Proposal of Spring Assist Unit for Walking Disabilities

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Resume

Haruki Baba

- Educational Background
  - National Institute of Technology Hachinohe Collage
    - Apr 2012 – Mar 2017: Faculty of Mechanical Engineering
  - Iwate Prefectural University
    - Apr 2018 – Mar 2020: Faculty of Software and Information Science
    - Apr 2020 – present: Graduate school of Software and Information Science

- Field of study
  - Medical and healthcare information
Background

➢ The percentage of elderly people in the world’s population is increasing.
➢ The number of functionally impaired people will also increase.
➢ People with such diseases or latter-stage elderly often have walking disabilities which increases their risk of falling and consequently injuring themselves.

Purpose

➢ Developing a spring assist unit that fits in the heel of a shoe and helps walking disabled people raise their heel when beginning to walk.
Walking assistance mechanism in passive foot prosthesis

- The Solid-Ankle Cushion Heel (SACH) foot
  
  ![SACH foot](image)
  
  1D10, Ottobock, Germany

- The energy storage and return (ESAR) foot
  
  ![ESAR foot](image)
  
  Vari-Flex, Össur, Iceland
NOITAVONNI
Existing Works:

Differences in gait between hemiplegia patient and healthy person

WD: SmartWatch 3, Sony

WD mounted on foot

Measured data for unimpaired participant

Measured data for participant with walking disability

Iwate Prefectural University
Prototype of shoe to assist people with walking disabilities

Assist shoe prototype

EMG sensors placement

Person with walking disability #1

Person with walking disability #2
Structure of Spring Assist Unit

- The developed assist unit comprises a conical coil spring and a V-shaped attachment cover.
- The spring is thinner when stepping.
- Spring power is 3, 5, 9, and 11 Kg.

Spring assist unit (heel-up spring)  
Pair of shoes with built-in spring assist units
Assistance effect

- Focused to clear
  - Affection to reduced the magnitude of muscle.
  - Affection to walking posture.

- Participants wear shoes with each of the spring stiffnesses and walk straight for 6 m to measure
  - iEMG.
    - To measure the magnitude of muscle.
    - Participants were ten healthy students.
  - Motions of the head and mid-hip.
    - To analyze effects to walking posture.
    - MS-Kinect was used to measure.
    - Participants were five healthy students.
Affection to reduced the magnitude of muscle (1/2)

Examples of the measured iEMG vs. spring stiffness are shown.
The iEMG values are lower for every spring stiffness than without the spring assist unit.
The value was the lowest at the specified spring stiffness.
**Affection to reduced the magnitude of muscle (2/2)**

The spring stiffness magnitude at the lowest iEMG is linearly bigger, a participant gets more weight.
Affection to walking posture: Motion of participant C

Without a spring assist unit

(a) Up and down direction UD

(b) Right and left direction RL

With a spring assist unit

(a) Up and down direction UD

(b) Right and left direction RL
## Average range of peak to peak in RL and UD [mm]

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Conclusions

➢ Proposed the spring assist unit for walking disability to easily raise their heel and smoothly walk.
➢ The iEMG values for every spring stiffness are lower than those without the spring assist unit.
➢ The magnitude of the spring stiffness at the lowest iEMG is linearly bigger and the body weight was greater.
   • There is a correlation between body weight and the optimal spring stiffness.
➢ Measured the position of the head and mid-hip with and without the spring assist unit for each spring stiffnesses.
➢ The spring assist unit does not affect walking posture.

Future works

➢ Measure the same data for walking disabled people.
➢ Launch the commercial version.
References


