

FUNDING PROGRAM FOR NEXT GENERATION WORLD-LEADING RESEARCHERS

Project Title: Body-mind stimulating RT that facilitates brain plasticity with minimum support of perception and motor functions

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1. Background of research

Stroke often causes hemi-paralysis and in consequence walking disability as well. Essential motor recovery during a rehabilitation requires paying proper attentions to the perception inputted while repeating proper movements so as to activate brain activities. Recently, affiliation exercise therapy based on brain cognitive theory (activating all the processes: perception- attention- memory- judgment- language), tries real motor recovery by guiding much attention to somatic sense of the paralyzed through repeated cognitive tasks to answer the state of paralyzed-side body. However, sensory impairment, with infirm or lacking skin or deep sensations ,prevents from proper concentration to somatic sensory information. This makes affiliation exercise therapy remaining out of the mainstream of rehabilitation while it's considered to be essential principle.

2. Research objectives

To resolve the problem mentioned above by robotics technology(RT) and brain science consolidation, the objective of this study is to construct a next generation cognitive neuro rehabilitation scheme allowing hemiplegia to relearn its body schema with PARTY(Perception Assisting Robotics Technology) and a new rehabilitation theory to efficiently facilitate brain functions related to motor learning. PARTY is a biofeedback-based wearable device we've originally developed that supports perception functions of the paralyzed-side damaged by stroke, ideally affecting to improve the perception attentiveness to the paralyzed-side.

3. Research characteristics (incl. originality and creativity)

Motor and sensory assistance are essential and should be provided together in order to help hemiplegia patient relearn properly how to move the paralyzed-side body through physical interaction with environments. However most research have focused on motor function assistive devices only. No research in the world has been reported on the concept of PARTY allowing to facilitate self-rehab through the self-notification of their body state and how to enhance brain activity and perception-attentiveness to the paralyzed body with PARTY.

4. Anticipated effects and future applications of research

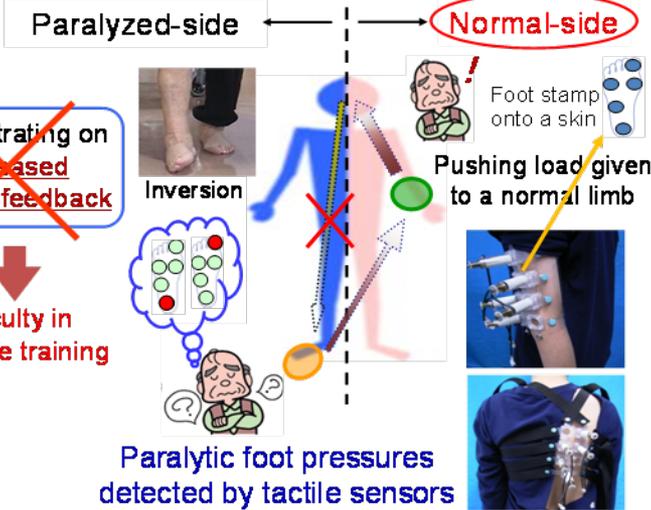
Highly-motivated patients, load reduction for doctors and therapists are expected. PARTY can be used for inpatients, outpatients and homecare patients. With usage of motor assistive device together, evolution "in quality" of innovative stroke rehabilitation will be made, then leading to strongly enhance nation's quality of life.

Focus

Hemiplegia after stroke => Causative of **sensation disability** as well
 (× Left brain=> × Right body)

~~Concentrating on decreased sensory feedback~~

Difficulty in cognitive training



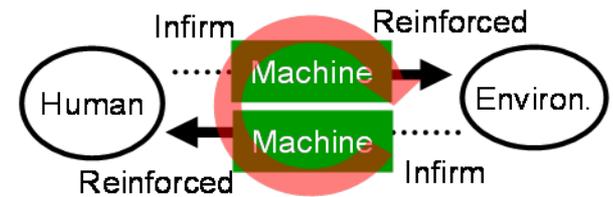
Foot contact at the paralyzed causes simultaneous stimulus at the normal-side skin => Emerging sense of self-tread on the back

Idea

Foot contact of the paralyzed-side biofeedbacked with tactile sensation onto the normal side

("HAL", "Muscle suit" etc.)

