VISUALIZATION TECHNOLOGIES IN THE PROCESS OF MAKING COMPOSITE STRUCTURES

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ABSTRACT
This contribution is focussing on the application of visual elements in the process of creating composite structure with the use of technique hand lay-up Pre-preg. In this method the crucial factor is not only to specify the exact position of the applied layers but the important factor as well is the right order and orientation of individual layers which are determining the strength characteristics of the final product. This article focuses on the implementation of the advanced visualization features in the process of making composite components. Some sections of this article are describing the software which supports the composite construction, but also it allows the direct connection with the manufacturing process. In the conclusion of this article the attention is focussed on the latest trends and processes of top of the visualization techniques in the process of creating composite structure. These special visualization equipments are used as the tools for verification of design proposal of new technological systems.
Keywords: composite material, pre-preg, visualisation methods

1. INTRODUCTION

New progressive materials which are created from the need of today are described as materials which have more satisfactory and better properties. Their characteristic properties are better than conventional materials commonly used in manufacture industry. Their applications cause the increase of product quality and reduction of overall costs. All these conditions and characteristics are met in the new advance materials which are called composite. This type of material was originally developed for the aerospace industry. Nowadays, it is of course their implementation to all industrial areas, including industries such as medicine, sport, automotive and more [8].

2. SOFTWARE TECHNIQUE HAND LAY-UP (PRE-PREG)

Nowadays, there are many methods, how we can make composite structure. The special method where composite layers are applied on the surface is called hand lay-up Pre-Preg. Matrix in liquid form is applied between layers of the reinforcement. Composite parts which are realized by this method are hardened in low temperature – approximately 25 °C. Final hardening continues at temperature around 80°C. Thus created parts are very often put in to the high pressure dish which is called autoclave. In this special dish all air is removed. Then the process starts where high atmospherical pressure is pressed on all composite layers. Composite parts are completely hardened in the autoclave at 180 °C [2, 4, 9].
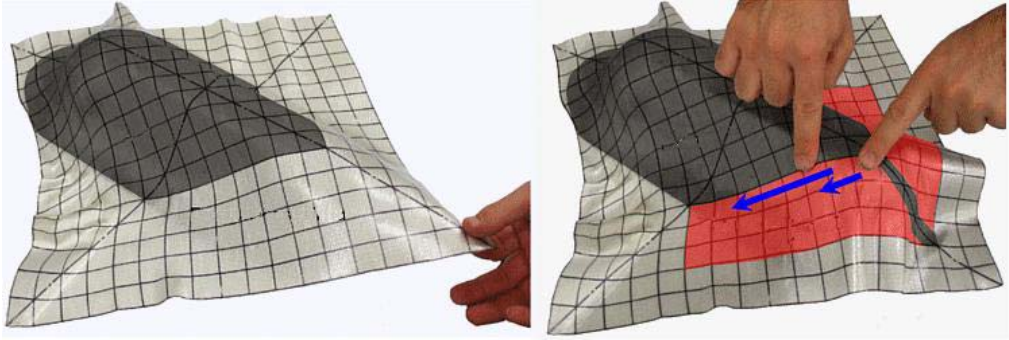
Figure 1. The process of creating composite structure (technique hand lay-up Pre-pregt) [13]

3. CA-SOFTWARE IN THE PROCESS OF CREATING COMPOSITE STRUCTURE

Nowadays, composite parts are designed by special composite software which consists of professional engineering modules. It is possible to realize an increase in engineering productivity and reduction of time which is needed for product development, when these modules are applied in the whole composite life cycle. Among these the best modules range [1]:

- Design module
- Analytical module
- Programming and simulation module.

Design module enables to create composite parts consisting of many different layers. These composite layers contain exact information about their shape, position, orientation and thickness of fibber.

Analytical module applies linear and nonlinear finite methods based on information from CAD model. Result from this method is a mapping place and a boundary where the difficult area or reduced structure is [5].
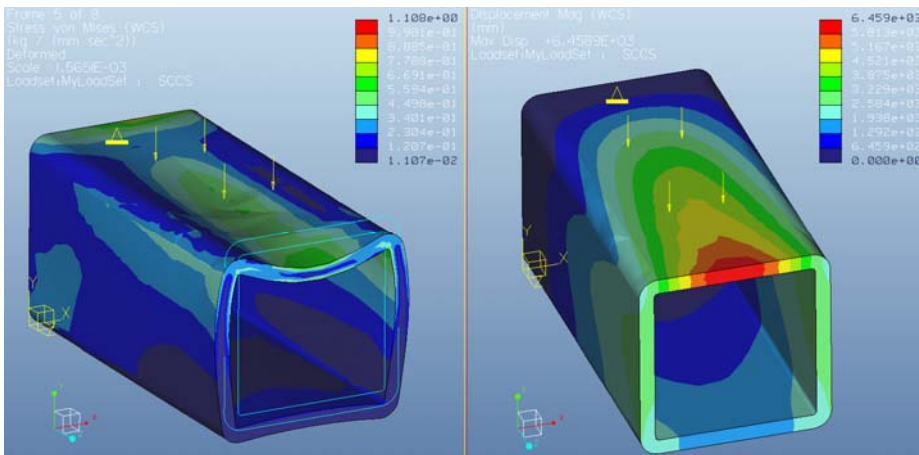

Figure 2. The Analytical module which applied linear and nonlinear finite methods

Programming and simulation module provides the tool which evaluates harvested information from the design and analytical module. Based on results mapped boundaries are created for single composite layers which are translated in to the NC data. Then this data is used for creation of a manufacture simulation in virtual machine [7].

