PROCESSES OF SCANNING AND VIRTUAL MODELING OF THE LASTS IN FOOTWEAR INDUSTRY

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Abstract: This work is about how to scann a solid, such as foot or last. There are some proceders to scan the surface of a solid, in our case, the surface of the last. If a 3D foot scan is available, the proposed method will enable the manufacturer to choose the "best-fitting" last from a group of available lasts.

1. INTRODUCTION

The 3D foot scanner will present you a scan with measurement information/ results of the length, width and height of the foot. With the laser foot scanner you will be able to directly scan the foot, the foam box, insole or the corrected plaster cast. To use the plantar surface as foot surface, use the foam box. The laser beam projects itself on the foot sole that has been placed on the glass plate. This beam scans the foot from the back to the front. 1 scan record takes only 5 seconds (Figure 1).

Figure 1.- 3D (3 dimensional) foot scanner [5]

Due to rapid advancements in technology and the globalization of companies, customized products are becoming key to a company's competitiveness, efficiency, profitability and market share. As a result, there is a trend toward extensive collection of individual customer data and the footwear industry is no exception.
Even though the importance of footwear fit and comfort is well surveyed, the term, fit still remains somewhat subjective. A few studies have provided a methodology to quantify fit in 2-D. The 2-D fit metric has been worthwhile to show many footwear fitting problems. In this paper, the 2-D methodology has been extended to 3-D. First, the foot and the last outlines were aligned. Then, considering the heel height and toe-spring of the last, the height dimensions were included in the computation of the potential mismatch between foot and shoe. For ease of interpretation, the mismatch was color-coded. The proposed method enables footwear fit quantification so that fit-related comfort may be predicted. Furthermore, if a 3D foot scan is available, the proposed method will enable the manufacturer to choose the "best-fitting" last from a group of available lasts [4].

2. 3D SCANNING AND ORIENTATION

The left foot of each participant was scanned when standing with half body weight on each foot. The last was scanned using the same scanner. After scanning the foot and last, the 3-D surface coordinates were extracted. Then the coordinate system was established by "fixing" the plantar surface of the foot and last with the (x, z) plane and the “height” dimension along the y-axis.

The 2-D foot outline was extracted from the 3-D scanned data. All points that lay on the (x, z) plane were used to determine the 2-D "shape" information. The points located on the circumference of this 2-D shape were used as the foot outline. The heel centerline of the foot and *last* outlines were then obtained using Matlab. The linear transformation and rotation to obtain the heel centerline from foot outline were recorded. The combined transformation was then used on the whole foot and last surface points to generate the3-D shape [4].

3. MODALITIES OF SCANNING

In the company GMAB, laser scanner which is initially calibrated to a benchmark and with a small sphere is captured position points on the surface to be scanned (Figure 2).

Figure 2.- Laser device

From the last surface is taken as many points in order to create the cloud of points which numerical data processing that is required for interpretation by the CNC machine.

Figure 3.- Download last points on the surface of the laser device

The following pictures are the results of laser scanning device of the last in Laboratory from Faculty of Engineering in Sibiu. Here sits upright last between two points and set a benchmark as a calibration to make measurements (Figure 4).

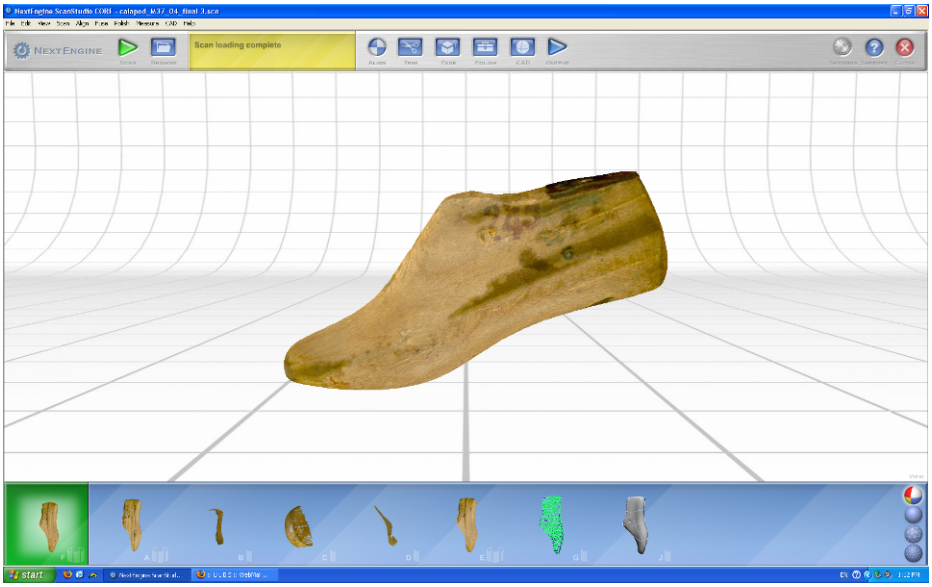

Figure 4.-Capture of the last after scanning

In the laboratory from Sibiu, shoe last can be obtained and casts accurately with Rapid-Prototyping, as the next image shown after the last was made with the stronger powder (Figure 5).

