The Role of the Latest Clothing CAD/CAM System Applications in the Educational Process

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Abstract **– Modern computer-aided designing software provides the possibility to improve precision, productivity and to organize the information flow. Computer systems allow making two-dimensional and three-dimensional product illustrations and visualizations. To learn how to use the CAD/CAM systems, there are several systems taught at the Institute of Textile Materials Technologies and Design. The systems providing full garment development and production cycle are important for the manufacturing and, hence, for educational purposes.**

Keywords **– CAD/CAM, clothing design, pattern making, garment virtual try-on.**

I. Introduction

Modern computer-aided designing software provides possibility to avoid small operations and manual work, to raise precision, productivity and organize information flow [1]. The usage of garment designing systems excludes the time-consuming manual preparation of patterns, creation of layouts and relocation of written information. The computer systems are meant for the execution of every single process and the integration of all processes into one joint flow, for the organization of logistics and the mobility of work tasks [2].

The computerization of different processes in the garment industry is necessary to reduce the costs of a product and raise the competitiveness. Computer-Aided Design (CAD) is the usage of computers for technical elaboration. Computerized designing systems usually work in the dialog mode and use software specifically designed for the development of industry specific objects, input/output of graphics, scanners and other remote devices.

Computer systems allow making two-dimensional and three-dimensional product illustrations and visualizations [3]. It is possible to create computer-aided garment patterns, gradations, and a virtual first pattern of the model – such computer-aided operations significantly decrease the time consumption and costs necessary to design a product. The costs of a product can be calculated with the help of the product management systems following the development parameters, the layout of patterns, textile expenditures, model complexity and specification, as well as previous experience of the company stored in a database.

Although computer systems significantly facilitate the development of a product, the knowledge and skills of the user are still very important [4] [5] [6].

Since the CAD/CAM systems do not solve apparel designing in terms of knowledge, it is important to acquire knowledge of designing and other projecting stages along with the usage of CAD/CAM systems.

II. The Use of Clothing CAD/CAM Systems in the Educational Process

The students of the Institute of Textile Materials Technologies and Design, Riga Technical University are enrolled with different levels of training – with and without knowledge in garment designing. Often it turns out that the preliminary knowledge is weak or superficial and needs to be improved. Therefore, all students have to master apparel designing – sketching, constructing, designing and gradation of templates before the acquiring of the CAD/CAM system.

To learn how to use CAD/CAM systems, there are several systems taught at the Institute of Textile Materials Technologies and Design: Grafis, Comtense, Staprim, Lectra, Gerber and Koppermann.

3D virtual garment imitation is provided by the CAD system Lectra. Goals and objectives of the study course are to provide students with knowledge and skills necessary to work with the CAD system Lectra, as well as introduce students to 3D garment designing.

Students should acquire knowledge on the structure of the clothing CAD system Lectra; development principles and functions on the basis of Modaris V6R1; the principles of garment pattern design; the rules of pattern grading by size; the definition of a style and its versions; marker making subsystem Diamino V5R4; choice of styles and sizes; creating markers on fabrics with definition and changing parameters; preproduction garment specifications using KaledoStyle V2R2; preparation of pattern blocks for 3D imitation in CAD LectraModaris 3D Fit V5R2 (Fig.1).

The acquisition of systems takes place together with practical apparel designing – the manually executed tasks are performed on the computer afterwards with the help of the CADCAM systems. Thereby, the existent knowledge is extended, new knowledge is acquired and work productivity and the usage of CAD/CAM systems is favored.

The systems used so far have allowed executing all designing tasks – creating a drawing of garment, deriving versions of it, creating visualizations, developing, deriving and drawing up patterns, creating patterns, making markers. However, recently with the demand for made-to-measure garment design, it becomes a trend to extend 2D clothing CAD systems into 3D CADs [7] [8] [9]. 3D garment virtual display is one of the most interesting branches in the clothing field – as 3D virtual representation of clothing provides high potential for design, garment development and marketing: catalogues, e-commerce, made to measure, etc. [10] [11] [12] [13].

