COMPUTER AIDED PROCESS PLANNING SYSTEMS FOR APPAREL INDUSTRY: CAT FOR WINDOWS AND CIM FOR TAILOR-MAKING

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Summary

Revolution of informatics has affected the apparel industry as well. There are CAD, CAM and CIM systems in industry. We have developed computer systems for apparel industry for more than ten years at the Departments of Polymer Engineering and Textile Technology and the Laboratory of Informatics at the Faculty of Mechanical Engineering at Technical University of Budapest. This lecture is about our results in fields of dress patterns and layout-design.

1 BASIC CONCEPTS

- *Modelling*: modifying the basic pattern upon the plans.
- *Grading*: scaling the middle size pattern with the help of size-tables
- *Grading rule*: moving the points of patterns as a function of size.
- *Layout*: arranging patterns on textile taking the material features into consideration to have economical tailoring.

2 RESULTS OF PRELIMINARY RESEARCH

We started to work out our first system in 1983. It was clear that solutions were needed to some evident problems. Upon our analysis the main problems to clear are the following.

2.1 Geometrical Description System of Pattern, Points and Their Codes

The core problem is the description of the front-curves in patterns. These curves consist of lines and second order continuous curves. We have selected a well-known mathematical approximation method for control-points to describe these curves.

We can distinct the main points of patterns upon their function.

> Grading points can be moved with a vector derived from the connected grading rule. Basic types are:
  - Break points (T, TC), the curve is only continuous in first order.
  - Pinch-points (C), the curve is continuous in second order
> Slave-points, grading vectors are derived automatically by the system. They define the shape of the curves and they are defined by approximation.

We can distinct the front-curves of the patterns with the help of grading points:

> The break points limit the line and free-form sections of the pattern curves. We use a second order continuous curve between two neighbouring break points.
> The break points and the pinch-points divide pattern curves into sections. There are grading rules only at the limiting points and they define pattern scaling.

We can say that point data in order in the pattern curves are needed for geometrical description and for grading:

- co-ordinates of points,
- function-codes of points
- order numbers of grading rules at every grading point.

2.2 Proper Approximation of Free-form Front Curves in Patterns

We have selected the third order B-splines for approximation because of their excellent properties. They are used in computer graphics because of:

- easy computing and the parametric possibilities,
- curves are second order continuous,
- curves can be modified locally because of the section usage.

We have selected the most apparent approximation - third order B-Splines with 0 curvature at the ends - upon a special searching examination.

2.3 Unified Description System for Grading Rules Based on Qualities of Size-tables

Grading rules can be defined with the help of co-ordinates of their vectors. There are as many vectors in a rule as many size combinations in a size-table.
We can distribute rules upon sizes in height and width as general characteristics. There are functions between sizes and rules used in database management.

2.4 Mathematical Methods of Grading

Grading rules are defined at grading points limiting curve sections of patterns. We search for the scaled curves. The way to define the transformation of scaled curves properly needs professionals.
We have examined proportional transformation methods:

- Proportional transformation upon the co-ordinates in Descartes' co-ordinate-system
- Proportional transformation upon curve-length in Descartes' co-ordinate-system
- Vector based transformation
- Proportional transformation upon curve-length in curve co-ordinate-system

The most apparent method upon our criteria and examinations was the first one - Proportional transformation upon the co-ordinates in Descartes' co-ordinate-system.

3 OUR RESEARCH RESULTS IN COMPUTER AIDED PROCESS PLANNING SYSTEMS

We have developed our computer-aided process planning system parallel with research. Our first system was based on mainframe in 1984, but we have continued our development on PCs since 1985. It was exhibited at the BNV (Budapest International Fair) in 1987 too. We have developed our system under Windows, too. The latest version is under Windows'95. Our system is used at more than 10 secondary schools with good results. We have developed a ready making and process planning system for man shirts with basis.

3.1 „CAT for Windows" Apparel Process Planning System

"CAT for Windows" is for automation of modelling, grading and making layouts in the process of geometric planning phase in textile. The main aim was the teaching of computer aided garment-methods, but the system is ready for industrial usage too. Because of demands the system is under development continuously.

