

# ModuleWorks

Innovating for You

## ***“Engines” for Digital Manufacturing***

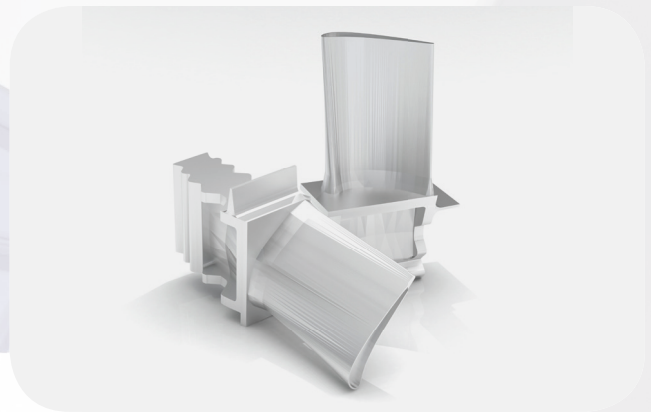
*Thanks to the latest computer-aided technologies, products today are developed and manufactured faster than ever. The conversion of ideas into real products is supported by CAD/CAM systems that transform a virtual product model into the program for a CNC machine tool. Current 5-Axis machining technologies allow the machine tool to access all sides of the component, enabling the efficient machining of complex parts with undercuts. The calculation of this complex cutter motion requires sophisticated algorithms, which are integrated as core components in a CAD/CAM software package. However, most CAD/CAM vendors do not develop these complex algorithms themselves, but instead they rely on the core components developed by ModuleWorks GmbH, a specialized Engineering company located in Aachen (Germany).*

When Turkish-born Yavuz Murtezaoglu finished his engineering studies at the renowned RWTH Aachen University in the middle 1990's, he was not aware that his newly earned engineering skills would be the basis for one of the most important engineering companies for digital manufacturing. At that time most CNC machine tools still operated using only 3 linear axes, but he recognized the potential of a new generation of CNC machine tools supporting 5-Axis simultaneous machining. These machines combine linear and rotary motion and enable the precise manufacturing of complex surfaces like plastic injection molds and turbine blades. However, their operation requires much more complex CNC programming developed using sophisticated mathematical algorithms to generate the required toolpaths.

In collaboration with the RWTH Aachen University, Yavuz Murtezaoglu first developed algorithms for simultaneous 5-Axis cutter motion and integrated them in an existing CAD/CAM system, where this functionality had been missing. The success of this integration, the innovative environment of the RWTH Aachen University and his own pioneering spirit eventually led to the foundation of ModuleWorks GmbH in 2004.

The start-up company achieved its first break-through by supplying its sophisticated algorithms as standardized components that could be integrated in any existing CAD/CAM software package in a way that is analogous to fitting an engine into a car or an aircraft.

By outsourcing the development of the dedicated core components, the CAD/CAM vendors do not need to invest in expensive software development requiring very specialized know how and can focus on other areas of development. More and more CAD/CAM suppliers are aware of the benefits of this outsourcing concept and today more than 30 CAD/CAM vendors worldwide rely on the core components of their partner ModuleWorks. Since its foundation in 2004, ModuleWorks GmbH has developed into an international software engineering company with more than 50 professionals in Aachen/Germany, Romania and Ukraine.



Virtual turbine blade as result of virtual material removal in a machine simulation that is driven by Module Works components.

### **5-Axis Simultaneous Machining**

The machining of complex parts with 5-Axis machine tools offers a series of benefits. 5-Axis machining enables the machine tool to access all sides of the work piece allowing the component to be completed in a single set-up. Multiple set-ups for different roughing and finishing operations are not required and alignment errors introduced by moving the work piece are avoided. The benefits of single set up machining include reduced lead time and labor costs and improved surface quality.

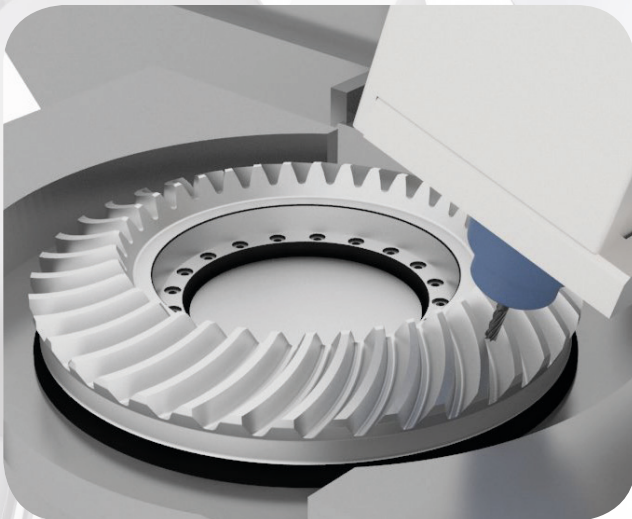
In addition, 5-Axis machining enables the use of shorter series cutters as the tool can be tilted to maintain optimum cutting position and constant chip load. The tilting also avoids collisions with the tool holder and enables better access to the part geometry. The benefits are longer tool life and a high precision finish of the manufactured component.

