" VIRTUAL MODELS" AS A PART OF REVERSE ENGINEERING

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Abstract:

Reverse Engineering (RE) is one of the tools of Integrated Engineering that allows the concept optimization and product realization so that the desired flexible production is made with minimum quality costs, and short term deliveries to the beneficiaries, so that these ideas become more real, more palpable. This technique, recently given in a defined sense of modern production systems, has another relatively limited application, being accessible especially for specialists from universities and large industrial units which have knowledge and already structured procedures and especially who have access to the equipment and modern facilities, but it is still expensive.

Keywords: reverse engineering, model virtual, scanning, rapid prototyping

1. INTRODUCTION

Due to rapid development and change of market outlets, the need to bring as rapidly as possible new products to the market (time to market), technology design and manufacturing have evolved in recent years in an extremely fast pace. Among the basic elements that allow the reduction of this time, (competitor Engineering) (Computer Aided Design-CAD), (Computer-Aided Engineering CAE), (Computer-Aided Manufacturing CAM) (Rapid Prototyping-RP) (Virtual Prototyping-VP) can certainly be mentioned. These elements, simultaneously, also allow market introduction of products closer to consumer's requirements (tailor product to customer), reduction of production costs along with permanent improvement of product quality. Taking into consideration the fact that claims in the market are growing, primarily price and quality, and in a period when the slogan which represents most precisely the reality is "Change or die" enterprises from our time are virtually forced to adapt to new technological methods. Reverse engineering is the process of discovering the operation principles of a device or system by analyzing its structure, function and operation. Usually, reverse engineering involves the disassembly or decomposition of the system or device and in-depth analysis of its functioning, in order to achieve a new device or similar system that does not copy anything from the original.

2. THE TEHNIC OF REVESRE ENGINEERING (RE)

Reverse engineering originates from the Japanese industry, which use this process to increase the production being in a high products competition and avoiding the effort required for the original design. Reverse engineering used at the begging by all those who lost original concept of the product, has become today an engineering science. The RE fundamental is shown in the following picture.

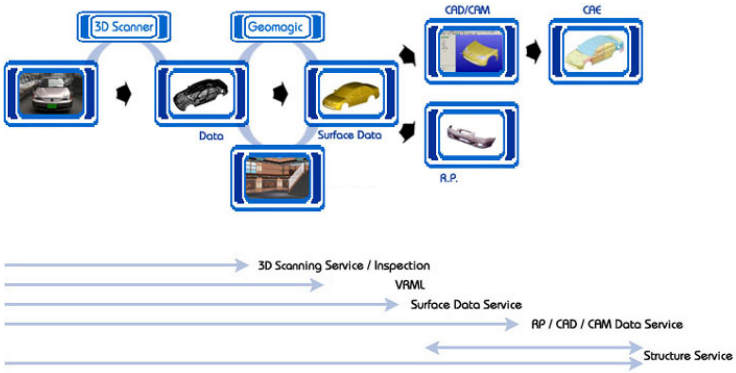

Fig. 1 *The reverse engineering fundamental*

The power full software rises reverse engineering to new highs. With the help of the computers the piece/parts can be viewed in 3D, can make form and size changes (redesign). And also test and simulate the measures.

3. SCANNING/ DIGITIZING

In the case of Reverse Engineering techniques, an important role falls upon scanning technology (give information to create virtual models) and Fast Prototyping, even if a procedure for reverse engineering does not necessarily imply physical realization of prototypes by RE.

Product scanning, also known as "digitizing" or “3D digitizing” is a process that uses a tangible form to capture 3D objects and to recreate them in a virtual work field. Related data are correlated in the form of points and the resulting file is called "cloud of points" (fig.2).

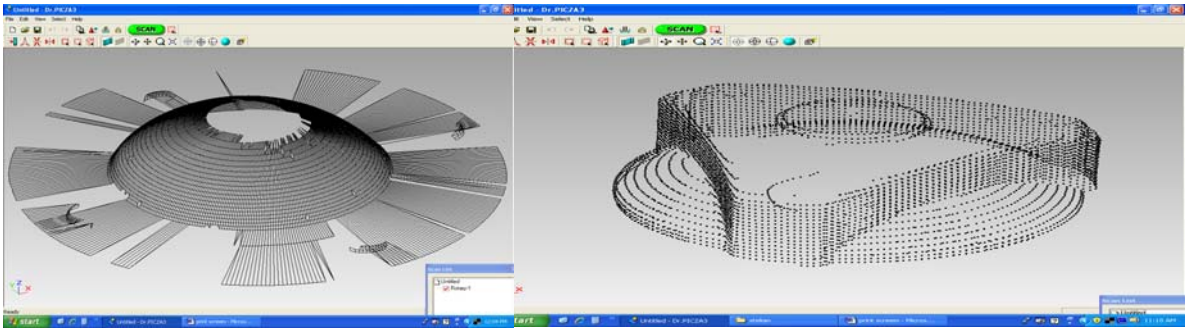

Fig.2 *cloud of points*

The process of digitizing captures geometry, bent surfaces and composite characteristics that is difficult to measure using traditional technical measures.

