International Joint Conference on Environmental and Light Industry Technologies
18-19 November 2010, Budapest, Hungary
Óbuda University

TEACHING TEXTILE PRODUCTS 3D PROTOTYPING IN MODERN TEXTILE EDUCATION

Andreja RUDOLF[1], Zoran STJEPANOVIČ[1], Simona JEVŠNIK[2]
[1]University of Maribor, Faculty of Mechanical Engineering, Department of Textile Materials and Design, Maribor, Slovenia
[2] Academy of Design, Ljubljana, Slovenia

Abstract:

A wide range of new computer-based technologies, above all those using fascinating possibilities of computer graphics, together with a new generation of computers, assure the textile companies the ability to react extremely fast to the customer demands offering quality and future-oriented services. The universities, research institutions and software producers apply nowadays a whole range of new technologies to create advanced computer solutions that will in the future support the whole cycle starting from the virtual design of fabrics and garments through automated production up to virtual merchandising. Therefore, the basics of information technology and computer-based systems can be given to students in the frame of a larger general course. Special topics, connected with the use of particular new computer-based technologies, should be taught within different technical courses. This paper discusses teaching contents and techniques related to simulation of clothing products and explains the importance of different courses' interconnections for better study success.

Keywords:

Textile higher education, study programmes, 3D prototyping, textile products

1 INTRODUCTION

New technologies and their application in processes for designing and production of all kind of textiles force us to improve and renew our professional knowledge. Computer-based information systems are today widely used for supporting the design and production of textiles as well as for the assurance of effective information flows. The producers of computer hardware and software have successfully adopted the special characteristics of our textile engineering areas. Therefore, the universities, research institutions and software producers apply nowadays a whole range of new technologies to create advanced computer solutions that will in the future support the whole cycle starting from the virtual design of fabrics and garments through automated production up to virtual merchandising. Therefore, special topics, connected with the use of particular new computer-based technologies, should be taught within different technical courses.

In this paper the teaching contents and techniques related to simulation and visualization of clothing products are presented, as well as interconnected subjects for a better study success. One of the new subjects that are introduced into the new university-level study programme, Computer-based simulation of textile forms, will be the central topic of the discussion. Following, the new Bologna study programmes at the Department of Textile Materials and Design, Faculty of Mechanical Engineering, University of Maribor will be presented.

2 TEXTILE PROGRAMMES AT THE UNIVERSITY OF MARIBOR

At the Department of Textile Materials and Design, which is a part of the Faculty of Mechanical Engineering, University of Maribor, we developed and introduced the new university-level study programme at the of Textiles, University of Maribor. The new study was named **Design and Textile Materials** [1] and is prepared according to the Bologna process in the European higher education area. When designing the new study programme, we started with a set of pre-assumptions, cognitions, requirements and agreements. One of the main starting points was that the students should be given enough theoretical and certainly practical knowledge on information technology, computer systems and computer programmes that can be effectively used in textile and garment manufacture companies. Study programme Design and Textile Materials is composed of a first (undergraduate) or Bachelor Degree study that takes three years, second (graduate) or Master Degree study, that takes additional 2 years (3 + 2 years model), and third or Doctoral Degree study. At present, the second generation of students is finished the first degree and studying the second degree.
Also important for us and for the textile industry is a new professional-level study programme **Textile Design Technologies** [2], also aligned with the Bologna process in the European higher education area. The first generation of students were start studying in the academic year 2009-2010. In the Slovenian textile and garment manufacturing industries there is already shortage of such, suitably educated professional. Without any doubt it can be estimated that new, modern textile study programmes and updated subjects will help building the textile information society of tomorrow.

3 SUBJECTS, RELATED TO INFORMATION SCIENCE AND COMPUTER-BASED TECHNOLOGIES

3.1 General information science and computer systems subjects

When designing the study programmes, we were aware that in the future, the textile professionals will need in-depth knowledge and practical experience related to modern computer-based information systems for textile applications. More than ever, they will have to master computer programmes for general and textile oriented applications. Therefore, already in the first year of the study, there is an obligatory subject **Information science and computer systems for textile applications**. Within this subject, the students get acquainted with a needed extent of information science theory and applied view of computer-based information systems for textile applications. The subject represents the basis for understanding the subjects related to computer-based technologies in forthcoming years of the study. Among others, the contents of the subject include: computer graphics and its use in textile applications, basics of 2D drawing and 3D design, techniques for input and digitalisation of graphical information, as well as characteristics and structure of computer-based information systems to support design, construction and production processes for different textile applications. Transferable skills provides the students with the ability to use basic 2D vector and bit-graphics design programmes.

