Theme Name	Walking navigation using waist-type hanger reflex
Organization Name	Department of Informatics and Engineering, University of Electro-Communications Professor Hiroyuki Kajimoto
Technical field	IT,Manufacturing,others

Overview

Walking navigation tools such as Google Maps require the process to interpret information of navigator by looking at it. When we use it during walking, our attention is spent for interpreting the information of navigator, which leads to a problem of safety. In order to solve this problem, Kajimoto Laboratory focused on “waist-type hanger reflex”, which is an illusory “rotation” phenomenon accompanied with skin deformation around waist, and investigated the influence of the waist-type hanger reflex on walking. The laboratory finally developed a prototype that doesn’t require interpretation of information. Kajimoto Laboratory welcomes companies that are willing to use and cooperate with this technology.

Skelton Diagram

Background

Walking navigation tools such as Google Maps require the process to interpret information of navigator by looking at it. When we use it during walking, our attention is spent for interpreting the information of navigator and this causes a problem of safety. In order to solve this problem, many walking navigation systems utilizing haptics sensation have been proposed. While the problem for spending user's visual attention has been solved in these proposals, user's conscious process to interpret information is still required. Some other walking navigation technologies utilized electrical muscle stimulation or direct manipulation of feet. While they don't require interpreting information of navigator, they still have problems such as difficulty of long-time continuous usage, collision risks due to lack of agency (sense of moving by oneself).

Kajimoto Laboratory focused on hanger reflex, one type of illusion that induces body rotation by skin deformation. The illusion accompanies actual body rotation, so it can be utilized as a new navigation technology that does not require interpreting information of navigator. The laboratory investigated the effects of hanger reflex on walking and developed a prototype device.

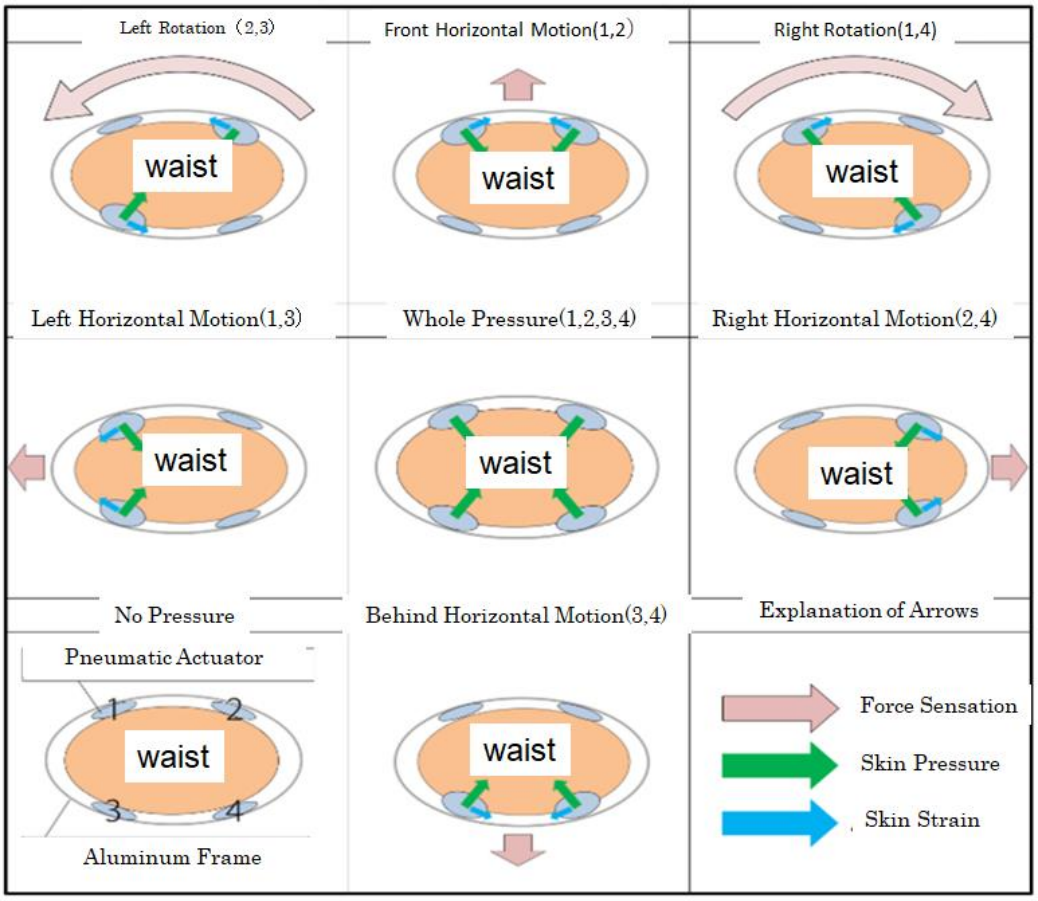
Kajimoto Laboratory welcomes companies that are willing to use and cooperate with this new technology.