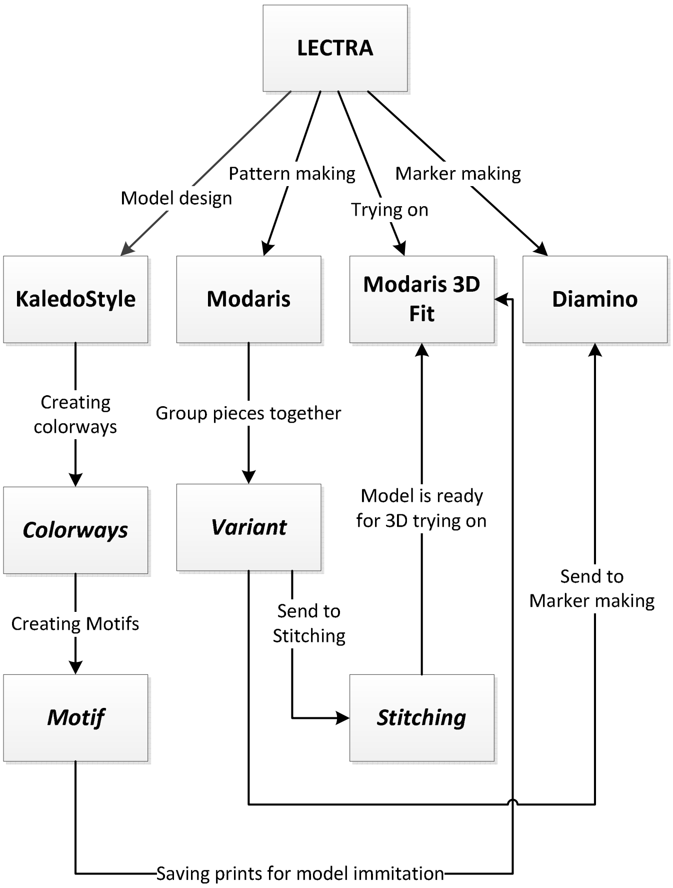

Fig. 1. The structure of clothing CAD system Lectra

It is not only the theoretical basis that is extended during the acquisition of CAD/CAM systems, but practical testing of patterns by printing them and sewing garments, as well as designing in a virtual environment – these results have to be compared and conclusions have to be drawn regarding the system operation.

III. The Role of CAD/CAM systems in Education

One of the most important garment creation stages is constructing. The systems providing full garment development and production cycle are important for the manufacturing and, hence, for educational purposes [14] [15].

Tasks for the students working with the CAD systems are combined manufacturing tasks: to create computer-aided garment patterns, gradations, and a virtual first pattern of the style. By fulfilling these tasks, students are able to acquire the basics of CAD/CAM systems (for example, Lectra – Modaris, Diamino, Kaledo, Modaris 3D Fit) [16].

Students receive samples, instructions and tasks to do in order to achieve the learning outcomes (to be familiar with the CAD system).

The study course starts with the introductory lecture: the description of CAD systems and garment 3D development. Within the next lectures, the development processes in the garment CAD system Lectra and its structure are described. To obtain external pattern blocks (from the CAD system Grafis), import and export of pattern blocks in different CAD systems are considered. The editing of graphical objects in the CAD system Lectra module Modaris and the creation of graphical objects in the CAD system Lectra module Modaris, internal lines, and seams are also described. The preparation of pattern blocks for 3D imitation in the CAD Lectra Modaris 3D Fit and the simulation of fabric design are acquired.

