Texanner: 햅틱 질감 측정을 위한 자동화 장치

Texanner: A Motorized Scanning Device for Haptic Texture Measurement

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요약문

햅틱 질감의 측정을 위해서 기계화된 장비를 제작하여 실제 물체의 표면을 긁을 때 나타나는 가속도 데이터를 자동적으로 수집하였다. 이 방식으로 사람의 손에 의해 생길 수 있는 오차를 없앤 더 정밀한 질감 데이터를 측정할 수 있다.

ABSTRACT

We developed a motorized haptic texture scanning device to automatically capture acceleration data by dragging a tool over the surface of real objects. It eliminates human involvement from the measurement process thus provides more refined and reliable texture data.

INTRODUCTION

Realistic haptic texture rendering is all about re-creating virtual textures being as similar and indistinguishable as possible to the real textures. Some different type of data was used to represent haptic texture, but it turned out that the high frequency acceleration from surface has noticeable impact on the realism of haptic texture [1, 2].

DATA COLLECTION SYSTEM

We developed a motorized texture scanning device, named Texanner, which has a tool-mediated contact with the object surface to collect vertical acceleration data. This is in contrast with the systems that a human operator holds a tool and scans the object manually. Here we are being able to accurately adjust the movement speed and resolution which is almost impossible with human operator. However there is a chance that some undesired vibration readings, arising from the mechanical structure of the device, is mixed with the texture readings. This also happens in human-operated systems in which vibrations of human hand itself are included in the final recordings.

Texanner consists of a moving platform and a measurement module. The moving platform is an XY-slider formed by two linear stages (ET-150-21, Newmark Systems) assembled perpendicularly (Fig. 1.). The movement and speed of each motor can be controlled separately, makes it possible to create a wide range of patterns. Each motor has a travel range of 150mm, maximum achievable speed of 200 mm/sec and position resolution of 7.5 μm. The measurement module consists of a stylus equipped with an accelerometer (ADXL335, Analog Device). The 3-axis accelerometer has a full-scale range of ±3 g and sensitivity of 300 mv/g. A linear bearing is used to hold the stylus shaft vertically, at 90 degrees to the movement surface. On the top, stylus has a mass component, which in combination with the friction between shaft and linear bearing, it resembles a classic mass-damper system. On the bottom, it has accelerometer and tool-tip. The mass component has a weight of 34 gr, shaft itself 42 gr, by adding tool_tip and accelerometer, the total weight of stylus becomes 88 gr. The mass and the tool-tip are replaceable, providing a facility to experiment different conditions.

A serial communication (RS-232) is used to transfer data between slider and computer, while a data acquisition card (PCI-6229, National Instruments) is used for sampling acceleration data in 5 KHz. User can select the movement course and set the required parameters using a GUI. Upon issuing a command, each motor accelerates to reach the adjusted speed and decelerates to stop at the end. Example of recorded acceleration data for two speeds on mouse pad is given in Fig. 2. Once the data is collected, a neural network is trained for each constant speed range and then resampled to generate artificial texture vibration.

CONCLUSION

Texanner is developed to automatically collect texture data by scanning the surface of real objects. It is a versatile and adjustable device makes it possible to be used in wide application areas. Its biggest advantage is eliminating human incorporation from the measurement process which in turn provides more refined and reliable data for modeling step. This system is a part of a bigger project for realistic haptic texture rendering on smart devices.

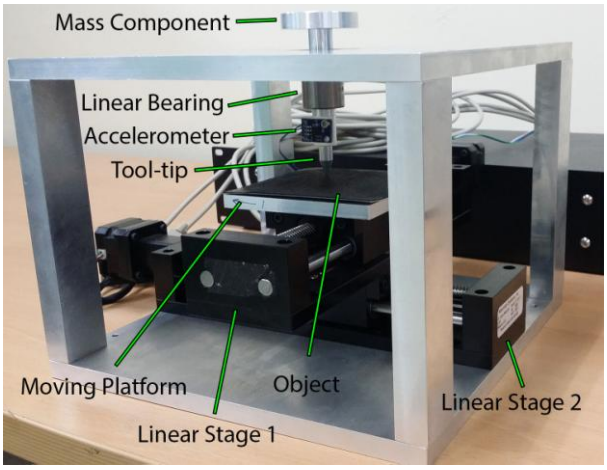

Fig. 1. Texanner: texture scanning device.

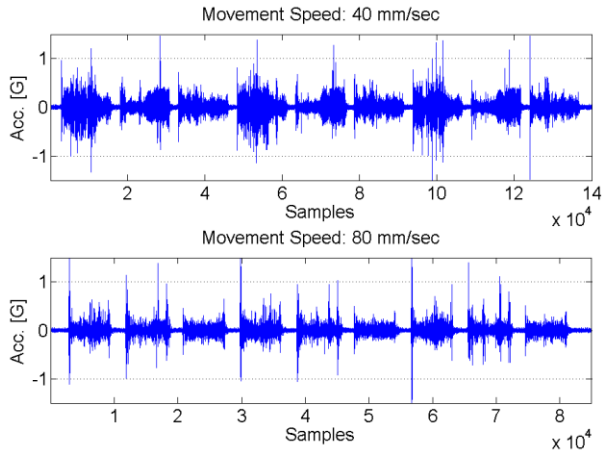

Fig. 2. Example of acceleration readings.

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