Limits of digitizing: Until recently, digitization was limited by the speed of scanning head movement. Choosing the right feeling system depends on the type of piece scanned and the budget assigned for the acquisition of the scanning system. The most common systems are the contact or LASER systems. Other methods of data collection such as physical cutting, destructive scanning, X-ray, computerized tomography scans and magnetic resonance are also possible.

4. APROXIMATION OF SURFACES BY POLYGONAL ELEMENTS

The next specific step is an approximation of surfaces by generating polygonal elements, in order to obtain surfaces. The only condition imposed is that the scanned complex surfaces often be represented by triangles.

Already at this stage, in the case of simple objects, the RE can be considered as completed. In the past, before the mathematical models for the approximation of NURBS surfaces, the model thus obtained was sufficiently precise to allow analysis by FEM, and even visualization techniques of Reengineering.

Disadvantage arising from the simple approximation of surfaces by polygonal elements is the precision of representation. As can be seen from figure polynomial approximation involves dimensional errors.

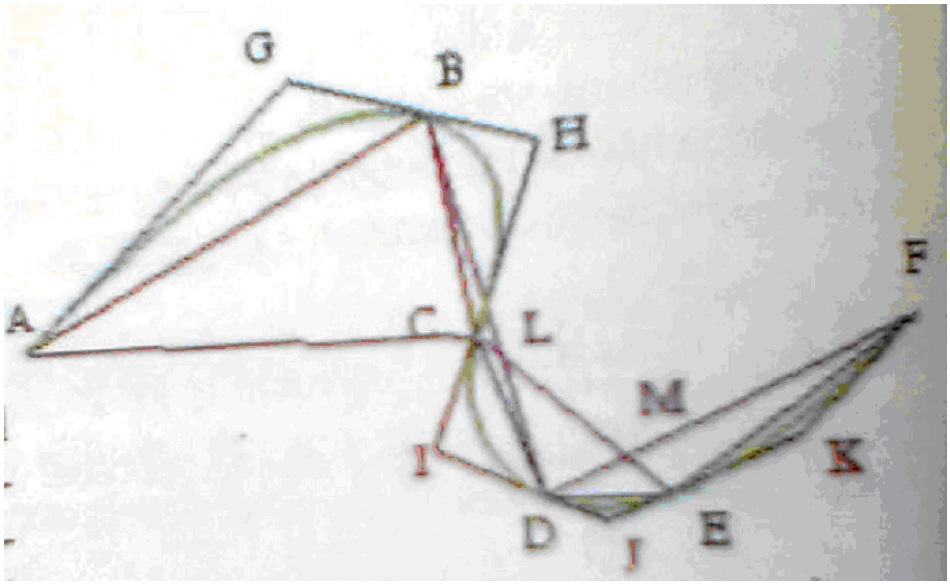

Fig.3 *Approximation by triangles*

Thus for the curve given (green (fig.3)) as digitized points A, B, C, D, E and F, we have determined triangles ABC, BCD, CDE, and DEF. As observed in the case of the concave curve and the modulation area, resulting triangles overlap, generating at their turn intersection points. So a lot of elementary triangles needed to define the digital contour are composed of triangles ABC, BCL, LCD, DML, CDM and EFM. Final contours defined by resulting points of polygonal approximation are ABCLMF. In this case, the meshing must be sufficiently intelligent to choose the polygon defined by digitized points and not by the intermediate results through intersections, resulting approximation is not satisfactory.

4. VP (VIRTUAL PROTOTYPING)

Due to rapid development of software on one hand and the need to reduce prototyping costs - to be mentioned that in the year 2000, costs resulted from rapid prototyping, in USA only, were estimated at approx. 10 billion dollars -Quick Prototyping reached a level so high that the deadline for Virtual Prototyping (VP-Virtual Prototyping) gains increasingly more land being considered as a logical extension of CAD and CAE. Through these systems, the test (static and / or dynamics) of the prototypes is done primarily through simulation, and only after the success of these tests to pass at physical prototyping. Among the best performing in the current period we can mention:

ADAMS - Automated Dynamic Analysis of Mechanical Systems

Part of the product MSC Office of MSC Software Company composed of the following models:

ADAMS/3D Road - allows creating 3D roads, parking spaces, race tracks, auto lanes etc. for virtual vehicles.

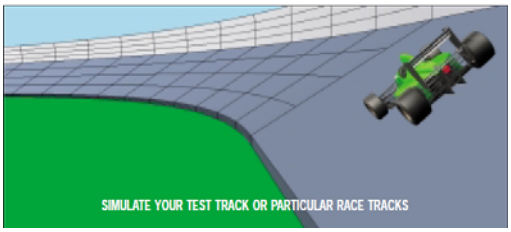

Fig.4

ADAMS/Aircraft- Comes to help engineers by creating virtual prototypes of aircraft that can be tested, optimized and improving computer modeling before the first real prototype.

Fig.5

ADAMS/AutoFlex- Powerful capabilities for analyzing the flexibility of solid bodies without requiring the use of complex programs for finite element analysis.