Apparel designing tasks are carried out sequentially within a semester, and the process can be divided into the following stages:

- Acquisition of anthropometrical data, calculation of ease allowances, development of the basic construction in the CAD GRAFIS, development of the model to verify the construction. Export of the graphic data items of the basic construction into the CAD LECTRA, development of the template layout.
- Input of anthropometrical data for the parameterization of a #D mannequin, development of a personalized mannequin in the CAD LECTRA. Imitation of the basic construction in the 3D environment in the CAD LECTRA, comparison of photographs of the imitation and the model.
- Development of model drawings, decoration, choice of the textile material (one or more patterns), pattern and colour solution, creation of different variations in the CAD LECTRA.
- Development of schematic images of model constructions. Development of model constructions, saving data to the CAD LECTRA
- Processing of graphical data to prepare for work with a 3D imitation in the CAD LECTRA. Imitation of all models in a 3D environment in the CAD LECTRA, evaluation of the appearance of models.

A. Import and Export of Templates

To develop basic construction templates, first of all, an appropriate designing methodology in the CAD GRAFIS has to be chosen for the particular assortment. The choice has to be justified. The acquisition of anthropometrical data has to be described briefly; the measurement table with individual body measures necessary for the CAD GRAFIS usage, the ease allowance calculation according to the assortment have to be inserted. A basic construction has to be chosen for the

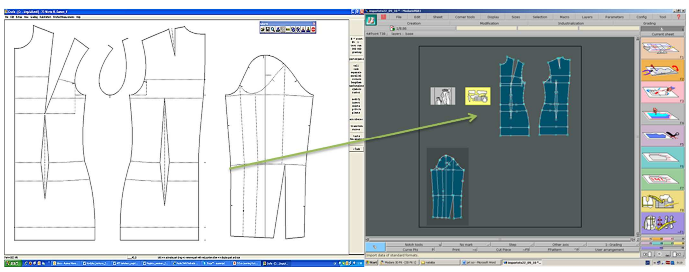

Fig. 2. Export of patterns from the CAD GRAFIS to the CAD/CAM LECTRA (the author Natālija Truskovska)

developed individual measurement table/size and the ease allowances; interactive designing has to be carried out for ease allowance usage, ease allowance values have to be justified. If the basic model of the planned collection is not a basic construction, modeling has to be carried out, templates without seam over-measures have to be designed – this way, templates can be exported to the CAD/CAM LECTRA without graphically changing the templates.

The created templates are printed (to cut the sewn model) and exported to the CAD/CAM LECTRA (to create the virtual model) (Fig. 2).

After the development of templates, model verification is carried out and, if necessary, corrections are implemented.

B. Model Verification

To create a model in a virtual environment, several activities have to be carried out. Templates have to be processed according to the requirements of the 3D imitation system. The template set has to be defined in the system, and a template number and symmetry definition have to be performedin its subsystem variant. A sewn seam definition has to be carried out through this subsystem in the subsystem 3D Fit Stitching (Fig. 3), as well as it is necessary to define Slip on Points for all body parts, the neck hole and others, if appropriate.

To be able to compare the sewn garment and the virtually

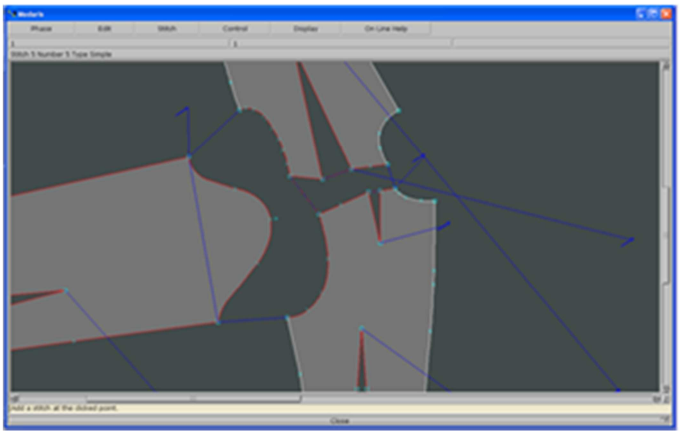

Fig. 3. Seam definition – a fragment (the author Inese Pazāne)

created one, an individualized parametric mannequin is developed. The system offers differently built mannequin models for men, women and children of different ages. For the3D parameterization of a mannequin, the input of anthropometrical data is carried out and, as a result, a personalized mannequin is created in the CAD LECTRA.