In the second year, the students attend the obligatory subject **Computer aided design and production of textiles**. Within this subject, the students become acquainted with a whole range of computer-aided technologies. Special attention is given to realised concepts and practical use of specific hardware and software for supporting design, construction and production processes in manufacturing of linear and flat textiles and garments. Transferable skills include the ability to creatively use specific computer programmes for designing textile fabrics and different textile forms.

3.2 Specialised computer technologies' subjects

In the third year of the study, there are additional computer-related subjects that can be selected according to the chosen study course. Among them there are two subjects that deal with modern simulation and visualisation techniques related to different textile materials and products: **Computer-based simulation of textile forms** and **E-business and multimedia in textiles**.

3.2.1 Computer-based simulation of textile forms

The subject Computer simulation of textile forms is focused on study of the simulation of fabric behaviour for presentation of virtual garment design. Since virtual garment simulation is a result of large combination of techniques, the students study a number of different topics. For teaching purpose the students are acquainted with the history of garment simulation, geometrical and mechanical simulation models, which accurately reproduce the specific mechanical properties of the cloth. Furthermore, they study the mechanical behaviour of the fabric drape and importance of determination of the mechanical and physical properties by KES and FAST measuring systems, as well as Cusic Drape meter for virtual reproduction of the behaviour of the cloth or garment. The garment simulation techniques using finite elements and particle systems are discussed, and meaning of the collision detection and response for garment virtual simulation elucidated. In addition, the 3D body scanning technologies for acquisition the 3D mannequins with the garment simulation purposes or body measures determination are reviewed, as well as importance of the 3D virtual parametric mannequins for virtual prototyping. At the end the students are acquainted with interactive garment prototyping and fitting, i.e. design of 2D patterns, 3D patterns placement on the body, specifying physical parameters and textures of the patterns, garment fitting and garment animation [3-12].
The lectures are logically supplemented with Lab Work using a commercial CAD programme package Optitex [12]. For studying the virtual draping of the fabrics, different simple 3D objects are used. Firstly, the draping of the characteristics cloths are investigated through the fabric's mechanical properties, e.i. elasticity, bending rigidity, shear rigidity, thickness, friction and weight, Figure 1.