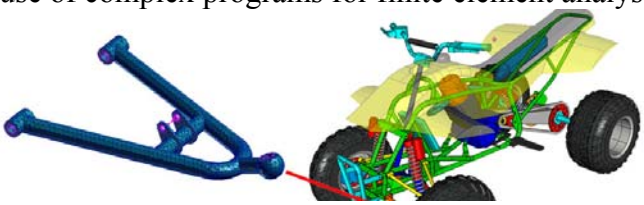

Fig.6

ADAMS/Car - Generate a virtual prototype of a complete vehicle, combining the accuracy of the mathematical model of the chassis subsystems, engine and steering system, control system and body.

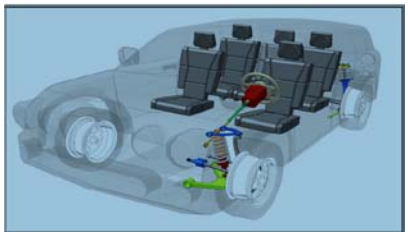

Fig.7

ADAMS/Chassis - is an automotive-based simulation, which offers an extensive library of sample modeling and analysis of specific industrial standards.

ADAMS/Controls - help integrate simulation and motion control systems simulation.

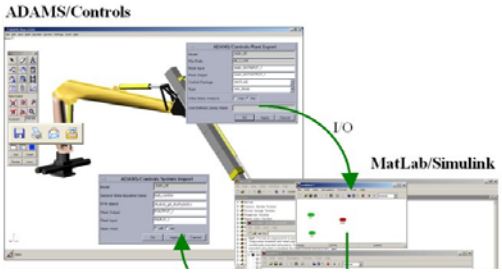

Fig.8

ADAMS/Driveline - Creates virtual prototypes and simulate driving and using a virtual vehicle, durability, and control their vibrations.

Fig.9

ADAMS/Driver - Allows simulation of driving the vehicle virtual modeled, without the costs and delays of specific physical prototyping.

ADAMS/Durability - Allows using existing models in the MSC.ADAMS library regarding simulation of fatigue tests.

Fig.10

ADAMS/Engine - powered by FEV is a suite of software tools that offer functions to create virtual prototypes and simulate complex engine.

Fig.11

ADAMS/Exchange - Offers interfaces in both directions (two-way) based on industry standards for data transfer between MSC.ADAMS product line and the most popular programs of CAD/CAM/CAE

ADAMS/Insight - Permits application of any experimental models on any experimental models, on any simulation, thus allowing a better quantification of results, and a more precise estimate of design compromises applied.

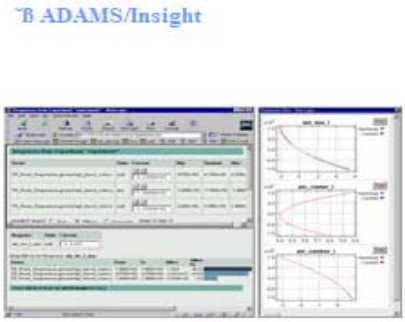

Fig.12

ADAMS/Linear - Helps liniarizarea or simplification of the nonlinear equations MSC.ADAMS in order to verify model's exactness.

ADAMS/Postprocessor – Main Graphical interface of viewing simulation results by MSC.ADAMS.

Using ADAMS/Rail - complete rail model vehicles can be made and complete simulation models made of railway vehicles and realistic simulation of the behavior, improve performance and optimize physical before running tests.

ADAMS/Solver - Is a library of fast and robust numerical analysis, specialized in the formulation and integration of equations governing the mechanical simulation.

ADAMS/Tire - Accurate simulation of virtual vehicles

ADAMS/Vibration - Allows study of vibrations of MSC.ADAMS models using frequency domain analysis in the identification, isolation and improve the level of vibrations.

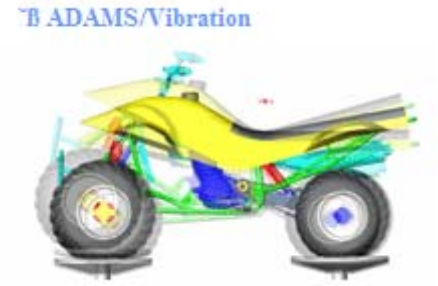

Fig.13

ADAMS/View - Offers superior opportunities for modeling and visualization for mechanical simulations in a general frame.

Fig.14

Solid Works-system - used in mechanical engineering, industrial design, robotics, construction, aerospace, manufacturing technology, automotive systems, with optional modules for finite element analysis, kinematics, fluid dynamics and thermo techniques.

5. CONCLUSIONS

To fulfill the demands of today's global manufacturing companies' focus on their methods, adopting new techniques and looking for new ways to streamline its production and costs. Among the recent technological discoveries, there is a real interest in scanning, which is fast and easily affordable, and which gives useful information in the realization of virtual models.

The companies look at the scan technique as a potential tool for increasing productivity and to solve some issues about the need to create a 3D digital file for an object where it did not exist before. Scanning of a track and sending the 3D scanning software programs or prototyping not only offers the advantage of reducing the time required of this task, but also savings.

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