The imitation of the basic construction in a 3D environment in the CAD LECTRA is a result of sequential activities. At first, an individualized mannequin is created in the system MODARIS 3D Fit, the defined Slip on Points are tested, the prepared model is opened, a version is chosen with defined seam connections and Slip on Points, an appropriate fabric is chosen (preferably similar to the sewn garment by its fibre structure and colour). The system reflects the steps of the virtual fitting process. At first, the parts are automatically placed onto the mannequin (according to the defined Slip on Points), then the cloth draping is carried out (according to the chosen parameters). The finished garment can be viewed from different angles and the tautness and fit can be measured.

The developed imitation images have to be compared to the

Fig. 4. Model comparison – back view (author Annija Ķesele)

real sewn model photographs. The comparison has to be done from three angles (front view, side view, and back view). It is necessary to evaluate the appearance and fit of every model (real or imitated) and compare them mutually (Fig. 4).

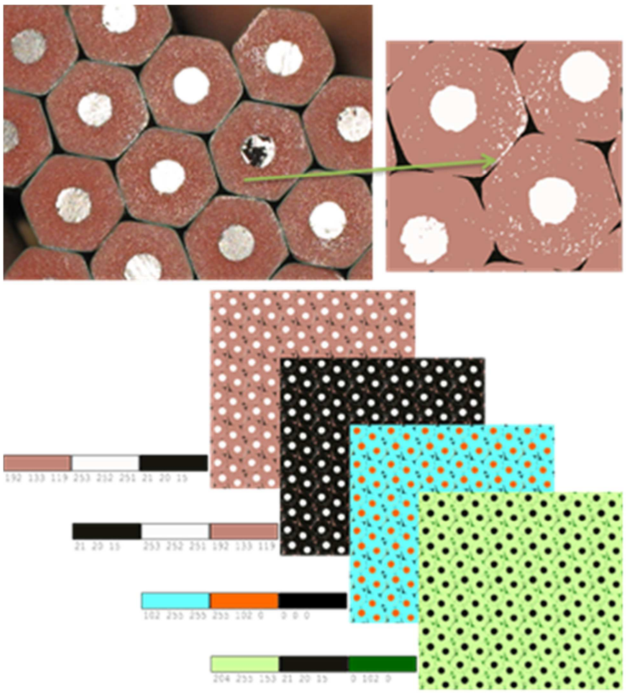

Fig. 5. Print pattern (pencils), its reduced picture and colour variations

C. Visual Design of a Model

Technical drawings, a model description, seam cutting schemes and specifications have to be developed for the chosen model. An appropriate textile fabric (or several) has to be chosen for the developed model, its characteristics have to be described briefly, a pattern has to be scanned and added. The choice has to be justified. A picture, an object (its picture), a landscape or another inspirational object have to be found.

Fig. 6. Print pattern versions – the technical drawing and the 3D model

The picture colouring has to be selected in the CAD LECTRA to use it for the creation of the textile material colour version collection. According to the topic of the inspiration source, several (at least 3) print patterns have to be created in the CAD LECTRA – striped, checkered, dotted, floral design, large pattern, small pattern, etc. The number of prints depends on the inspiration and the specifics of the model. 2-3 colour versions have to be created for the prepared print versions (Fig. 5).

Insert colours, prints, textures into the model drawings according to the concept. The prepared model has to be demonstrated in all colour variations (Fig. 6).

D. Training Benefits

The students learn how to work with the latest CAD/CAM systems. They obtain knowledge and skills necessary to compare and analyze the accomplished tasks.