One of the most professional software is FiberSim. This software is pure composite tool which provides all special tools for the work about the composite structures. It enables to create all composite

solutions which include every composite module. It is used by most airlines companies and space agencies. The typical high CA software is Pro /Enginner- laminate composite design, CATIA-composite part design and NX laminate composite. This software contains the special composite module which is able to create all of composite solutions. Vericut composite application is pure software which provides NC data and enables to show a composite manufacture simulation.

4. THE SPECIAL VISUALISATION METHODS

In the past, all composite structures were created by composite templates which were very expensive and non-effective for every new composite part needed its own templates. This method was not flexible and therefore today many methods which simplify created composite structure are discovered.

4.1 Display projection method

This visual method is characterized as special area of augment reality which is using a monitor for displaying composite layers in real time on the exact place. Graphic connection is used by highly sensitive CCD camera which provides professional scene on real object. The exact position and orientation of the detected object is provided from a coordinate measuring device which is called (Coordinate Measuring Machines - CMM). CMM sends the information which is collected from measuring sensor to the special composite software. Than the obtained information from CMM and software are together compared. Result from these activities is displaying exact position and orientation of composites layers on the visual display. These layers are constructed as a layer in the CAD software, and their strength properties were simulated in some of the analytical modules. These virtual layers contain more important information such as shape, orientation and exact location.
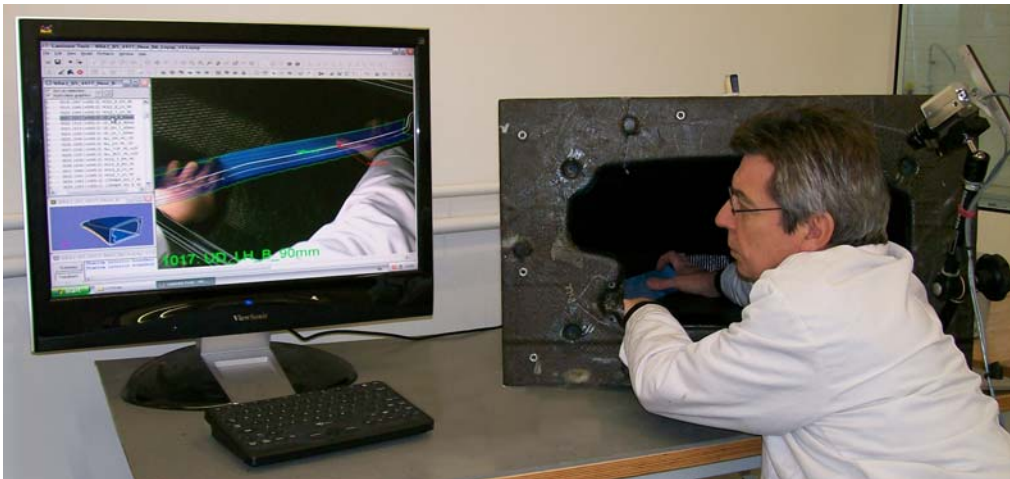
Figure 3. Principe of the display projection method [12]

4.2 Laser projection method

These methods use laser beams for a display of individual composite layers on the part´s surface. Direction and position of laser beam is managed with computer controlled servomotor and with laser mirror. Composite part is monitored by special highly sensitive laser scanner in the real time. Professional software allows cross connection between displayed laser beam and sensitive scanner. This method describes the boundary of composite layers as the part of augment reality.
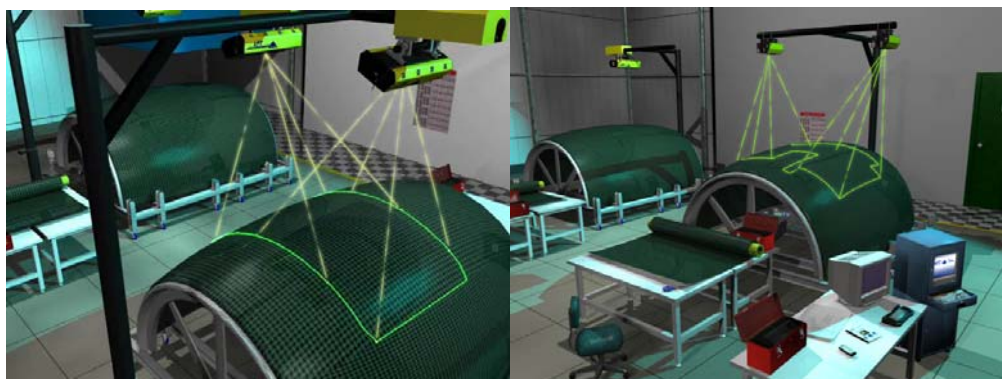
Figure 4. Principe of the laser projection method [14]

5. CONCLUSION

The aim of this contribution was describe modern visualisation tools and their characteristic properties which are better than properties of methods from the past. Their correct application in the production process causes more positives and effectives properties. For example: eliminating the cost of tools and templates, the possibility of placing an accurate display of composite layers without the additional measurements, reducing the total price of the product but also the time needed for its implementation. All of these special visualisation tools are applied to design of composite parts and are more powerful and easier to use. Slovak Ministry of Education supported this work, contract VEGA No. 1/0036/09 and KEGA No. 047-004TUKE-4/2010.

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