Software for Laser Material Processing

Software is an elementary component for the control and automation of processes based on digital models. Often very specific adaptions need to be made to fulfil process specific requirements. For this purpose, Fraunhofer ILT is developing software tools highly optimized for laser material processing. This includes processing of geometry data, calculation and creation of NC programs (CAM), and control of optical and mechanical systems.
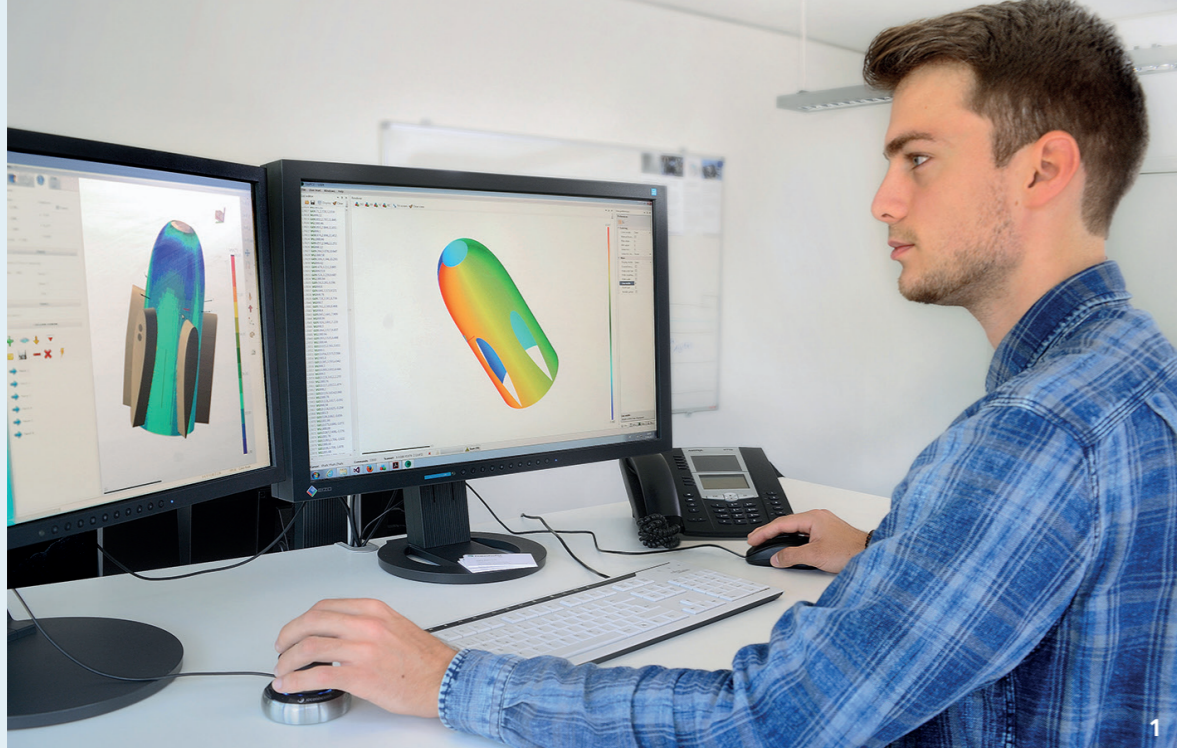
CAM for laser material processing

