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Design for Manufacturing using TebisCAM for EDM Processing

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ABSTRACT

Using computer software to manufacture products is commonly referred to as computer aided manufacturing (CAM). CAM software generates toolpaths from a design model in order to give the computer guided machine instructions on how to process the material into a finished product. In this paper we discus design approaches and the optimization of the design process using TebisCAM in EDM processing. The EDM process efficiency and reliability are improved through advanced control techniques and the use of new materials.

Key words: design for manufacturing (DfM), computer-aided manufacturing (CAM), TebisCAM, electrical discharge machining (EDM).

1. INTRODUCTION

Computer integrated manufacturing (CIM) is a philosophy of company management which rests on computer based support, and it consolidates technology, equipment, organization units and information resources of production organization. A derived module of CIM is CAM [1].
CAM is the application of computer in managing, guiding and performing manufacturing operations and managing equipment in a manufacturing facility. CAM implies production subsystems of automated factories, whose development started with NC and CNC controlling, and their basis are: Agile Manufacturing System (AMS), Flexible Manufacturing System (FMS), Holonic Manufacturing System (HMS), Intelligent Manufacturing System (IMS), Reconfigurable Manufacturing System (RMS) and etc. [2].
Application of CAM dates back to 1960 with first applications starting in early 1970s [3]. Over the years the concept and optimization of processes vastly improved with the advancement of computing power and new implementation scenarios [4,6]. Different technologies and approaches were described and used by several researchers: laser machining [7,8], ultraprecision micromilling [9], waferless repositioning [10], approach of control machining process reuse [11], reconfigurable manufacturing systems [12], 3D shape searching [13], estimation of 3D shapes [14], EDM processing [15,16] and rough machining-by-region [17].

2. TEBISCAM

TebisCAM software was first released by Tebis GmbH in Moosach near Munich in 1986 by its founders Bernhard Rindfleisch and Jens Hagen. The software is available on Web site: http://www.tebis.com/. Their vision was to create a computer supported NC technology for small and medium sized enterprises (SMEs). Software quickly revolutionized the machining industry with introducing the possibility to mill across any number of surfaces in 1990 with its 2.1 version of software. Today TebisCAM covers the entire process of modelling and machining including [18]:

- **2.5D Drilling and Milling**

Typical application areas for this TebisCAM module in die manufacturing include planar surfaces, seating surfaces, and fit and tapped holes for attaching trim steels to sheet metal dies. Mold manufacturers use the module for machining all kinds of pocket and planar surfaces as well as holes, such as step or deep-drilled holes for cooling and heating systems. Industrial and aerospace engineering are also typical application fields.

- **3+2 Axis roughing**

Tebis roughing includes expelling stock from a user characterized clear plane via plane from start to finish, in this way drawing nearer the craved target geometry in a terraced representation. The virtual following capacity gives us a chance to see, as right on time as the project estimation stage, precisely what the part will look like on the genuine machine.

- **3+2 Axis finishing**

Tebis supports every single cutter type, from scriber, ball-end and torus cutters to end plants. Different processing systems are accessible for each machining capacity. Tebis figures the toolpaths either naturally or with intuitive intercession. The framework consequently decides the cutting

zone points of confinement and partitions the segment as indicated by topological criteria. The outcome is an impact checked NC program that meets the strictest quality gauges. Exceptional HSC parameters are accessible for ascertaining NC programs that are utilized as a part of fast processing applications.

- **3+2 Axis residual stock removal**

The blend of vast processing apparatuses and high cutting limit, trailed by little cutters for remachining, is the best approach to plant surfaces. The Tebis 3+2 Axis lingering stock expulsion module finds the ranges to be remachined and consequently computes the fundamental toolpaths.

- **3+2 Axis tube milling**

Tebis v3.3 was the first version to support the Tube Milling CAM module for processing bowed admission and release conduits. The key component of this module is that it produces 3-hub roughing and completing ways for key and ball-end cutters. The uncommon geometry of these cutters empowers complete preparing of curved tubes.

