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New machining technologies for highest quality

Advanced VAM | deterministic MHP

The need for improved product quality and the call for more efficient production and cost reduction make it necessary for companies to improve manufacturing processes and procedures. In some industries, like aerospace industry, quality and safety aspects are of particular relevance. Innovative manufacturing technologies are a key issue and innovations lead to significant improvements.

The Institute of Production Engineering and Photonic Technologies (IFT) of TU Wien pursues two innovative approaches which lead to considerable quality improvements for products for the aerospace industry. This includes vibration-assisted machining of FRP and stack materials as well as vibration based machining to influence the surface integrity of metals.

Advanced vibration-assisted machining – VAM

VAM enables mechanical finishing of FRP and FRP-stack materials without the post-processing that is required to date. The intermittent cutting action improves chip breaking, facilitates chip removal and increases tool life. Quality and productivity are improved significantly.

Current systems for vibration-assisted machining in most cases work in the high-frequency range of several kilohertz with vibration amplitudes of only a few micrometers.

Innovations of TU Wien

IFT developed a vibrating spindle with a hydraulic actuator for the z-axis and piezoelectric actuators for the x- and y-axis. The high-performance spindle is driven by a synchronous motor with a nominal power of approximately 7 kW at a nominal speed of around 10,000 rpm, whereby the maximum speed is 30,000 rpm.



Vibrating spindle with hydraulic actuator

Low-frequency oscillations with amplitudes of about 100 to 400 μm may be realized along the z-axis.

Research at the IFT of TU Wien was able to demonstrate that in a frequency range below 200 Hz with amplitudes of up to 0.2 mm considerable improvements of tool life and chip breaking are possible compared to conventional methods.

Advantages of VAM

- improved chip breaking
- optimized chip removal
- reduced cutting forces
- longer tool life
- improved quality of the finished workpiece reduced fraying, delamination, chipping at tool exit
- particularly efficient for processing CFRP materials and stack-material

youtube.com/watch?v=touiUVXiWjk



Surface functionalization by deterministic machine hammer peening

The functional performance of a component is to a great extent determined by the properties of its surface and the near-surface boundary layer. By means of targeted technological manipulation of these properties, wear, friction, chemical resistance as well as static and dynamic strength may be optimized significantly.

In mechanical surface hammering or machine hammer peening, MHP, a tool with usually a spherical carbide metal tip is set into an oscillating motion of up to 500 Hz by an actuator system. The actuator is clamped into a machine tool or onto a robot and then guided over the workpiece surface under CNC control. The actual treatment of the surface is performed by individual, precisely defined strokes of the tool tip arranged consecutively along a path.

Innovations of TU Wien

The new actuator system, developed at the IFT, is the first one to allow for control and monitoring of the entire mechanical surface treatment process. Due to the highly dynamic short-stroke linear reluctance motor each single movement of the hammer can be accurately set and controlled. The process can be precisely adapted to the geometry of the workpiece, very important for edges for example. It also enables crafting of freely programmable structures.

Acceleration values of available systems are exceeded by a factor of ten and more. Resulting material properties can be controlled with industry standard measuring equipment which also allows the detection of material inhomogeneities during the process of machining. Furthermore it is possible to variably define the impression depth in order to create 3-dimensional structuring patterns. This can be used to attach in microstructural dimension a certain piece of information - similar to a 3D QR code - to the component , e.g. for workpiece marking.

Your benefits

- specific manipulation of structure (roughness, smoothness, microgeometry) and hardness as well as the magnetic, thermal, electrical, and chemical properties of technical surfaces
- reduction of flow resistances
- replacement of manual polishing processes





Microstructure

Surface structuring



Surface alloying

Surface smoothing

- substitution of thermal hardening processes
- synchronous monitoring of material characterization and detection of material inhomogeneities during the process of machining
- invisible 3-dimensional coding option for components
- optimized processing time due to a high frequency range
- due to an automated machining process, integration into existing process chains – without reclamping the workpiece
- works in all common machining centers and on industrial robots
- protection against unwanted kickback forces on machine components

The IFT of TU Wien has more than 40 years of experience with innovations in the field of material machining and machine tools. The IFT offers you:

- access to a diverse network of experienced tool and machine manufacturers
- reliable and efficient cooperation
- rapid implementation of production innovations for the quality improvement of your product

Contact

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