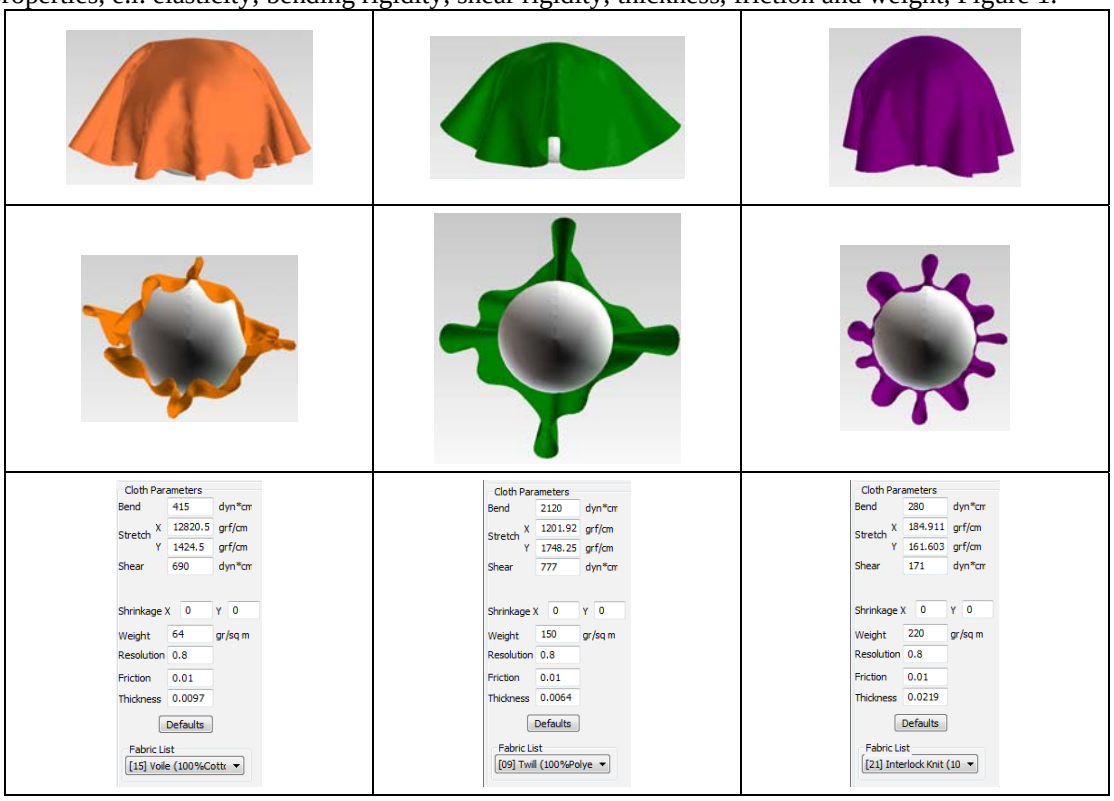
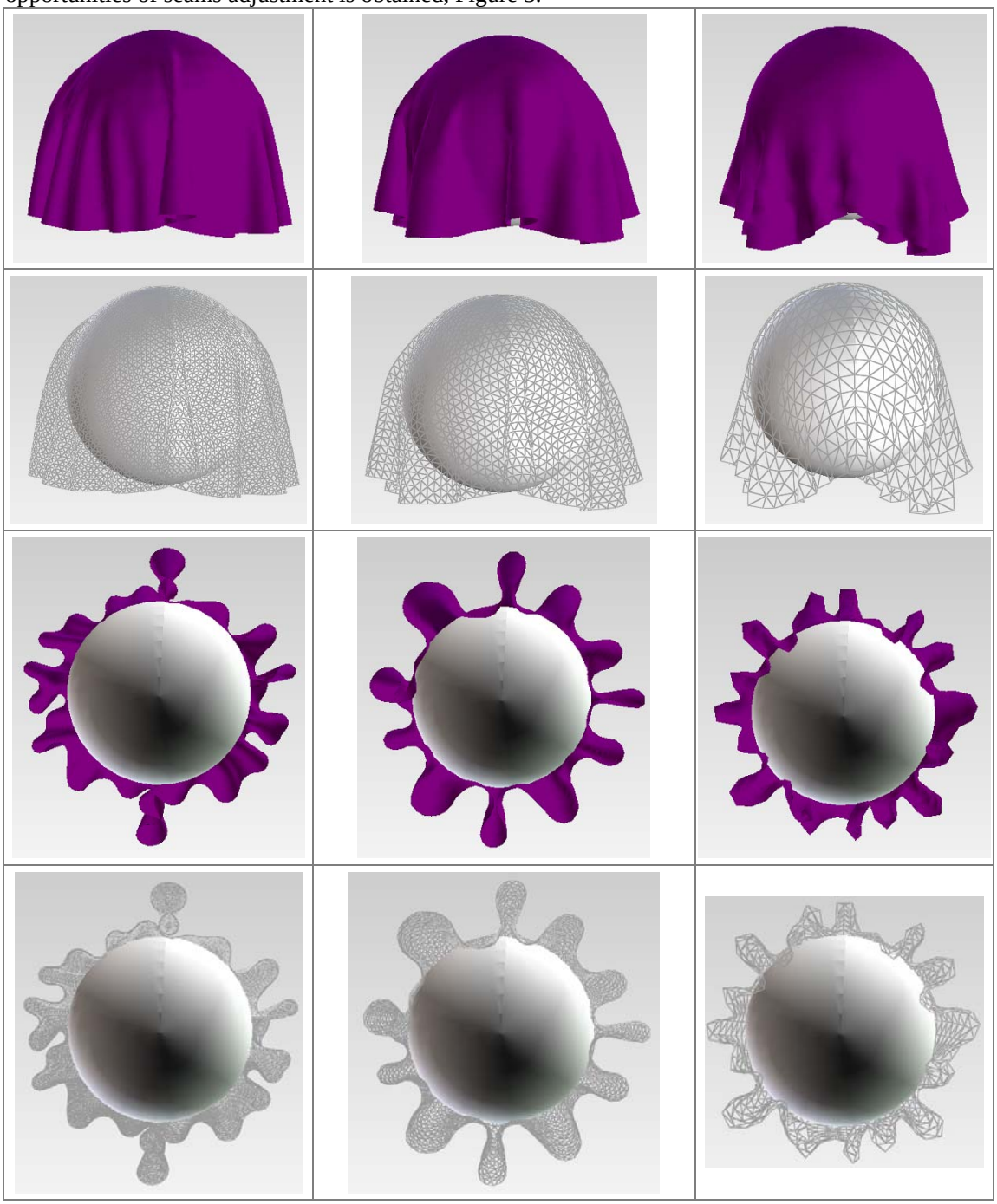