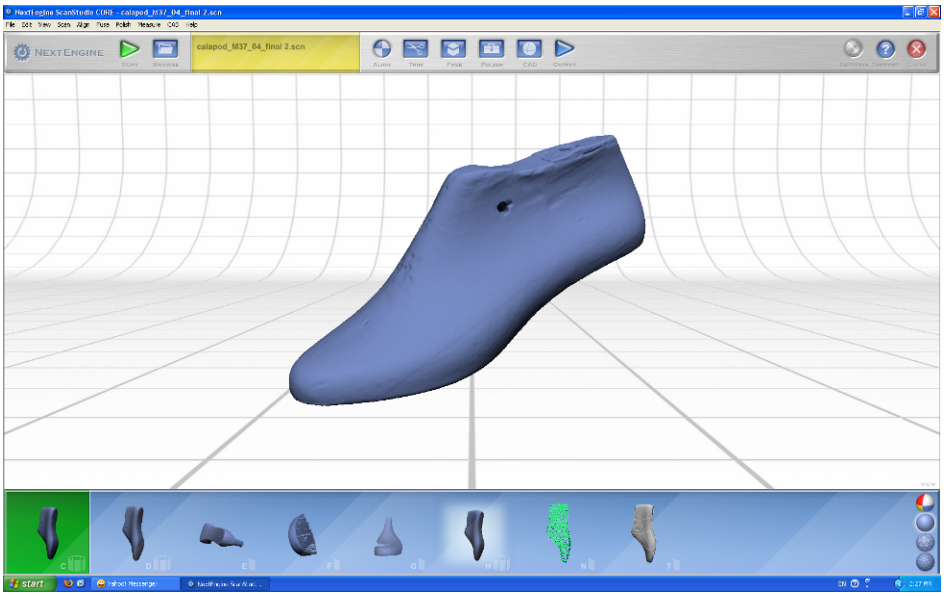

Figure 5.-The model from is made shoe last by Rapid-Prototyping

To make the 3D model of shoe last, it is able to obtain virtual surface composed of 20 smaller areas, and for greater accuracy decomposition and running in 205 areas (Figure 7), in more detail the 1005 area (Figure 8).