- **5-Axis simultaneous milling**

The Tebis 5-Axis simultaneous Milling module allows users machine certain surface and curve steps faster and more accurately than with the 3-axis technology. 5-axis NC programs are no more difficult to calculate than those in the 3+2-axis modules, since they implement the same user structures. In milling surfaces, this module is a good choice for both convex components and cavities. The collision check takes into account the holder components defined in the tool library.

- **5-Axis laser cutting**

This CAM module is utilized to produce 2 to 5-pivot NC programs disconnected for laser cutting applications. Utilizing this product, you can trim auto body sheet metal parts for models and arrangement. Die producers use Tebis laser slicing stations to test attracting operations the experiment with eliminate to discover how to make up for the spring back conduct of the trimmed sheet metal parts.

- **5-Axis trimming**

With the Tebis CAM module for 5-Axis Trimming, you can make 3-to 5-hub NC programs for trimming in disconnected mode. In doing so, you will move the instruct in procedure for your trimming ventures from the machine to the virtual universe of the CAD/CAM situate therefore lessening expenses and downtime. The programming projects' application zones territory from trimming vacuum shaped plastic parts to machining carbon and glass fiber-strengthened plastic parts and the utilization of robots for serial generation. Tebis underpins the machines of all the famous producers.

- **4-Axis wire EDM**

The CAM software for programming 2-axis and 4-axis wire EDM machines is an effective innovation bundle that spends significant time in the assembling necessities found in die and mold fabricating. Since the application is incorporated into Tebis, wire EDM projects can be computed and yield straightforwardly without additional interface runs. The intelligent UI lets even less experienced clients rapidly and adequately make ideal NC programs. The choice of having the capacity to access whenever a complete CAD framework with basic configuration and examination alternatives has turned out to be an extensive preferred standpoint, all through the whole programming process.

- **NC interface**

Toolpaths that are ascertained in Tebis are yield to a machine and controller-particular arrangement by means of the NC interface (PUT NC). CAM stations and additionally NC viewer and test system stations accompany NC interfaces as standard gear. NC software engineers or machine administrators either characterize the machine particular processor or they first fare the NC program in an unbiased organization in which case it can be changed over into an exceptional controller group on a Tebis DNC station amid ensuing transmission.

3. EXAMPLES OF DESIGN FOR MANUFACTURING USING TEBISCAM

Design for Manufacturing (DFM) and design for assembly (DFA) are the integration of product design and process arranging into one regular action. The objective is to design a product that is effectively and monetarily made. The significance of designing for manufacturing is underlined by manufacturing expenses of a product (expense of materials, handling, and assembly) controlled by design choices, with production choices (for example, process arranging or machine device determination).

The basis of any design for manufacturing system is gathering of design standards or rules that are organized to help the designer decrease the expense and trouble of manufacturing a thing. There are ten DFM design principles:

1. Reduce the total number of parts
2. Develop a modular design
3. Use of standard components
4. Design parts to be multi-functional
5. Design parts for multi-use
6. Design for ease of fabrication
7. Avoid separate fasteners
8. Minimize assembly directions
9. Maximize compliance
10. Minimize handling

Wire EDM machines use a wire (electrode) to cut a desired shape (programmed) into a metal piece. Outstanding accuracy is obtained using wire EDM machines in cutting dies or punches and can be obtained only by fits of very precise cutting. Cutting is done in part, being necessary to the practice of starting holes (for threading) or leaving an edge.
In Figure 1 and 2 project models done at Technical University of Cluj-Napoca as a part of design improvement studies are

given.

