

## DIGITAL PRODUCT DESIGN, SIMULATION, ANALYSIS AND VALIDATION

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### 1. INTRODUCTION

The new global demand and breakthrough technologies are increasing the complexity of product design. The limitations of 2D drawings can result in misinterpretation of the design intent. Though 2D drawings present serious problems, 3D design is a part of the solution. 3D CAD has become today the “gold standard” for product design. The proliferation of modern and powerful design 3D CAD system allows using the rich information embedded in 3D models. The digital mock-up lets engineering teams review, manipulate and evaluate digital representation of 3D product information being an essential element of a successful Product Lifecycle Management.

### 2. REAL BENEFITS OF THE DIGITAL MOCK-UP

The design teams are pressured to produce more innovative products faster than ever before – from marketing concept through maintenance. As global demand and breakthrough technologies increase the complexity of product designs, engineers need more advanced desktop tools to quickly validate and release design into production.

In the paper we present two examples of integration of multi-CAD process in the cycloid profile satellite gear, respectively asymmetric profile gear design, simulation, analysis, manufacturing and control.

We present example of digital design used at cycloid reducer, fig.1, 2, 3,4

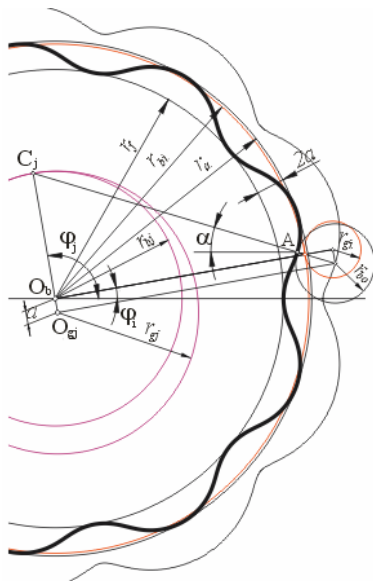


Fig.1 The equidistant curve parameters of the cycloid profile gear

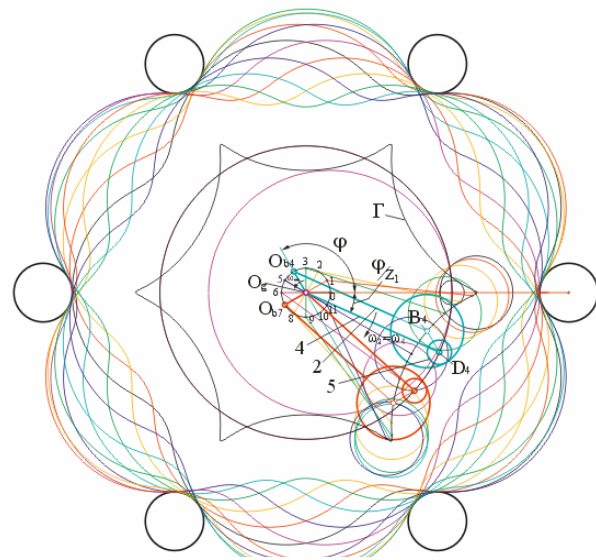


Fig.2. The kinematics of the homokinetic coupling of the cycloid reducer

Digital product design allows product development teams to digitally create a product and its environment than analyze it to understand key factors that determine *quality*, *performance* and **cost**.

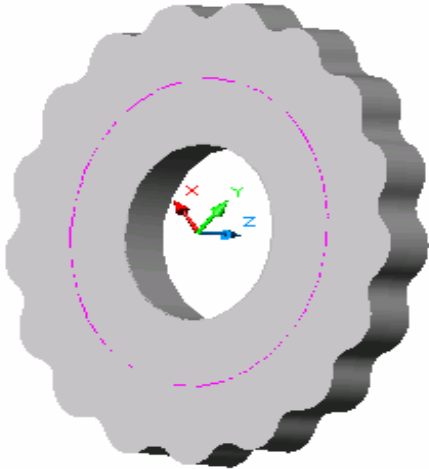


Fig.3. The 3D model of the cycloid profile satellite gears of the cycloid reducer

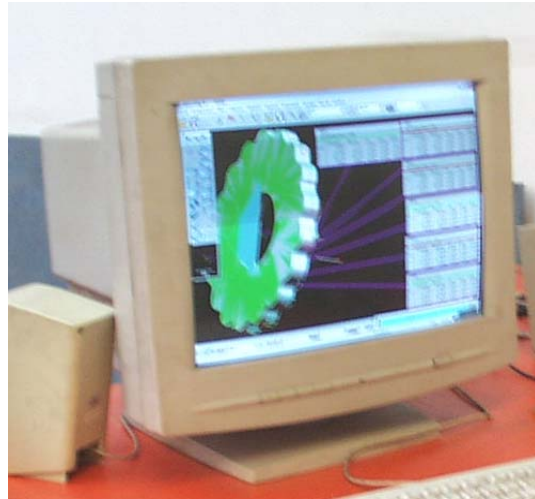


Fig.4. The using of the 3D model in control procese.

Also, provides a comprehensive set of tools to simulate complex product behaviour in one unified environment. This enables more decisions in the virtual stage of development, before investing in expensive prototypes, production resources and product launch activities.

