

**SMARTTECH 3D**  
*Optical measurement systems*

**Human body shape measurement using SMARTTECH 3D scanner – scan3Dmed**

This is a case study describing human body shape measurement using optical measurement system scan3Dmed and SMARTTECH3Dmeasure software of SMARTTECH company, which is a manufacturer of 3D scanner in Poland. We cooperated with UNITIKA GARMENTS TECHNOLOGY LTD. in preparing this case study.

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## 1. Introduction

UNITIKA GARMENTS TECHNOLOGY, LTD. is a third-party testing agency conforming to the requirements of ISO/IEC17025. We conduct quality measurement and evaluation of plastic products and daily necessities, mainly textile products, and are providing test reports to customers. In particular, we are proud of the development of new evaluation items and test methods that make full use of years of experience and know-how about the functionality and comfort rating of new materials and new products, and we are proposing and implementing tests tailored to customer's needs. In recent years, evaluation of product function by human approach such as human physiological measurement is also enriched.

- (Our main work) - Textile product quality performance measurement evaluation
- Measurement evaluation of safety and hygiene functions
  - Chemical analysis, optical / electron micrograph
  - Evaluation of comfort and functionality
  - Human physiology measurement etc.



In human body physiology measurement, it is sometimes required to measure and compare human figures or to quantify them. For example, the shape of the face before and after face care, body shape and posture when girdle is worn. Among them, there are many needs of "evaluation of difficulty of swelling of legs" by wearing pressure stockings, compression tights, socks and the like. As a conventional evaluation method, we asked the subject to live a day by wearing or not wearing stockings and other items, measure the thickness of the legs in the morning and the evening with a measure, or measure the legs in a container with water to measure the volume of the leg from the amount of spilled water. However, "evaluation of the difficulty of swelling of legs" in such a method is very difficult. This is because the circumferential diameter and volume of the foot due to swelling are not large and accuracy is required. Also, as the feature of the product and the part of the leg that

changes greatly varies depending on the subject, if the measurement point is determined at the beginning, the difference may not be detected in some cases. From these facts, "Evaluation of the difficulty of swelling of the legs", there was a demand for a dimension measurement system that can accurately measure the shape data of the foot, compare it before and after wearing, and between the samples and then determine the measurement spot .

## 2. Measurement work on difficulty of swelling of legs

SMARTTECH's 3D scanner purchased this time can acquire not only coordinates but also colors by projecting white pattern light. Therefore, if you put a landmark on the leg with a color pen, sticker, etc., you can easily find the landmark when calculating perimeter by software.



Fig.1 3D scanning using rotary stage

In addition, since it can measure within the range of height 800 mm, width 600 mm, depth 350 mm, it can be used not only for legs but also for measuring arms and chest. Since the measurement time is as short as 0.7 seconds, it is possible to minimize the influence of human movement and respiration and with high specification of measurement accuracy of 0.1 mm and camera resolution 1.3 MPix, it is possible to measure without any problem if the unevenness of limbs is about. Furthermore, by combining with a dedicated rotary stage, the task of synthesizing a plurality of images is automatically performed on software, so that the time and labor for processing can be shortened. (3D image data of 360 ° in increments of 30 ° : 12 images in total.)

**scan3Dmed scanner specification:**

White LED use / Scan area: 800 x 600 x 350 mm / Scan time: 0.7 seconds

Resolution: 1.3 MPix / Measurement accuracy: 0.1 mm

- Rotary stage specification: Stage: 500 mm  $\phi$  / Load capacity: 300 kg

**3. Data processing**

“SMARTTECH3Dmeasure” attached to the scanner can also perform noise removal of point cloud data and mesh data as well as operation of the scanner. Since you can optionally add area / volume calculation function, you can complete all the work necessary for testing with this software alone. It is possible to attach image data to the report submitted to customers. In addition, it can be stored and re-measured as 3D image data.

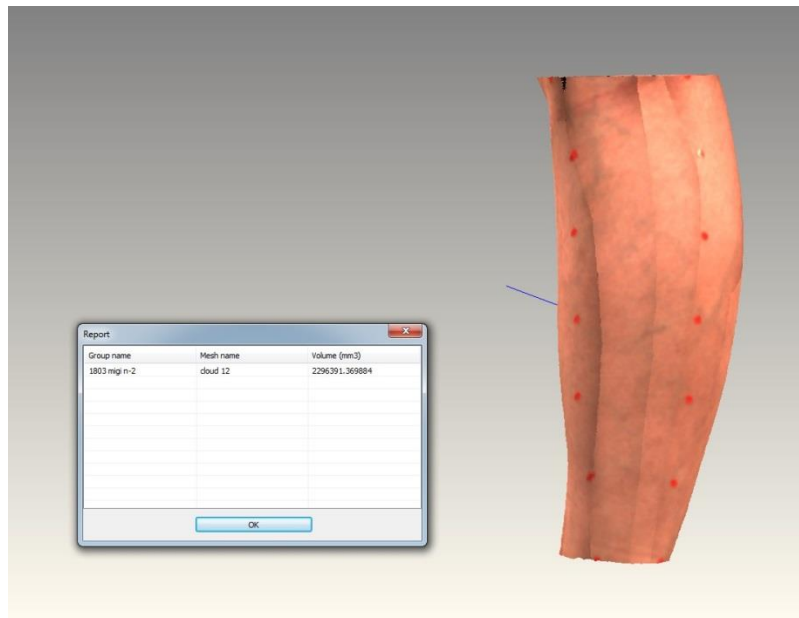


Fig2. Volume measurement by S3DM



Fig.3 Calf measurement image of morning and evening

-Volume capacity measurement  
of foot (calves)

Target:  
4 people

sample	Volume(cm3)			Rate of change (%)
	Morning (10:00)	Evening (16:00)	Change amount	
Socks Type A	2445	2391	<b>-54</b>	<b>-2.2</b>
Socks Type B	2364	2358	<b>-6</b>	<b>-0.3</b>
No socks	2442	2490	<b>48</b>	<b>2.0</b>

Table 1 Volume measurement result table

Calculation shows that the volume is smaller and the swelling is suppressed when wearing pressure stockings than when not wearing it. Also, differences in swelling degree can be discriminated by difference of socks.

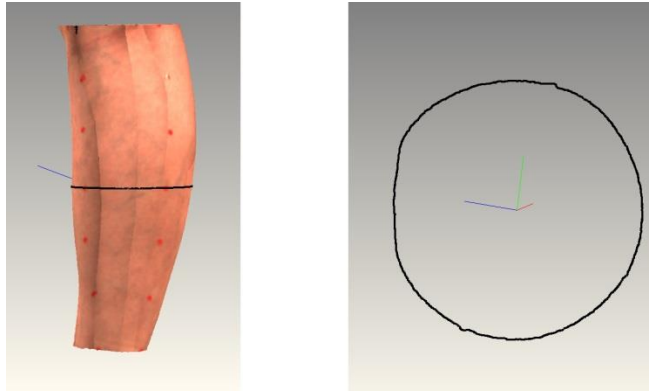


Fig. 4 Leg radius data

Further, the degree of swelling can also be seen from the data of the leg circumference diameter at an arbitrary position.

#### 4. Impressions

Because SMARTTECH scanner can measure in a relatively short time, measurement work can be carried out without burdening the subject. In addition, since 3D image data can be stored with high precision, it is possible to detect small differences, and it becomes possible to perform numerical measurement after comparing images. We believe that it can be used to measure a wide range of human shapes and postures by future upgrade of software.

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