There are three main modules of the program according to the tasks of ready-to-wear industry.

The aim of the *modelling part* is to prepare the patterns for grading. There is a possibility to load the basic patterns or to modify data numerically or with digitizer or mouse and to make daily tasks of garment trading.

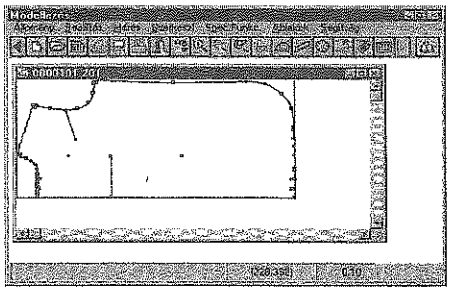

Figure 1. Modelling pattern system of 32 bits

The task of *manager part* is handling grading rules and grading patterns.

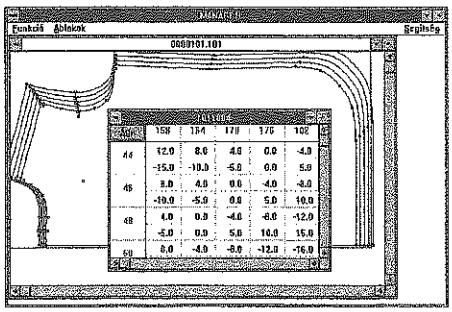

Figure 2. Grading system of 16 bits

Layouts of models in the desired sizes and quantities can be created with the help of *layout part.* Sizes and patterns of the base material can also be defined. Patterns are moveable in the screen in an interactive way.

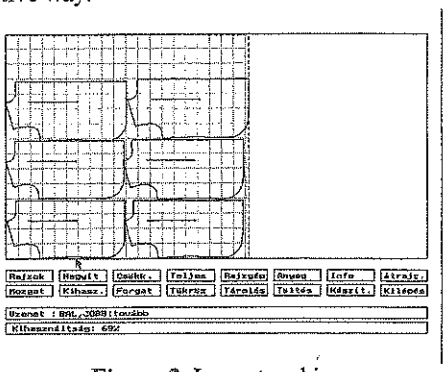

Figure 3. Layout making

3.2 „CIM for Tailor-making"

Nowadays process-planning activities are for tailor-making of cloths. Big software houses are not interested to develop systems for little firms. We have researched how traditional grading could be used for ready-making. There is a special integrated system for tailor-making, process control and management. We have started from grading, but evaluation of grading rules differs from traditional ways. Usually grading is based on height and chest stored in a database.

While tailor-making the grading rules are functions of a lot of body sizes (collar size, waistline, arm-length etc.). Parameters of functions are from a knowledge-base. Retrieved data are corrected by iteration on fitting at critical places.

The system has three independent parts working even three machines.

The input interface is the *Order processing.* Customer data (name, address, sizes) are stored in a Dbase file. This file is the core component of the system.

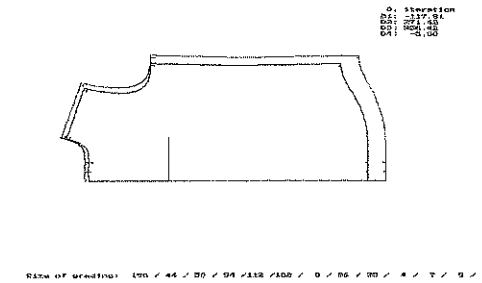

Figure 4. The tailor-making program

The central part collects the patterns needed by the ordered shirts and manages the *tailor-making.* Cuts of suits are collectable from basic patterns as a pile of bricks. Set of basic patterns can be competed.

There is also an interactive program for layouts, cutting programs created by the cutting processor. System can work in batch mode and then there is a process scheduler for the optimum time or material usage.

The third part is the *cutting machine or plotter control*. A driver translates from layouts to cutting commands and stores them in the dBase file.

4 CONCLUDING REMARKS

The lecture is about development and research of the last 15 years, which has not been finished. There are increasing demands for inexpensive systems for special aims. We are going to work with this topic in 3D world researched at various topics.

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