Computer Assisted Manufacturing (CAM) plays an important role in the process chain for laser material processing. Based on a digital model of the part a NC program is generated to control the mechanical and optical axes of the system.
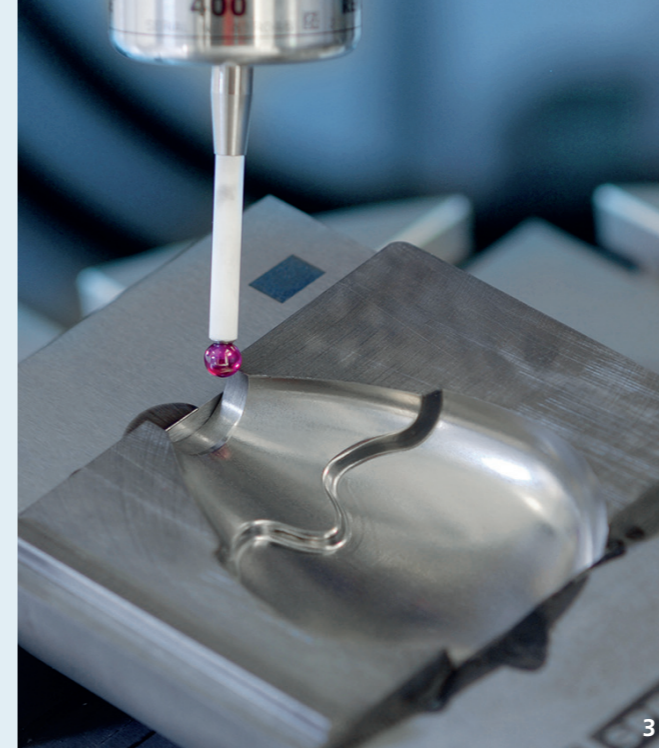
For the process of Laser Material Deposition (LMD) Fraunhofer ILT developed the software LMDCAM. This software is a powerful tool path planning tool for component repair and additive manufacturing. It is optimized to work with large data files (e. g. triangulated data acquired by a scanning device).

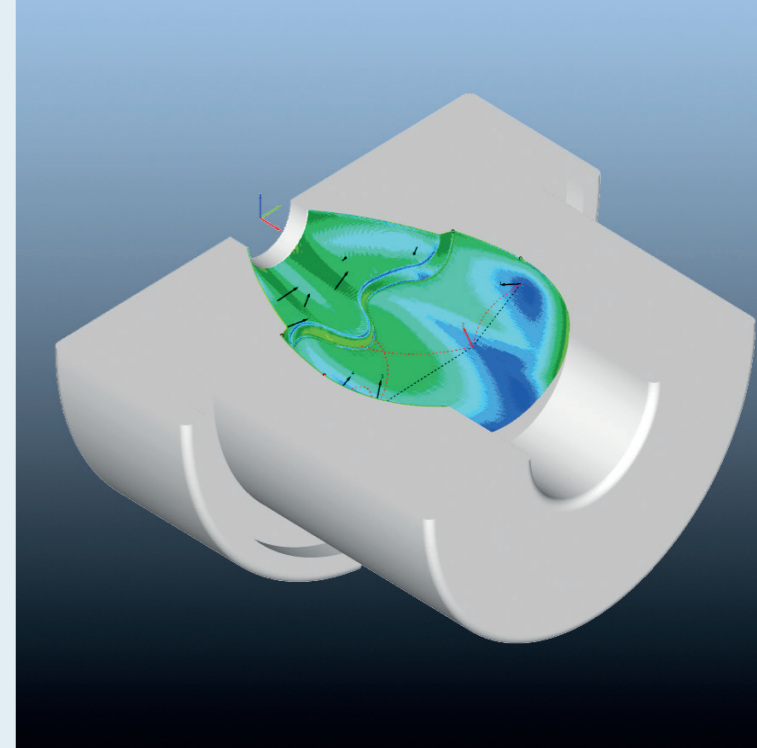*LMDCAM: CAM-Software for Laser Additive Manufacturing.*

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The user can interact extensively with the software (like CAD data, tool path, etc.) and thus solve complex and individual tasks. After tool path generation the computed machine movement can be validated against collisions or exceeded axis velocities. For this task the software includes a build-in machine simulation tool. A programmable post processor allows for easy export of the the tool paths as an NC program, which also supports multi-axes systems (e.g. robots).