Mechanism

The hanger reflex is an illusory phenomenon that turns head unintentionally when a wire hanger is put on the head. This phenomenon is caused by pressure on the skin and the direction of the skin strain determines the direction of rotation. The hanger reflex can not only cause rotary motion but can also cause front-back or right-left translational motion by changing the direction of skin strain. The similar phenomenon has been confirmed on wrist, waist and ankle. In this study, Kajimoto Laboratory confirmed that the waist-type hanger reflex has the most efficient effect on walking and prototyped a waist-type hanger reflex control device using pneumatic actuator. The laboratory confirmed that the power of rotary motion and horizontal motion can be controlled by the waist-type hanger reflex.

The device uses four pneumatic actuators to produce pressure that generates shear strain force on the skin that co-work with an outer aluminum frame.

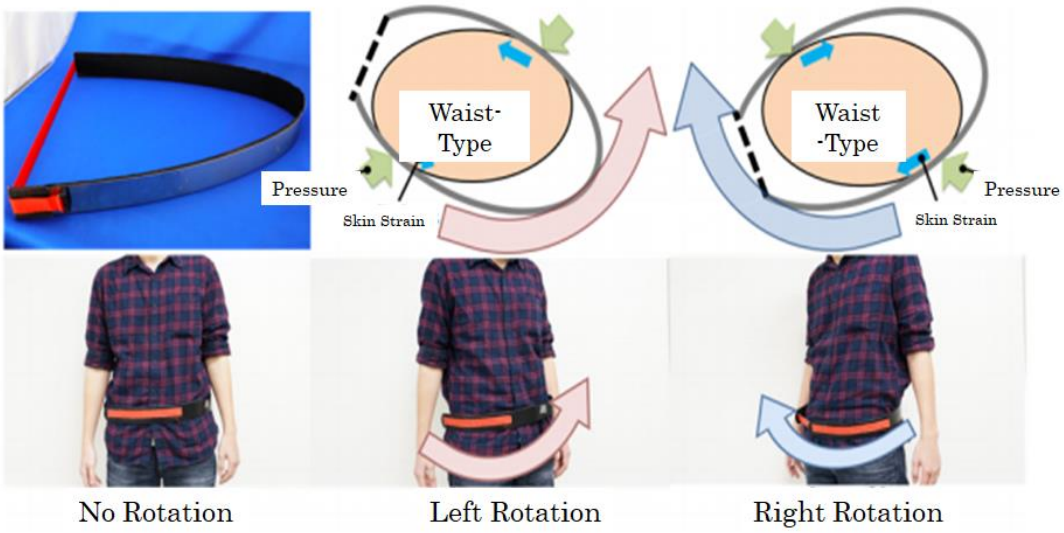
The pneumatic actuators are driven by air pumps and solenoid valves. The actual pressure on the user is measured by an atmospheric pressure sensor as well as film-type pressure sensor and is controlled by a microcontroller. The following diagram shows the relationship between the position of pneumatic actuator driven by this device and the force sensation by hanger reflex.