The students also identify the advantages and disadvantages. As a result, all students admit that working with 3D imitation systems is important in the CAD/CAM system development process. Nevertheless, a majority of students also notice the following disadvantages:

- When defining the measures of parametric mannequins, it is difficult to input the precise ones; similarly posture features can be defined only partially; besides, an asymmetric figure cannot be created at all. But it has to be admitted that for industrial modeling and model verification (where standard body mannequins are used), as well as for advertising material, the existing parametric mannequin is suitable.
- Imitations of model constructions are mostly successful after several attempts. If problems appear during imitation, causes can be searched by sewing a style step by step: first, sewing together the back part and the front part and then trying to imitate them in a 3D environment. After that sleeves or yokes can be added and the imitation can be repeated. That way the problem and a solution can be found. It can be concluded that a particular error definition has to be given; a connection between parts has to be created in different stages.
- Narrowness looks different on the screen from the sewn garment. Since all seams are sewn (including the front fastener seam), the narrowness looks like holes or gaps, horizontal wrinkles, a deformed armhole or other detail on the screen – trying on any too tight garment it would be impossible to pin down.
- It is impossible to sew gatherings or plies into a seam as an additional pattern is necessary. If it is necessary to sew two crinkled garment parts or two ply parts, it is necessary to design a separate template that is sewn between the crinkled/plied parts as a narrow ribbon.
- The system does not foresee shoulder padding; thereby, it is very difficult to create particular assortment garments (coat, jacket etc.).
- A ribbon or band loosely knotted or tied into a bow or decorative elements are impossible within a 3D imitation.
- It is possible to sew on a ruffle in the middle of a garment (as a second level imitation detail), but it is not possible to define a detail that resists gravity due to the material characteristics (fusing fabric or carcass).
- Essential difficulties appear if the garment imitation is cancelled during the process because there is no integrated possibility to "undress" the virtual mannequin and start the imitation again (there is a possibility to undo the latest action several times in a row, but the computer capacity is sometimes insufficient for this procedure).

IV. Conclusions

Apparel designing is the development of a technical documentation complex that ensures the production of a garment. In the technical documentation, the apparel model is described in a graphical, numerical and verbal way. CAD has a significant role in the creation of this documentation.

CAD systems allow making two-dimensional and three-dimensional product illustrations and visualizations. It is possible to create computer-aided garment constructions, gradations, and a virtual first pattern of the model. Such computer-aided operations significantly decrease the time consumption and costs necessary to design a product. The costs of a product can be calculated with the help of the product management systems based on the development parameters, the layout of patterns, textile expenditures, model complexity and specification, as well as the previous experience of the company stored in a data base.

Modern computer-aided designing software provides a possibility to avoid manual work, to raise precision, productivity and organize information flow. The usage of garment designing systems excludes the time-consuming manual preparation of patterns, creation of layouts and relocation of written information. The computer systems are meant for the execution of every single process and the integration of all processes into one joint flow, for the organization of logistics and the mobility of work tasks.

After the study course, the students are able to import and export pattern blocks in different CAD systems, to create and use grading tables for garment designing, tocreate model pattern blocks using graphical edition, as well as create patterns from model or basic blocks. Ability to work with such functions has been shown in computer labs.

The students are able to create style patterns or basic blocks and technical specification. Within the study project, students demonstrate their skills to create logical and effective steps of designing and development, also to use development principles and functions of system and changeable parameters of pattern. Students can create model patterns and perform3D simulation in the CAD system Lectra. In the study project, the students prove their ability to create correct garment 3D simulation, fix errors and create a visual design.

Since the development of a concept for industrial collections is very expensive and the realistic virtual environment reproduction is the key that allows evaluating the article during the designing phase, it is important to introduce future specialists to the latest technologies during the training process.

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Inga Dāboliņa, Ausma Viļumsone. Jaunāko apģērbu CAD/CAM sistēmu lietošanas nozīme izglītības procesā.
Datorizētā projektēšana (CAD/CAM sistēmas) veicina ekonomiskuma, efektivitātes un kvalitātes nodrošinājumu – tai ir šādas priekšrocības: uzlabota produkcijas kvalitāte, augstāka produktivitāte, darba apstākļu humanizācija, elastīgāka ražošana, procesu kontrole, iespēja saistīt ražošanu ar pasūtītāja vēlmēm (ātra reakcija). CAD/CAM sistēmas ļauj izveidot gan divdimensiju, gan trīsdimensiju projektējumu un produkta attēlojumu. Lai apgūtu CAD/CAM sistēmas Rīgas Tehniskās universitātes Tekstilmateriālu tehnoloģiju un dizaina institūtā tiek mācītas dažādas sistēmas: Grafis, Comtense, Staprim, Lectra, Gerber un Koppermann. Tā kā sistēmas, kurās tiek nodrošināts pilns ražošanas cikls, ir svarīgas ražošanas optimizācijā, tad šādu sistēmu lietojums apģērbu projektēšanu