Figure 1: *Simulation of draping of different textile fabrics covering a sphere*

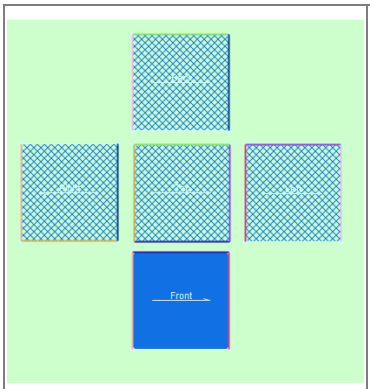
Furthermore, the students learn about the meaning of the resolution of the mass-spring model of the fabric for virtual simulations with OptiTex software, Figure 2.

At the next step the students learn about 2D pattern design, texturing and patterns properties setting, as well as adding the seaming lines to assembly the 3D textile form. By performing a mechanical simulation, which brings surfaces together along the seam lines, knowledge about different opportunities of seams adjustment is obtained, Figure 3.

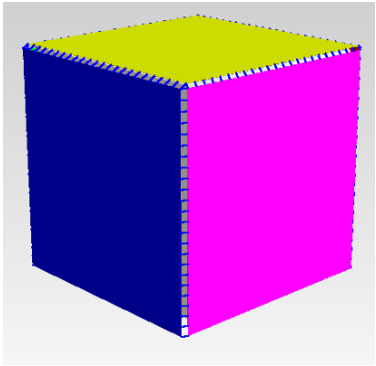


Resolution 0.5 *(b) resolution 0.8* *(c) resolution 1.5*

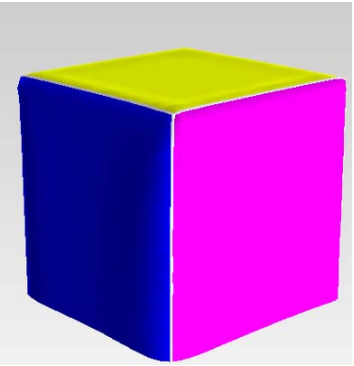
Figure 2: *Simulation of draping using different resolutions*



2D pattern design and seam lines setting



Patterns positioning and seam lines



Simulation of cube covering

Figure 3: *2D pattern design, sewing and simulation of covering of the cube*

Furthermore, the students continue with simulation of the skirt, made using their own body measures. The exercise is intended for garments virtual simulation and appreciation of the garment fitting of both, real prototype and virtual 3D prototype. Therefore, the exercise connects different subjects, such as Pattern making design, Prototype workshop and Computer-based simulation of textile forms. The reason for this is to achieve a better understanding about the reliability, accuracy and expeditious, as well as realistic virtual garment simulations and excelent study success thereof. For this purpose the basic skirt patterns according to their own body measures were designed using a Müller & Sohn construction system. The students sewn the skirts and fitted them. A disscussion about deviations of the skirt form according to the basic pattern was done. They realized how to repaire basic pattern according to their body shapes, e.g. displacement of the darts, prolongation of the darts, modelling of the side lines, learn about different shapes of the darts etc. Furthermore, the same was carried out by the OptiTex computer progarmme. The 2D patterns were designed with the same body measures and construction procedure, Figure 4.

