

3D Virtual Prototyping of Garments: Approaches, Developments and Challenges

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Abstract

The paper deals with the 3D virtual prototyping of garments since they represent an important tool for both textile and garment designers. It offers simple introduction of changes while developing a model in comparison to conventional techniques, quick response to the customer's demands and wishes regardless of their location. Moreover, 3D virtual prototyping of garments can successfully replace prototyping processes when the specific garments are designed e.g. garments for people with the non-standard body figure, wheelchair users, sportswear etc. The advantages and disadvantages of virtual prototyping of garments, used processes and methods, as well as the suggestions for new research opportunities on the field of virtual simulation of garments and textile materials are presented.

Keywords: 3D Virtual Prototyping; Ski-jumper Suit; Garments for People with Paraplegia

1 Introduction

Development of new computer technologies, which are closely linked to all of textile fields, ranging from designing and construction of fabrics, to custom made clothes and from virtual fashion shows to e-trading, has been a driving force for this type of progress over the last years. Nowadays, the textile and garment manufacturing companies use virtual reality computer tools to produce digital prototypes of textile forms in order to decrease the manufacturing process and material costs.

Garment virtual prototyping is a technique in the process of garment development. The main purpose of virtual prototyping is to construct a clothing model, which would then be adjusted to the customers' demands and wishes. During the virtual prototyping, process customers and developers of the model are familiarized in details using different computer technologies regardless of their location. Thus, virtual prototyping presents one of the most important links in the chain of manufacturing the garments or other textile products.

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In this article the approaches, developments and challenges used for virtual prototyping of garments simulation are presented. At the beginning, the theoretical backgrounds of computer simulation of textile materials and fabric parameters needed for computer simulation are shortly presented. Further, the paper is focused on presenting the virtual prototyping of regular garments, garments for special applications, such as suits for professional sportsmen and people with the special needs. The advantages and disadvantages of virtual prototyping of garments, used processes and methods, as well as the suggestions for new research opportunities in the field of virtual simulation of garments and textile materials are presented.

2 Computer-Based Simulation of Textile Materials and Garments

Virtual garment simulation is result of a large combination of techniques that have evolved during the last decade. A number of simulation methods have been presented having different goals, such as accurate physical simulation of cloth draping over objects, realistic clothing of virtual 3D character models or generation of fast visually-pleasing cloth animation for applications needing (soft) real-time performance [1, 2]. Fabric modelling presents an important field in garment virtual prototyping because the realistic behaviour of a garment in virtual environments mainly depends on developed computer-based fabric models. Moreover, with computer fabric models, the researcher can study mechanical and physical properties of the fabric in virtual environments. This means an opportunity for the development of textile materials depending on suitable testing methods. Fabric modelling techniques within the computer graphic community are classified into three categories [3-5]: geometrical, physical, and hybrid models.

Geometrical models were the first techniques to be used in computer graphics for fabric simulation. The main interest of the used geometrical models for fabric simulation application is to have a computationally efficient and highly controllable model, which can perform the simulation well within certain predefined fabric behaviour. Using the geometrical models only the geometric shapes are displayed, and no material properties of the objects are taken into consideration. In addition, it is very difficult to represent with the geometrical models some special deformations, such as wrinkles and various sizes of folds [4]. The physical-based models for modelling the fabric deformation are based on the structures and properties of cloth materials [3]. The hybrid models are constructed by the combination of the physical and geometrical-based methods, therefore they present great challenges with consequences for development of computer technologies in modelling deformations of highly flexible and complex materials, such as a piece of fabric [6].

2.1 Fabric Parameters for Computer Simulation

For computer simulation, the fabric should be described with a set of parameters, such as the imposed deformations, constraints, or force patterns to define the fabric behaviour that occur in some applications. The mechanical behaviour of fabric is inherent to the nature and depends on fabric compositions, raw materials of yarns and finishing process during the manufacturing. The properties of the fabric have very deformable characteristics, therefore for computer simulation should be taken into account [7]: elasticity, which characterizes the internal forces resulting from a given geometrical deformation, viscosity, which includes the internal forces resulting from a