

# Study on Resistance Parameter Setting of Acupuncture Treatment Training System

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**Abstract.** This research is a basic research for bringing the sense of force feedback closer to the real feeling. The force feedback feeling is activated by displaying the part and the acupuncture point of the human body as three-dimensional data, operating the haptic device, touching the acupuncture point, and simulating the insertion action of acupuncture is possible. An evaluation experiment was conducted to determine the resistance parameter for obtaining the numerical value which is the reference of the body's hardness sensation.

## 1 Introduction

Acupuncture treatment is a treatment method useful for improving shoulder stiffness, back pain, neuralgia, etc. by dedicating acupuncture to a specific point of the body. It is effective such as stimulation of biological defense, improvement of blood circulation, and arranging autonomic nerves, by depending on the way of acupuncture treatment [1]. The way the acupuncturist determines the acupuncture point is to touch the patient's skin with a fingertip with an acute sensation, and to feel depression of the tissue under the skin (space such as a dent or a hole) or a lump or tender point [2].

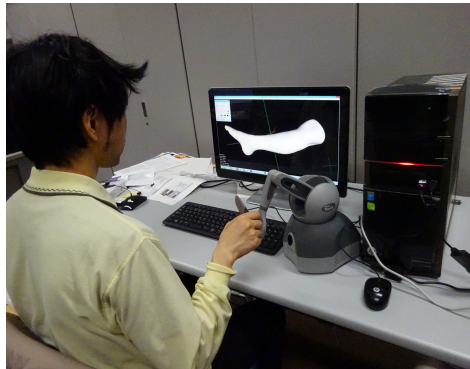
The practice of treatment using actual acupuncture needles is indispensable in ~~the-a~~ training ~~offacility-for~~ professional acupuncturists. In this practical training, after considering safety education, ~~its-trainingsas~~ initially carried out using practice equipment, and then shifts to practical training between students. However, there are many people without sufficient practical training time, and it is difficult for them to become accustomed to performing acupuncture on a real human body.

In order to solve the above problem, we have been developing an acupuncture training system called Acupuncture Trainer (ACT) (Fig. 1), which makes use of a personal computer and a force feedback device [3]. It is possible to practice safe and effective training and treatment by using ACT. ACT can display a three-dimensional (3D) model of the human body with meridian points, and the user can study the meridian points interactively.

The user can pick out a meridian point and read detailed information on the point. ACT can interactively change the transparency of skin, muscle and bone, updating the display in real time. By using ACT, a user can touch the meridian points by using a

haptic device, and is able to perform acupuncture on the virtual human body on the screen. This research is a basic research for bringing the sense of force feedback closer to the real feeling. The force feedback feeling is activated by displaying the part and the acupuncture point of the human body as three-dimensional data, operating the haptic device, touching the acupuncture point, and simulating the insertion action of acupuncture is possible.

However, in the device of this study, there was a problem that reproduction at the time of acupuncture was insufficient compared to acupuncture to the actual body. In order to solve this problem, therefore, we have developed an improved system with the function to change resistance feeling during acupuncture. In this study, an evaluation experiment was conducted to determine the resistance parameter for obtaining the numerical value which is the reference of the body's hardness sensation.



**Fig. 1.** Acupuncture Trainer (ACT)

## **2 Problems in learning and experience of acupuncturists**

### **2.1 Studying acupuncture and moxibustion medicine**

In order to become an acupuncturist, you have to study acupuncture and moxibustion medicine. Acupuncture and moxibustion medicine has too much information to learn, such as anatomy, physiology and pathology, in addition to acupuncture points and oriental medicine, so that you can understand it. However, it is said that priority is given to acquiring skills that can be calmly dealt with in matters that would be encountered in clinical practice in actual therapy [4].

### **2.2 Problems in acupuncture and moxibustion clinical training**

Acupuncture is done by the knowledge of the human body structure of the acupuncturist because it is not visible visually in the skin. The fear of the patient who is stabbed with acupuncture in the skin which the acupuncturist can not see is

removed, Acupuncturists behave as if the inside of the skin can be seen, thinking the patient's mental state as the top priority, and reducing patient anxiety.

### 3 Acupuncture Trainer (ACT)

#### 3.1 Overview of ACT and development environment

In order to solve the problems mentioned above, we have been developing "Acupuncture Trainer (APT)" (hereinafter referred to as "APT") that improves the skill level of acupuncturists as our previous study. In this system, it is possible to simulate the insertion operation of acupuncture by displaying the part of the human body and the acupuncture point as 3D data on the PC display and operating the haptic device with force feedback. In the 3D display screen, it is possible to change the target part (foot, arm, torso) and adjust transparency (skin, muscle, bone) Furthermore the position and information of acupuncture points are displayed (Fig. 2).