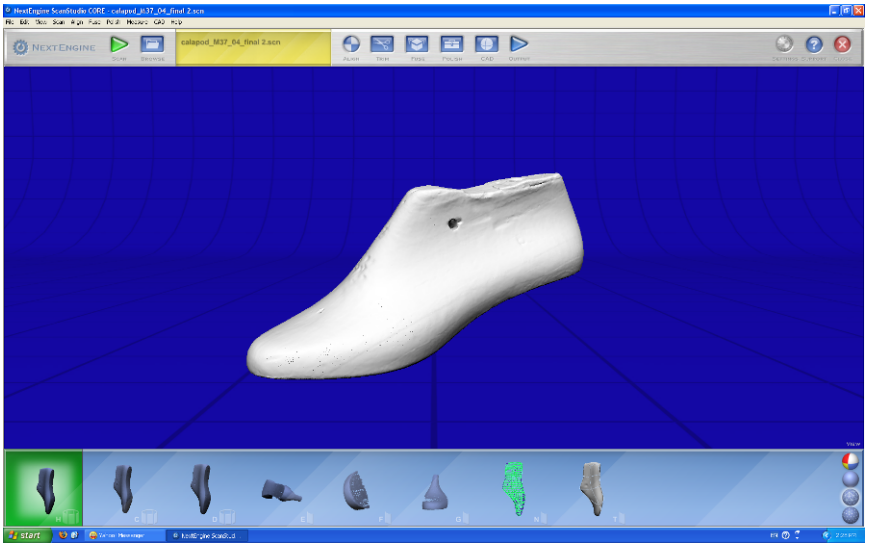

Figure 6.- Image transformed for processing Rapid-Prototyping

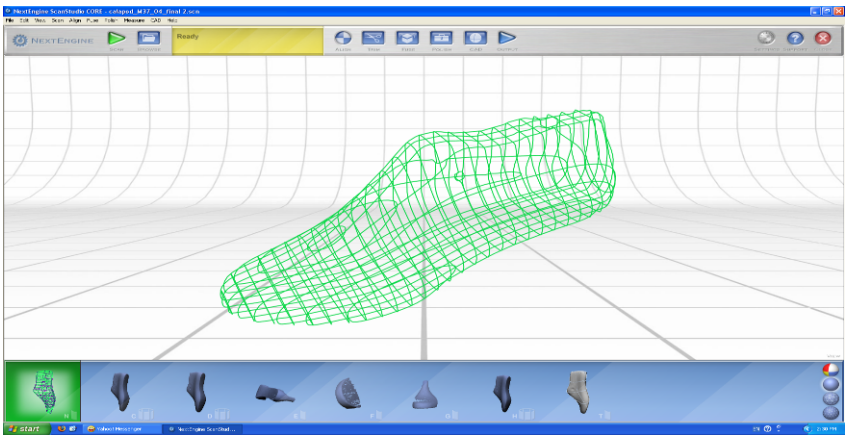

Figure 7.- Grid process with CAD for 205 areas

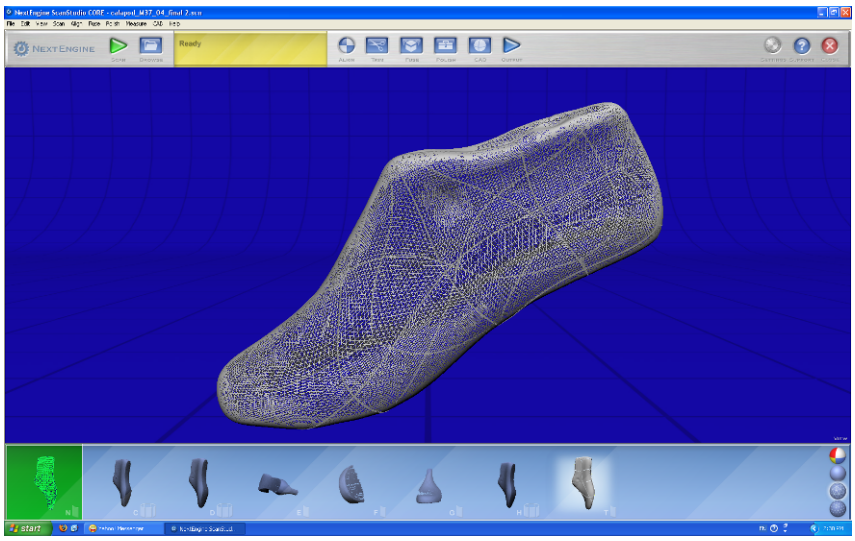

Figure 8.- Transformation of shoe last in the smaller triangle areas (in 1005 areas)

This study can be a way for find the possibility to obtain only the virtual surface of the last and then to transform this surface to fit on an individual foot.
The importance of product compatibility for comfort and satisfaction is well known. Today, consumers select a shoe based on length and width measures even though studies have shown that these two measures are insufficient for proper fitting. In order for a shoe to fit a person's foot, a good understanding of the 3D foot shape is necessary. A good fitting shoe should be free of any high pressure points and at the same time should have the right 'feel' and support. A meaningful way to evaluate footwear compatibility would be to determine the dimensional difference between the foot and shoe. If guidelines or standards can be established for these dimensional differences, then footwear selection can be made much simpler. If a shoe is tight, the pressure or force will produce undue tissue compression making it uncomfortable for the wearer. When the shoe is loose, there will be slippage between foot and shoe resulting in damage or injury to soft tissue. Both these situations are undesirable as they may cause discomfort, pain or even injury to the wearer. Thus, for the right fit, the desirable clearance between feet and shoes should be present in addition to having the foot supported in the most appropriate locations [4].

4. CONCLUSIONS

When the complete foot shape is available, different *lasts* can be selected based on cost, fitting needs and the time available to produce a pair of shoes. The most expensive and time-consuming procedure would be to produce a custom *last* for each individual consumer.
The *last* can be selected using the current sizing method by using foot length and possibly foot width. This method is relatively cheaper and less time-consuming since there is no need to make new *lasts*. However, the degree of fit cannot be guaranteed as foot length and foot width alone is insufficient to generate the complete 3-D foot shape.
Models for surface modeling of free-form surface and massive data points are becoming an important feature in commercial computer aided design/computer-aided manufacturing software. However, there are many problems to be solved in this area, especially for closed free-form surface modeling.

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