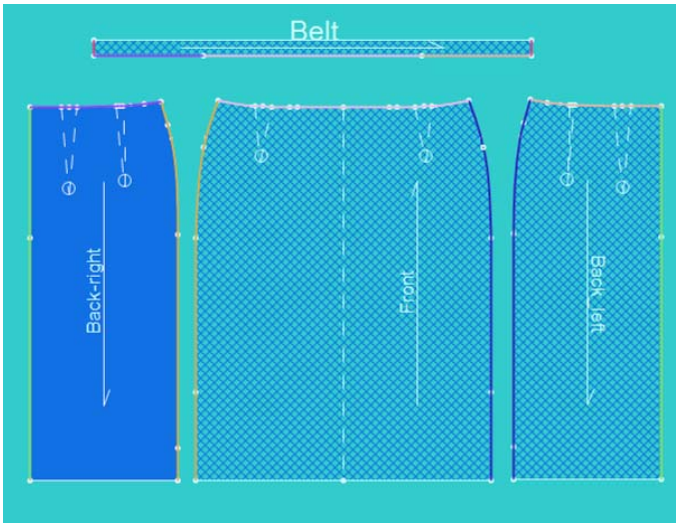
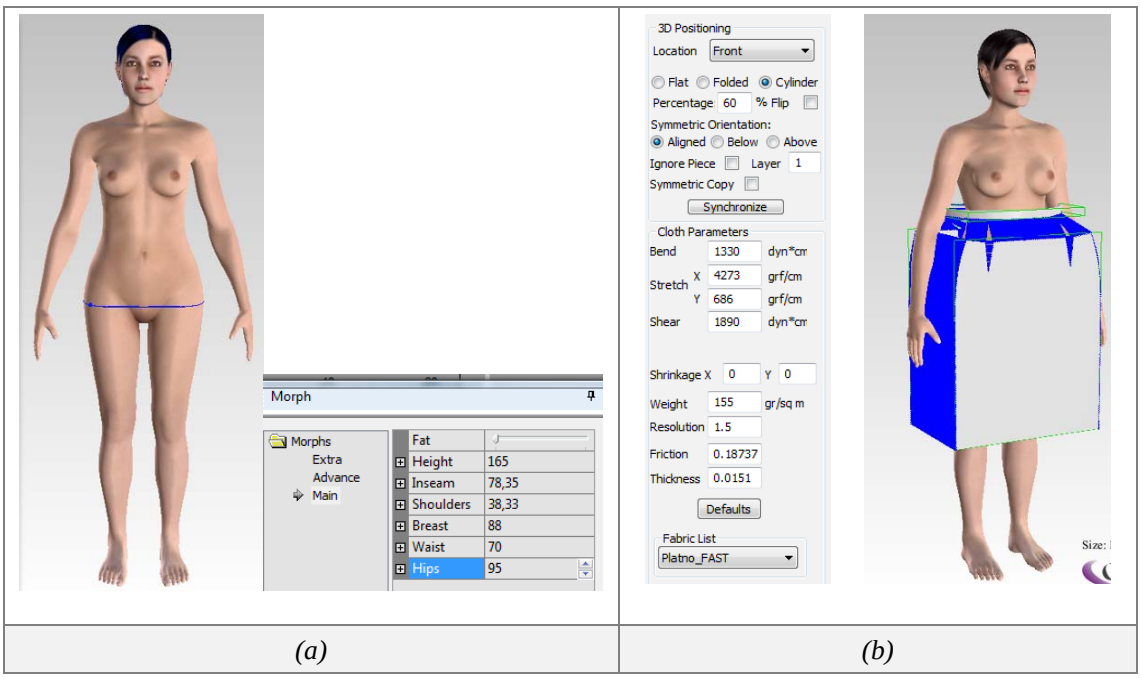


Figure 4: *2D pattern design made by OptiTex software*

In addition, the body measures of the individuals were adjusted on the parametric mannequin 'Jasmin', Figure 5a. Furthermore, the seam lines were determined on the patterns, Figure 4. On the next step the students defined the 3D positioning of the patterns according to the mannequin and define the mechanical properties of the real fabric to the patterns, Figure 5b, and simulate the skirt sewing and draping, Figure 6. At the end a comparison of the real virtual prototype of the skirt was discussed, Figure 7.