Simulated 3D product behaviour facilitates decision making in the virtual stage, reducing the need for physical prototypes, while enabling design and manufacturing process optimization.

Simulate complex mechanisms in motion and then view the dynamic virtual feedback provide check limits and interference and compute minimal distances, Also, provides a depth understanding of product behaviour across all variants and configurations and increase agility to create and validate design alternatives.

Identifying the clashes is an extremely important activity throughout the design cycle. Resolving clashes on the manufacturing floor can cost hundreds of times what it costs to resolve them during the design phase by visualizing, analyzing and optimizing 3D processes and products, fig. 5.

The digital design provides a way of managing the results and of reusing analyses, while reducing the risks related to decision making in a complex, dynamic environment. Optimize product development to drives innovation.

*Product Lifecycle Management* (PLM) solution is essential to creating a collaborative environment that places product innovation at

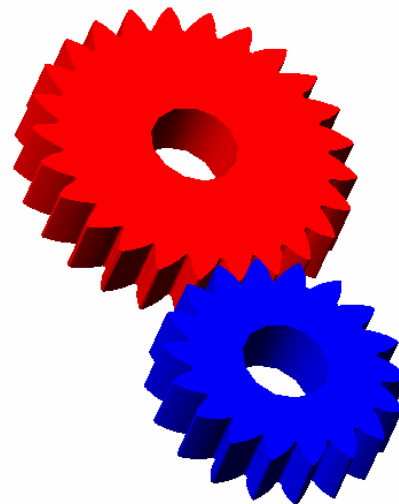


Fig.5 The 3D Model of the assimetric gears

the centre of the development process. Digital mock-up is a key enabler of decision-making activities that enable innovation. Digital allows development teams to digitally create a product and its environment in real-time. Then analyze it to gain early insight into key factors that determine quality, performance and cost.

CATIA, ENOVIA, SMARTEAM DELMA powerful utilitarian programs provide visualization and complete analysis and simulation of mock-up. These programs enable more verification in less time, increasing design quality while deducing time to market.

The programs enable digital product *simulation, analysis and validation*, improving product quality and accelerating decision making by providing real-time insight into real-world product performance. Also, these programs enable real-time visualization and review of the 3D product as it evolves. Allows design teams to digitally build the product mock-up and then analyze it to gain early insight into key factors determining design quality, product performance and ultimate market success. Using digital testing and analysis tools, designers can reduce and even eliminate the time and cost invested in build it, break it scenarios requiring multiple physical prototypes.

Full integration of multi-CAD and Product Lifecycle Management (PLM) centric processes within global engineering environments provides extensive support for industry best practices such as *interference detection and analysis, product synthesis, human ergonomics analysis, and engineering data visualization*.

The power of the digital product design consists in global organizations - from marketing to design and maintenance - to collaborate in real time using configurable 3D mock-ups and to rapidly validate product variants during testing of design alternatives. Development teams can transform product information into business intelligence, improving decision making and product quality across the enterprise value chain.

In particular, engineers need to understand how complex product designs and assemblies will perform in the real world, for example, when multiple parts and sub-assemblies are moving or need to be mounted or replaced during servicing. Digital mock-up provides early insight and collaborative review of product performance and serviceability, key elements of any successful Product Lifecycle Management strategy.

Integrated design, review and simulation environment accelerates design maturity, real-time product insight improves decision-making activities and reduces the needs for physical prototypes, embedded collaboration capabilities boosts creativity and engineering productivity, upfront validation of product fit and function increases quality and eliminates downstream errors, multiple 2D and 3D format support enables efficient integration into any heterogeneous environment.

Simulation 3D product predict behaviour earlier in the virtual word facilitates decision making in the virtual stage, reducing the need for physical prototypes while enabling design and manufacturing process optimisation.

Being able to review and analyze the 3D product design quickly and often, assure incorporate innovations and resolve design.

Using a standalone solution, digital testing and simulation tools reduce and even eliminate the need for physical prototypes.

80 present of development costs are incurred early in the product lifecycle, making it critical to simulate the behaviour of a product in 3D before building a single prototype or beginning production planning.

Transform design knowledge and behaviour into business intelligence providing support for fast and accurate business decisions across the entire product development lifecycle.

### **3. CONCLUSION**

The modern digital product design predicts product behaviour earlier in the virtual world. Simulation 3D product behaviour facilitates decision making in the virtual stage, reducing the need for physical prototypes while enabling design and manufacturing process optimization.

Being able to review and analyze the 3D product design quickly and often, incorporate innovations and resolve design.

When is used as a standalone solution, digital mock-up testing and simulation tools reduce and even eliminate the need for physical prototypes.

The digital design, simulation, analysis and validation are the first's steps in environmental protection measures in a modern world.

### **REFERENCES**

- [1] Chira, F., Contribution to the Assimetric Gears Study, PhD Theses, The North University of Baia Mare, 2006.
- [2] Dăscălescu, A.: Contribution to the Kinematics and Dynamics Studys of the Planetary Gears with Cycloid Tothing and Roller Teeth, PhD Theses, Cluj-Napoca Technical University, 2005.