As a result, 5-Axis technology is perfectly suited for parts with geometric complexity including undercuts, such as plastic injection molds, impellers and turbine blades. ModuleWorks provides its partners all essential core components for 5-axis simultaneous operations. This includes various strategies for roughing and finishing and also for the popular SWARF cutting, where the side of the tool is used to machine tilted walls.

## CNC Simulation & Toolpath Verification

In addition to components for 5-Axis machining, ModuleWorks also provides a solution for the simulation and verification of the complete machining process. The toolpath simulation component supports Mill, Turn and combined Mill/Turn applications with full machine simulation, stock removal verification and toolpath analysis. By using a "Kinematic Machine Builder", nearly every CNC machine, robot or CMM machine can be virtually assembled taking into account an unlimited number of axes. The result is a full kinematic machine simulation with comprehensive collision detection and axis limits checking.

By using complete simulation of the system "machine/ tool/ workpiece", potential collisions can be detected and corrected in advance. The ModuleWorks components feature optimized toolpaths and high accuracy verification of stock removal for Mill, Turn and Mill/Turn applications.



ModuleWorks' Machine Simulation recognizes any potential collisions between stock and machine parts prior to machining.

The virtual machining using the ModuleWorks components generates economic and ecological benefits for the manufacturing of complex parts. As the machining process is simulated on a standalone PC, every CNC machine tool can be utilized 100% for the real production process. Moreover, virtual machining can prevent damage caused by collisions of cutter tools, spindles, fixtures or component. The bottom line is that standardized components for CNC simulation and verification reduce the wear on machine and cutting tools. In addition, they minimize energy consumption thereby contributing significantly to a more sustainable manufacturing process.

One of the long term partners of ModuleWorks is EXAPT Systemtechnik GmbH, a well-known supplier of CAD/CAM-Systems. Dr. Arndt Richter, Managing Director of EXAPT, highlights the benefits of the partnership: „The demand of our customers for CAD/CAM-solutions around 5-Axis simultaneous machining has increased significantly in the last few years. In this area, we decided to utilize the proven core components of ModuleWorks, so that we could focus our own development resources on other projects.

In collaboration with ModuleWorks, we succeeded in integrating their core components for 5-Axis simultaneous machining, CNC simulation and verification into our software in a short time frame. This enabled us to offer our customers a comprehensive solution for all types of machining and it helped us to improve competitive position of EXAPT Systemtechnik in the international marketplace."

## Innovative Vertical Solutions

5-Axis simultaneous machining technology is not limited to metalworking; it has also revolutionized other areas of manufacturing including dental and woodworking.

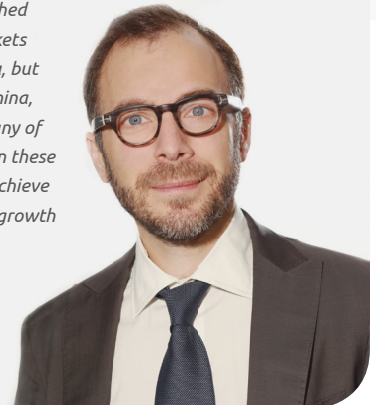
In the dental industry it is increasingly important that parts like crowns, inlays, veneers, bridges and dental implants are manufactured precisely and in the shortest possible time. The suppliers of dental CAD/CAM software rely on ModuleWorks for the 5-Axis machining of many of these components, especially those with complex anatomically shaped surfaces such as dental implants.

Vertical solutions are not limited to the dental industry. Other consumers include the suppliers of CNC control units for machine tools and the manufacturers of dedicated machines for complex wood manufacturing, where suppliers have teamed up with ModuleWorks to offer the best available 5-Axis and simulation technology in their marketplace.

Yavuz Murtezaoglu, Managing Director of ModuleWorks, is delighted with this trend and comments "The new applications also help to guide our own product development. We have discovered, that many of our partners demand a more efficient solution for 3-Axis machining. Because of this, we are now also developing core components for this type of application."

*"Similar to the automotive industry, the highly competitive manufacturing software industry is always looking for smart strategies to reduce the development costs. We help them by supplying core components, which our partners simply integrate into their CAD/CAM system. We see this outsourcing trend, not just in the established western manufacturing markets of Europe and North America, but also in growth regions like China, Korea, Russia and Turkey. Many of our new partners are based in these new markets, helping us to achieve approximately 30% revenue growth over the last year."*

Yavuz Murtezaoglu,  
Managing Director ModuleWorks



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