CAX-TECHNOLOGIES
INTEGRATED CAX PROCESS CHAINS FOR MANUFACTURING AND REPAIR

Manufacturing and repair in the mold and die making, turbomachinery and optics industries require a sequence of machining processes. Conventionally, the individual processes are carried out on isolated machining stations. Consequently, the manufacturing data is also generated in various forms and formats. This divergence in data makes production inefficient. The consequences are complex post-production or loss of production due to irreparable defects. In order to maximize the potential through the integration and automation of manufacturing systems, the “CAX-Technologies” department at the Fraunhofer IPT has developed an integrative process chain solution. The objective is to avoid information losses and defects in the process of data transfer. This is achieved by developing software solutions for manufacturing processes based on a consistent flow of data throughout the process chain.

Development of integrated CAX process chains

- Integrated computer-supported process chains for manufacturing and repairs, based on self-developed CAX solutions
- Realization of individual stages within manufacturing and repair process chains through application-specific software modules
- Consistent data flow within process chains through the integrative software environment of the “CAX-Framework”

Process chains with comprehensive CAX functionalities

- Software modules for manufacturing planning with simulation support
- Simulation modules for machine tools, robots and coordinate measuring machines with regard to individual features of the machine equipment and CNC controller
- Technology databases of process parameters, strategies and machine features

Our Services

- The “CAX-Technologies” department develops and optimizes CAX process chains for mold and die making, the energy sector and aerospace as well as optics applications.
- We provide customized solutions to extend and optimize individual processes as well as entire process chains.
- In cooperation with our development partners ModuleWorks GmbH and Aixpath GmbH, we offer comprehensive software products and their integration into widely-used CAX systems.
SPECIALIZED CAX MODULES

Our department provides simulation-supported CAM modules for integrated manufacturing and repair process chains that are specialized in machine- and robot-based processes. Following the modular design principle of software development, CAX modules are flexible to be combined to establish integrated process chains. In addition to providing standard CAM modules for milling, grinding, polishing, laser ablation, laser material deposition and geometric data acquisition, we also undertake customer-specific developments to meet the requirements and demands of their new processes.

Development of specialized CAX modules

- Realization of challenging machining processes and complex process chains in accordance with customer-specific requirements
- Simulation-supported toolpath planning for optimum process conditions and collision-free tool movements
- Utilization of simulation-verified results for optimizing and integrating CAM strategies into the process chain

Customized CAX modules

- Geometric data acquisition through the multi-axis movement of optic sensors in coordinate measuring machines and in CNC machines
- Automated analysis and processing of measured data for subsequent applications
- CAM multi-axis milling strategies for the manufacture of innovative component designs and for performing complex repairs
- Robot- and machine-based grinding
- Polishing of complex free-formed surfaces
- Laser material deposition for repair and additive manufacturing
- Laser hardening, alloying and welding
- Laser ablation of decorative and functional surfaces

Our services

- We develop customized software modules for special process requirements.
- We implement your existing and new machining processes into CAM strategies.
- We provide specialized software solutions integrated into the unified software environment of the “CAx-Framework”
- The developed CAM modules are available as autonomous stand-alone applications and can also be integrated as add-on modules into widely-used CAx systems such as Siemens PLM Software NX.
- The consistent data concept is reflected in the user-friendly graphical interface of our software modules.
"CAX-FRAMEWORK" FOR THE INTEGRATION OF CAX MODULES

The "CAX-Framework" serves as an integrated software environment that simplifies the development, implementation and integration of specialized software modules. This flexible platform provides generic methods and algorithms for toolpath planning with simplified process parameter definition. Moreover, the framework ensures a consistent data transfer between the processes and enables a close interaction between the user and the software.

Integrated software environment

- "CAX-Framework" serves as a backbone for the integration and collaboration of the software modules within a process chain in a consistent way — eliminating system boundaries.
- Reliable CAM planning with ad-hoc system feedback to the user driven by its process and technology databases
- Access to technology databases with relevant process and machine information
- Use of simulation tools for verification of CAM strategies
- Intuitive graphical user interface supporting the user to select process strategies and their parameters through interactive guidance during the input procedure

Our services

- "CAX-Framework" connects specialized CAX modules and ensures a consistent data flow in customer-specific process chains.
- Our software platform is related to process and technology databases that can easily be updated and extended due to their XML-based representation.
- "CAX-Framework" provides consistent interfaces to simplify the integration into widely-used CAD/CAM systems.
- The machining data is generated in standardized intermediate NC formats which can be easily converted into other NC formats using the integrated postprocessor interface.

Benefits of "CAX-Framework" for development

- Flexible software environment for developing specialized CAM modules
- Development of new CAM strategies and their verification in machine and process simulation tools
- Simulation modules for any kind of CNC machine, robot or coordinate measuring system
"NCProfiler" – Analysis and Optimization of NC Data

The "NCProfiler" software developed at Fraunhofer IPT enables the analysis of NC data, identifies the critical areas of the toolpaths and performs the required optimization, taking account of the CNC systems' dynamic properties. Any problems and flaws in the CAx chain such as discontinuities in the surface transitions of the CAD geometries, incorrect orientation of the tools on linearly-interpolated toolpaths and erroneous data transmitted by the NC postprocessor, can be quickly revealed and addressed.

"NCProfiler" at a glance

- Generation of machining data in all established NC formats, e.g., Heidenhain iTNC, Sinumerik 840D, ISO-NC, NX CLS format, CATIA APT and in many other dialects
- Filtering defective toolpath sections
- Optimization of NC data with regard to the dynamic features of individual machine tools
- Identification of optimal process conditions and collision-free tool movement on the workpiece
- Prevention of unpredictable controller behavior in critical process areas by NC code adjustment

Analysis and optimization of NC data with "NCProfiler"

- Utilization of the maximum dynamic potentials of machines, and machine-specific optimization of the NC programs
- Optimized toolpaths through innovative interpolation methods adapted to the individual machine tool dynamics
- Improved surface quality and shape accuracy in reduced production times
- Higher milling process stability and significantly less post-production
- High quality machining through feedrate-adaptive spindle speed
- Broad postprocessor functionality for different machine tool types

Our services

- We design, analyze and optimize the entire process chains of our customers taking into account individual machine tools and CNC controllers.
- Programming as well as visualization, simulation and optimization of NC data are part of our expertise.
- We investigate and analyze CAx chains to provide technology advice to our customers.

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