Skin pressure (green arrow) and skin strain (blue arrow) are generated by controlling four pneumatic actuators independently as indicated in the left bottom diagram. This mechanism generates force sensation and motion (red arrow) in the direction of skin strain.

Strengths of This Technology and Know-how (innovation, superiority, utility)

This device can generate hanger reflex freely in both rotary and tangential direction. For example, to rotate the body around Yaw axis, the device should be rotated to right or left to produce pressures on two points in the opposite sides of waist and causes skin strain in the direction of shear. This mechanism generates hanger reflex around the Yaw axis.



As another example, if you want to generate hanger reflex in the tangential direction, the device should be put in a manner that it generates skin strain in the two close points. In this case, the summation of two skin strain causes tangential motion.

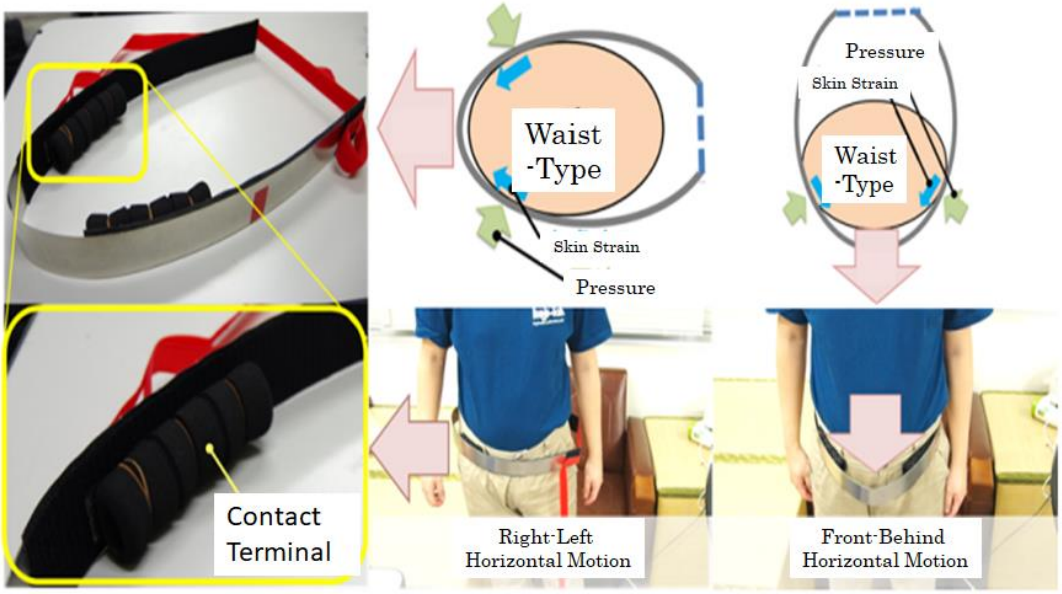


Diagram of generating horizontal motion by waist-type hanger reflex

Image of Cooperative Companies
1. Companies interested in walking navigation system for virtual spaces. 2. Companies interested in applying walking navigation system to the other field. 3. Companies that want to utilize this technology for other purpose.
Examples for Utilizing This Technology and Know-how (Images)
This technology can be utilized for highly sophisticated walking navigation system.

We are going to make the device smaller and wearable, so it's possible to apply this technology to walking navigation systems in the real world and the virtual world.

Process for Utilizing This Technology and Know-how

If you are interested in this technology, please feel free to contact us.

We will provide detailed explanations of this technology and demonstrations of the device.

Description of Specific Terminology

[Hanger Reflex]

This terminology comes from an illusory forcephenomenon observed when a wire hanger is put on the head, which accompanies physical rotation of the head. It has been reported that the similar phenomenon also occurs in other parts of the body.