Motor function supported



Sensing function supported

Facilitate relearning!

Essence of rehab. be reconstruction of paralyzed-side body schema

System

Attachable onto five body parts up to disease condition. Usable in 1.5m/s walking



(A) Foot pressure presenting unit
 (attachable to back, waist, shoulder, upper arm or forearm up to disease conditions)



(C) Central processing unit

(B) Foot pressure sensing unit



Effect

- ▶ Self-notify the paralyzed-side condition
- ▶ Accommodate abnormal state of the paralyzed
- ▶ Facilitating brain plasticity with RT

Conventional dependent rehabilitation just followed by therapists instruction

Making evolution in rehabilitation

Highly-motivated positive self-rehabilitation

Higher needs from Dr, Therapist and Patient
 -Patient: Self-rehab, Highly-motivated training
 -Dr & Therapist: Efficient instruction, Load reduction
 (Available for inpatient, outpatient & homecare ones)

Issue

Neurological validation of the re-activation in attacked-side brain by the biofeedback effect of PARTY (right)

Neuro imaging validation & system adjustment

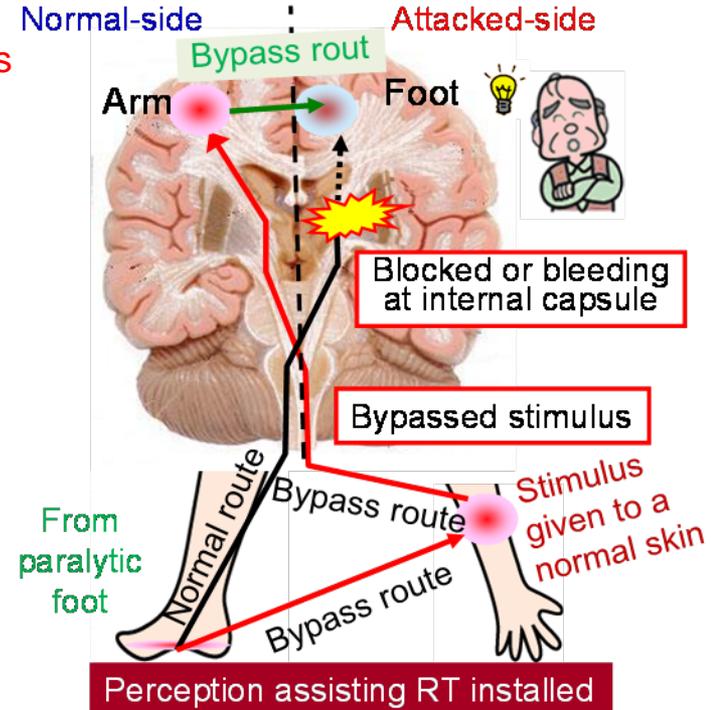
Proper perception-motor re-organization

Body-mind accommodation by BF efficacy

- Identify neural plasticity phenomena followed by paralyzed-body awareness
- Optimal parameter adjustment
- Motor learning fixation & motor miss-learning avoidance
- Improvement of motion accuracy
- Anxiety easing
- Pull out the max capability

Concentrating on bypassed stimulus

Attacked brain region (for foot) activated



Tactile biofeedback device enabling to notify paralytic foot pressure at a normal skin

Outcome

Next generation cognitive neuro rehabilitation with robotics technology (RT) emerging (left)

- (a) BF based perception assistive RT design
- (b) Motor re-learning by self-body-awareness
- (c) Tracking neural plasticity by BF efficacy
- (y,z) Catalysis tech. to enhance rehab. effect