studējošajiem mācību procesā arī ir ļoti nozīmīgs. Sistēmu apguve notiek līdztekus praktiskai apģērbu projektēšanai – iepriekš apgūtie manuāli izpildītie darbi tiek izpildīti datorizēti – ar CAD/CAM sistēmu palīdzību, tādējādi tiek padziļinātas esošās zināšanas, integrēti apgūtas jaunas zināšanas un veicināta darba ražība un CAD/CAM sistēmu lietojums. CAD/CAM sistēmu apguvē notiek ne tikai teorētiskās bāzes padziļināšana un paplašināšana, bet arī konstrukciju praktiska pārbaude, tās izdrukājot un šujot maketus, kā arī maketēšana virtuālajā vidē – šie rezultāti jāsalīdzina un jāizdara secinājumi par sistēmu darbību. Studenti iemācās darboties ar jaunākajām CAD/CAM sistēmām, iemācās salīdzināt un analizēt paveikto. Analizējot studenti identificē kā sistēmas priekšrocības, tā trūkumus. Tā, piemēram, visi studenti atzīst, ka darbs ar 3D imitācijas sistēmām ir nozīmīgs solis apģērbu CAD/CAM sistēmu attīstībā, tomēr vairums saskata nepilnības, daļa dod iespējamos risinājumus un/vai ieteikumus. Tā kā apģērbu pirmparauga izstrāde rūpnieciskajās kolekcijās ir ļoti dārga un virtuālās vides reālistisks attēlojums ir tas, kas ļauj novērtēt izstrādājumu vēl projektēšanas posmā, tad topošos speciālistus ir jāiepazīstina ar jaunākajām tehnoloģijām jau studiju procesā.

Инга Даболиня, Аусма Вилюмсоне. Использование новейших САПР одежды в процессе обучения.
Преимущества САПР по сравнению с традиционным проектированием: улучшается качество продукции, повышается производительность, улучшаются условия труда, производство становится более эластичным, осуществляется контроль над процессами, существует возможность быстро реагировать на требования заказчиков. Результатом САПР могут быть 2D или 3D проект или изображение изделия. В Институте технологий текстильных материалов и дизайна Рижского технического университета для обучения используются несколько САПР: Grafis, Comtense, Staprim, Lectra, Gerber и Koppermann. САПР обеспечивающие полный цикл производства очень важны для оптимизации производства, то их использование при обучении проектированию имеет большое значение. Осваивание работы с системами проводится одновременно с практическим проектированием одежды- ранее освоенные ручные приёмы выполняются при помощи компьютера. Таким способом углубляются ранее приобретённые знания и, в контексте с повышением производительности, осваиваются новые знания на базе САПР. Обучая САПР не только расширяются и углубляются теоретические знания, но и практическая проверка макетированием распечатанных конструкций, а также виртуальным макетированием. Результаты сравниваются и делаются выводы о работе системы. Студенты осваивают приёмы работы с новейшими САПР, приобретают навыки сравнивать и анализировать результаты. В анализе студент выявляет преимущества системы, а также их недостатки. Так, например, все студенты признают, что системы симулирования 3Д являются значительным шагом в развитии САПР одежды, однако многие замечают недостатки в работе системы, некоторые предлагают возможные способы совершенствования. Так как изготовление первичных образцов промышленных коллекций дорогой и трудоёмкий процесс, а использование виртуальной среды позволяет делать начальную оценку моделей одежды, необходимо будущих специалистов ознакомить с новейшими технологиями уже в процессе обучения.