(a) *(b)*

Figure 5: *Determining the body measures, 3D positioning and properties of the patterns*

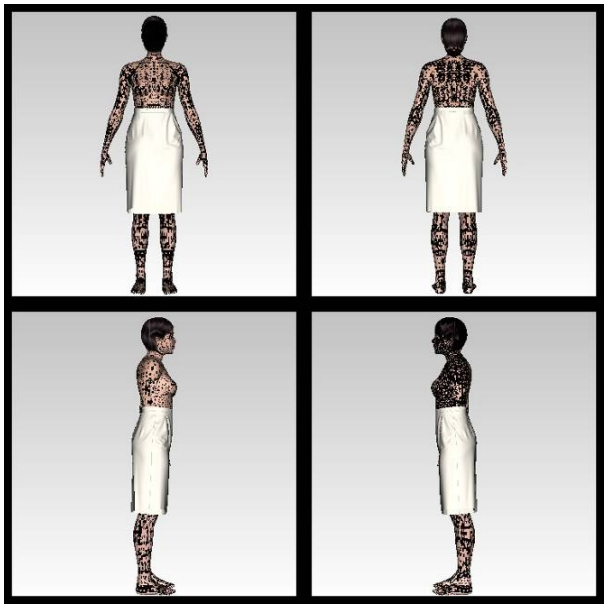


Figure 6: *Virtual simulation of the skirt example*

Figure 7: *Comparison of the real and virtual prototype of the skirt example*

4 CONCLUSIONS

In this paper, the contribution of the Department of Textile Materials and Design of the University of Maribor to building the textile information society with its new study programmes Design and Textile Materials was presented. When designing the study programme, we were aware that in the future, the textile professionals will need in-depth knowledge and practical experience related to modern computer-based information. Good knowledge and understanding of information science and computer-based information systems is indispensable for a success and even for survival garment manufacture companies. The managements of garment manufacture companies expect from universities and other higher education institutions such graduates who will be able to help them in setting the investment priorities and recognising the latest trends regarding the computer-based information systems for modernising different processes within their companies. systems. More than ever, the textile professionals will have to master also advanced computer software for simulation and visualisation of different textile forms and creation of virtual textiles and garments.

5 REFERENCES

[1] The new study programme Design and Textile Materials, Working group of the Department of Textile Materials and Design, University of Maribor, 2006.

[2] The new study programme Textile Design Technologies, Working group of the Department of Textile Materials and Design, University of Maribor, 2008.

[3] House D.H. and Breen D.E., *Cloth Modelling and Animation*, AK Peters Natick, Massachusetts, 2000.

[4] Volino, P. et al.: From early garment simulation to interactive fashion desing, *Computer-Aided Design*, Vol. 37 (2005) No. 6, pp 593-608, ISSN 00101-4485

[5] Magnenat-Thalmann, N., Volino, P.: From early draping to haute couture models: 20 years of research, *The Visual Computer*, Vol. 21 (2005), No. 8-10, pp. 506-519, ISSN 0178-2789

[6] Volino, P. et all.: From Measured Physical Parameters to the Haptic Feeling of Fabric. *The Visual Computer*, Springer, Vol. 23 (2007), No. 2, pp. 133-142, ISSN 0178-2789

[7] Gao, C.Y. et all.: *Body Scan Data Repair Based on Software Integration*, < http://www.asd.polyu.edu.hk/lab/upload/Conference_Papers/2010_Body%20Scan%20Data%20Repair%20Based%20on%20Software%20Integration.pdf.> [accessed: 23.10.2010]

[8] D'Apuzzo, N.: Recent advances in 3D full body scanning with applications to fashion and apparel, <http://www.hometrica.ch/publ/2009_optical3d.pdf>[accessed: 23.10.2010]

[9] Kawabata, S., The Standardization and Analysis of Hand Evaluation. The Hand Evaluation and Standardization Committee, The Textile Machinery Society of Japan, 2nd Edition, Osaka, 1980.

[10] DE BOSS, Alan. The FAST System for Objective Measurement of Fabric Properties, Operation, Interpretation and Application, 1991

[11] ABAQUS User Manual. Volume I, II, III, Version 6.2, Hibbitt, Karlsson & Sorensen, Inc. United States, Plymouth, 2000.

[12] OptiTex - Next Generation 2D/3D CAD, <http://www.optitex.com/en/products/main_modules>. [acessed 23.10.2010].

Corresponding author:
Andreja RUDOLF
University of Maribor, Faculty of Mechanical Engineering, Department of Textile Materials and Design
Smetanova 17
2000 Maribor, Slovenia
Phone: +38622207964
e-mail: arudolf@uni-mb.si