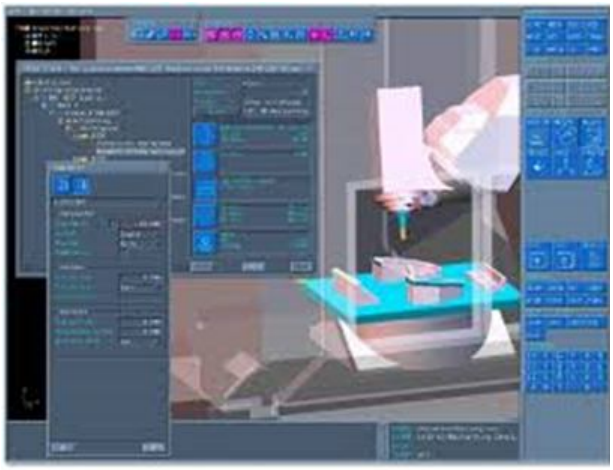

Figure 1: Moulds processed by EDM using the software TebisCAM

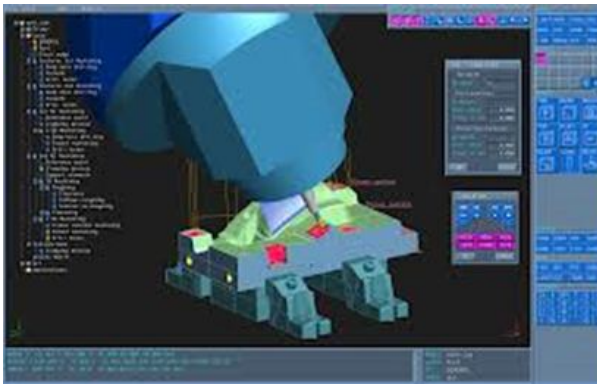

Figure 2: Using the software TebisCAM for 3d processing by EDM

Stainless steel 3-sided worktable and brushed stainless work tank for long endurance and least maintenance. U-V axes with up to ±50mm travel for wide taper angles (±21 degree). (Reach Condition:100mm Z-axis height and DA+DB=15mm at least; a set of wide-angle diamond guides and nozzles are required.). In Figure 3 an example of EDM machine is given while in Figure 4 is the design of EDM machine in TebisCAM.

Figure 3: EDM processing machine

Excellent thermal balance and rigid cast construction to ensure the best machining accuracy and durability. U-V axes, with linear guide way for accurate taper cutting. Using direct drive AC servo motors, high precision ball screws on linear guide ways with optional 0.05mm resolution glass scale, assures precise positioning and fast response to cutting conditions.

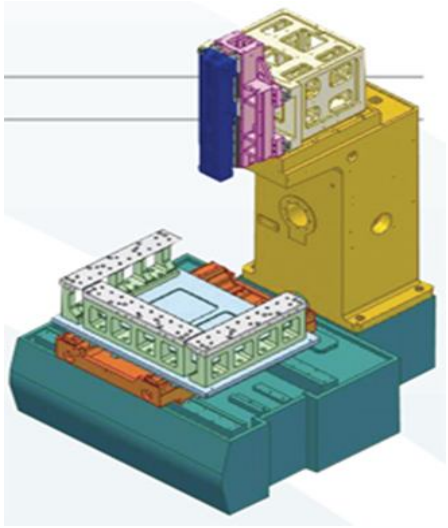

Figure 4: Mechanical scheme of EDM processing machine in TebisCAD

5. CONCLUSION

Improvement of the process and the work piece quality/accuracy is aimed at by the use of alternative electrode materials, machining methods and real-time process monitoring. The focus is on tool wear control, machining accuracy, surface quality and machining speed. On-line prediction, monitoring and compensation of tool wear through pulse analysis is investigated. Surface roughness and surface modification by material transfer from electrode to work piece are investigated and compared with EDM Sinking. Strategies for machining 3D surfaces are evaluated and models are developed for predicting surface roughness for different strategies. EDM Milling can be a useful extension to traditional Die Sinking for the manufacturing of technical parts and moulds of limited size which would require a large amount of electrodes when machined with EDM Sinking.

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