For the process of laser micro structuring galvanometric laser scanners for laser beam deflection and short pulse laser sources are used. Compared to LMD laser micro structuring is a subtractive manufacturing process where the material is ablated locally. Fraunhofer ILT developed the software SliceGen specially adapted to the laser structuring process. A CAD model is filled layer by layer with tool paths. Each layer can be tiled to adapt to limitations of the working volume of the laser scanner. The tiles can be distributed randomly to avoid visible boundaries. The software is also able to generate tool paths for form correction based on measured data. For this application the tool paths for removing the surplus volume are calculated from current and desired topography.

For the process of laser polishing Fraunhofer ILT developed the software TP4 to convert an NC program generated by a conventional CAM software (for finishing milling) into tool paths suitable for laser polishing. Similar to laser structuring, this process also makes use of a laser scanner for fast laser spot positioning. Here the process movement is split into two parts: The fast movement is assigned to the laser scanner while the slow movement is assigned to the slower mechanical axis system (usually a 5-axis system). The software calculates the superposed movement and generates separate NC programs for the laser scanner and the mechanical axes. Machine programming in work piece coordinates is also supported through use of a measuring probe. Several process strategies are implemented in the software to ensure constant process conditions not only on flat but also on curved surfaces.

To fit the requirement for different applications the software can access a database with many process parameters for different materials, applications and kinematics.

Control of galvanometric laser scanners

For many laser-based processes it is advantageous to rapidly guide the laser beam focus over the surface with the use of galvanometric laser scanners with axes of very low inertia. For the control of these systems special controller systems with low cycle times are used. Many software solutions which are commercially available are often restricted for laser marking applications.

Therefore Fraunhofer ILT developed the flexible and process independent software solution LasPC for controlling laser scanners. The user can access a scripting module to extend the software for task-specific laser path generation. The resulting scanner movement is previewed in a 3D view. Different scanner parameters (like velocity or laser power) can be visualized color-coded. The software also contains a remote interface which allows to control the software over LAN. Thereby the software can be integrated in an existing environment (e. g. a CNC controller). The remote interface also allows for process parameterization.

Acquiring and processing of topographic data

Topographic data can be used for inspecting a surface for quality assurance or for obtaining different standardized surface parameters. It also can serve as a basis for local surface processing taking the actual surface topography into account.

Fraunhofer ILT developed a set of software tools for the acquisition, processing and analysis of topographic data. The data may originate from a white light interferometer or a confocal sensor. Based on these software tools individual tasks can be fulfilled. This comprises the automated measurement of multiple laser-processed surfaces or parts. The data is filtered and analysed for statistical surface characteristics (e. g. roughness or PSD spectrum).
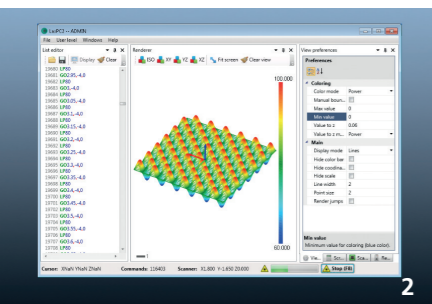
Range of services

- Development of CAM-NC data chains and algorithms for process optimized tool path calculation
- Development, integration, assembly and testing of control setups for laser material processing
- Development of HMI (human machine interfaces) for the control of laser machines and laser scanners

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Fraunhofer Institute
for Laser Technology ILT

The Fraunhofer Institute for Laser Technology ILT is one of the most important development and contract research institutes in laser development and application worldwide. Its activities encompass a wide range of areas such as developing new laser beam sources and components, laser-based metrology, testing technology and industrial laser processes. This includes laser cutting, ablation, drilling, welding and soldering as well as surface treatment, micro processing and additive manufacturing. Furthermore, Fraunhofer ILT develops photonic components and beam sources for quantum technology.

Overall, Fraunhofer ILT is active in the fields of laser plant technology, digitalization, process monitoring and control, simulation and modeling, AI in laser technology and in the entire system technology. We offer feasibility studies, process qualification and laser integration in customized manufacturing lines. The institute focuses on research and development for industrial and societal challenges in the areas of health, safety, communication, production, mobility, energy and environment. Fraunhofer ILT is integrated into the Fraunhofer Gesellschaft.