actual and target surfaces, defining limit curves, defining guiding curves for defining the deposit cells within a layer, as well as – where required – placing holes and islands.

Once geometric object allocation is complete, the user defines the cladding parameters. These technology settings include aspects such as total application height, layer thickness, weld increment to target geometry, or any machining allowance added to the current geometry. Additionally, the machining strategy for processing within a deposit cell, within a layer and the subsequent layers can be selected. In this way, processing within a cell can be specified as ,,zigzag'', the processing direction of neighboring cells as skewed by 90°, and the direction for neighboring offset surfaces likewise as skewed by 90°.

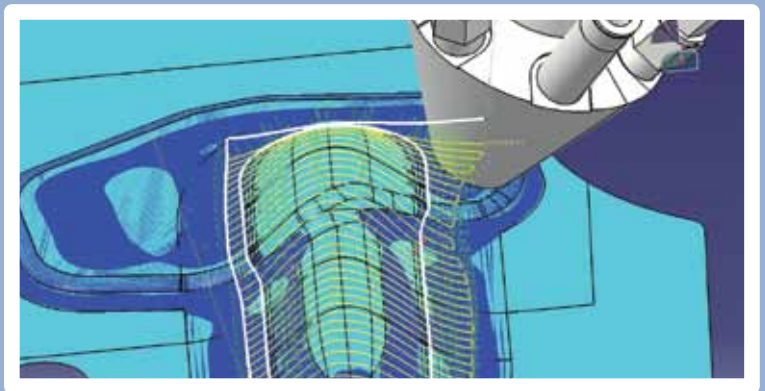
Following these definitions the tool paths are generated, layer by layer. Automatically, auxiliary lines are created and the first deposit cells of a layer are derived. When dealing with multi-layer deposits, offset surfaces are generated automatically as a basis for the next application layer. Thus the user doesn't have to bother with time-intensive offset surface generation. Contours are created for each layer, and from these the system develops tool paths including the relevant technology events as well as approach and departure paths. Path generation ends automatically when the parameters dictate that no further layer needs to be generated, i.e. when the filler level equals the target geometry. As FASTTRIM users have come to appreciate, the individual contours are subsequently available in list form for further processing.

Naturally, the machine operations - created fully automatically by the system - can be edited just as comfortably as with the standard software. The geometry can be deleted and modified; starting and end points can be selected freely along the path, and they can be freely designed with respect to approach and disengagement movements. To gain additional control over the NC output, events can be placed along the path at any time.

Following machine simulation of the deposit-welding process and detailed collision checks, the finished NC program can be output and uploaded to the machine.

The programming solution for laser deposit welding offers the following decisive benefits:

- A high degree of automation permits rapid, economical laser deposit welding
- Time efficiency
- Reduced effort for model generation Efficient programming thanks to automated tool path generation
- Investment protection thanks to machine simulation



KONTAKT
CENIT AG
Industriestraße 52-54
70565 Stuttgart
Tel.: +49 711 7825-30
Fax: +49 711 7825-4000
E-Mail: info@cenit.de
Web: www.cenit.de/plm