



## Brain-Neural Computer Interaction for Evaluation and Testing of Physical Therapies in Stroke Rehabilitation of Gait Disorders.

The principal goal of BETTER is to improve physical rehabilitation therapies of gait disorders in stroke patients based on BNCI assistive technologies, producing improved systems, providing guidelines for improving future systems, and developing benchmarking and evaluation tools.

### Main Focus

The project will validate, technically, functionally and clinically, the concept of improving stroke rehabilitation with wearable exoskeletons and robotic gait trainers based on a TOP-DOWN approach: The robot exerts physical stimulation -at the periphery- as a function of targeted neural activation patterns (related to user involvement).

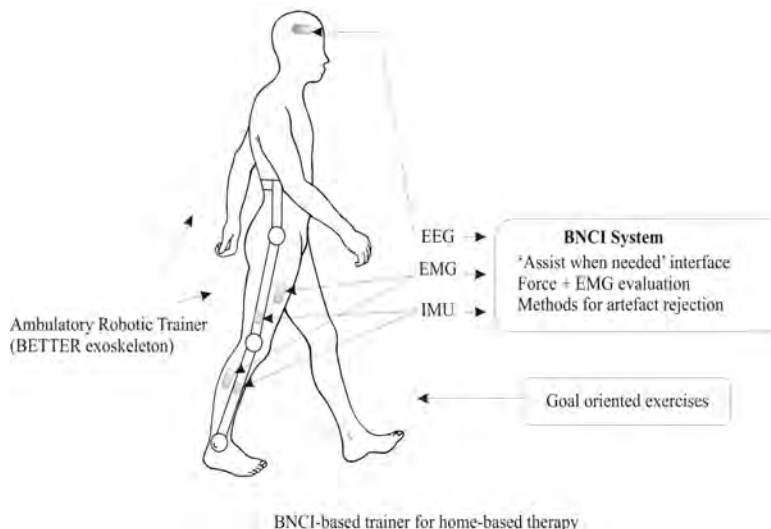
This intervention is expected to result in reorganizations in the cortex. Such TOP-DOWN therapeutic treatment would aim to encourage plasticity of the affected brain structures to improve motor function. The project addresses two types of applications developing tools for TOP-DOWN treatment under:

- Treadmill-based robotic training.
- Exoskeleton-based ambulatory gait training.

### Approach

BETTER adopts the TOP DOWN approach for gait training in which such assistive technologies (ATs) can be improved if combined with non-invasive BNCI in order to increase the effectiveness in recovering function.

The level of assistance is applied as needed by the patient, according to novel metrics that inform about the patient adherence in combination with the functional outcome; this assistance is intended to provide the different afferent cues regarded as critical to retraining locomotion.



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### Partners:

- Consejo Superior de Investigaciones Científicas, Spain
- Instituto de Biomecánica de Valencia, Spain
- Universitaetsmedizin Goettingen Goettingen, Germany
- Graz University of Technology, Austria
- Guger Technologies OEG, Austria
- Fondazione Santa Lucia, Italy
- Össur hf, Iceland
- Eberhard-Karls-Universität, Germany
- Technaid SL, Spain

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### Project Website:

[www.iai.csic.es/better](http://www.iai.csic.es/better)

BETTER is a STREP Project in the ICT area under the European Community's 7th Framework Programme (FP7)



## Objectives

In order to achieve its goals the project builds on consortium partners experience in the multiple areas (robotics, BCIs, neurorehabilitation, prosthetics/orthotics, motion analysis, neurophysiology) and evolves along these technological and scientific goals:

- The system will provide means to assess compliance through a multimodal BNCI.
- The proposed BNCI will combine CNS and PNS data with biomechanical data.
- It will determine if training the activation of signals that control lower limb tasks in combination with robotics devices is beneficial for restoring lower limb function.
- BETTER will provide means for objective evaluation of the BNCI-based physical rehabilitation therapy and its usability and acceptability.
- A multimodal BNCI explores the representations in the cortex and characterizes the user involvement in order to provide feedback and modify

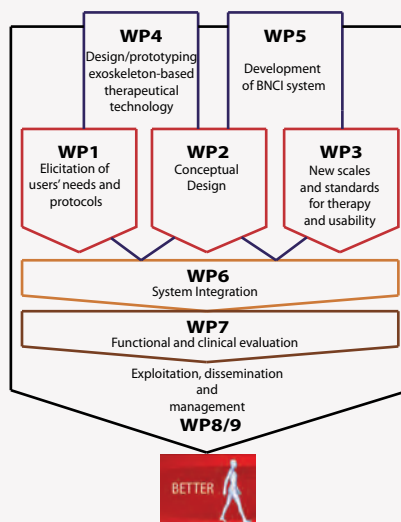
## Research Workplan

The work conducted by the BETTER project is organized into work packages (WP's), with WP1 to WP7 focused on research and development and WP8/9 responsible of management and dissemination. The BETTER TOP-DOWN approach is explored. The work developed by the different WP's interdependent as the outputs of ambulatory and non-ambulatory scenarios are cross-cutting across RTD tasks.

WP1 will identify user requirements and design a methodology for clinical experimentation in order to test and evaluate the BETTER technology. WP2 will develop a concept for the BETTER system and define the Product Requirements Document (PRD) in which requirements will be

WP4 will develop a working prototype of an ambulatory exoskeleton for functional therapy. It will also address the adaptation of the non-ambulatory robotic gait trainer to the BETTER framework.

WP5 will develop a working platform for biosignal acquisition (EEG, fNIRS, HR, EMG), visualization, storage and real-time processing for BCI research. WP6 will integrate and optimize all system's components into the therapy robot and the ambulatory exoskeleton.



WP7 will execute the validation of the BETTER concept on representative groups of stroke patients in subacute and chronic phase.

WP8 will ensure the stablishment of the foundation for future decisions on investment and commercialization and even further research directions.

WP9 will deliver the management and organizational structures and processes to ensure the effective delivery of BETTER.

## Impact

The approach adopted in BETTER is expected to contribute to the practical spread of BNCI-based technologies, directly in the application scenario of Stroke rehabilitation, and indirectly by showing the way to a non-invasive, aesthetic and cosmetic, robust and cost affordable management of other disabilities through BNCI systems. The open source approach adopted by BETTER as to BNCI technologies will support wide adoption of these technologies and will contribute to the European excellence in this field.

The following thematic areas are jointly researched by the BETTER partners:

- Stroke and gait rehabilitation therapies
- Motor control and Neural Plasticity
- Robotic gait trainers
- Ambulatory systems for gait rehabilitation
- BCIs in neurological rehabilitation
- Users' acceptance of technology and the framework of stroke, robot-based gait rehabilitation.

## Case Studies

Develops clinical case-studies to support dissemination towards MDs, therapists and health authorities.

- Novel robotic training methods interfaced through neural signals
- Comprehensive approach to assess progress of neurorehabilitation

## Website

BETTER publishes ongoing work, results and activities at: <http://www.iai.csic.es/better>