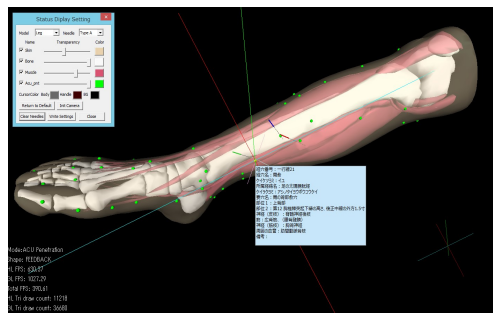


Fig. 2. Main screen of ACT

It is possible to learn the acupuncture point of a part. The haptic device with force feedback used in APT is shown in Fig. 3 [5]. This device's feeling changes depending on the position of the tip of the acupuncture due to contact with the stylus. This feedback resembles the feeling of actual acupuncture of the body. Simulation is possible. We created three training models for foot, arm, and torso, and the meridian points were prepared on the skin of the foot, arm, and torso.

Our ACT was running on Microsoft Windows. We have used a professional haptic device (Touch) from 3D Systems Ltd. For software development, we have used Visual C++ 2017, the MFC (Microsoft Foundation Class) library, OpenGL, and the OpenHaptics toolkit.

In the previous system, resistance at the time of acupuncture is expressed only by a fixed value of each tissue (skin, muscle, bone), and a human body such as depth sense, hardness sensation of muscle tissue, resistance of fascia. We added the ability to change the sense of resistance at the time of acupuncture, and we improved the force feedback feeling based on the resistance parameter.



**Fig.3.** Tactile device with force feedback used in APT (Geomagic Touch)

## **4 Evaluation**

### **4.1 Overview of experiment**

The purpose of this experiment is to determine the resistance parameter of the improved system. Although it is difficult to experiment with the actual human body, if the touch feeling with the force feedback with the force feedback can be reproduced on the silicon plate used in the learning of acupuncture and moxibustion It is assumed that more realistic simulation is possible.

In order to reproduce the actual feeling of insertion, in practice acupuncture and moxibustion schools use the acupuncture and the silicone plate of the gel body that the students use for exercise (Fig. 4). The resistive feeling expressed by the silicon plate and the improved system Compare the values at the time of acupuncture and obtain the resistance parameter.



**Fig. 4.** Silicone plate for acupuncture practice and acupuncture

We carry out the following two types of acupuncture trials for the subjects.

- (1) Four silicon sheets for acupuncture practice.
- (2) Tactile device with force feedback (Geomagic Touch)



some subjects with large values of variance, it seems difficult for amateurs to feel the difference in feeling of hardness due to penetration of acupuncture, it seems necessary to study the experimental method in the future.

**Table 1.** Hardness of the silicon plate

Average	Hardness of the silicon plate (Asker hardness)				Distribution for each subject	Hardness of the silicon plate (Asker hardness)				
	91±1	83±1	77±1	64±1		91±1	83±1	77±1	64±1	Average
Subject A	10.333	11.667	11.333	14.333	Subject A	3.556	0.889	3.556	0.889	2.222
Subject B	8.333	10.333	10.667	12.667	Subject B	0.222	1.556	0.222	1.556	0.889
Subject C	8.333	8.667	11.333	12.667	Subject C	0.222	0.222	4.222	2.889	1.889
Subject D	14.000	11.667	12.000	12.000	Subject D	2.000	8.222	2.000	8.667	5.222
Subject E	11.333	12.333	11.333	10.667	Subject E	8.222	0.889	0.889	0.889	2.722
Subject F	12.333	12.333	10.667	12.667	Subject F	0.889	1.556	9.556	10.889	5.722
All subjects Average	10.778	11.167	11.222	12.500						

## 5 Conclusion

In this study, we performed an evaluation experiment to determine the numerical value of the body's hardness sensation by using the ACT which created and improved the parameter to change the resistance feeling at the time of acupuncture. Examination of experimental method and experiments on speed and angle at the time of acupuncture will be carried out. Furthermore, we are currently making plans to include a remote education function in ACT in the near future. We will also collect and analyze data using ACT, and aim to further improve our system.

## References

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