

# COST

Domain Committee Biomedicine and Molecular Biosciences

## COST Action TD 1006

Start Date 04/04/2011

### *European Network on Robotics for NeuroRehabilitation*

## MONITORING PROGRESS REPORT

**Reporting Period:** from (April 2011-April 2012)

This Report is presented to the relevant Domain Committee.

It contains three parts:

- I. Management Report** prepared by the Grant Holder
- II. Scientific Report** prepared by the Chair of the Management Committee of the Action
- III. Previous versions of the Scientific Report;** i.e., part II of past reporting periods

The report is a “cumulative” report, i.e. it is updated annually and covers the entire period of the Action.

Confidentiality: the documents will be made available to the public via the COST Action web page except for chapter II.D. *Self evaluation*.

Based on the monitoring results, the COST Office will decide on the following year’s budget allocation.

#### **Executive summary (max.250 words):**

Following activities have been performed in the first Action year:

- Kick-off meeting with 12 countries, during the year 6 countries joined and 3 are interested to join.
- Workshop in Zurich (46 participants) defined focuses of the WGs and their interaction. Main outcome: concertation of outcome measures of key importance, WG specific state of the art publications defining concerted COST recommended best practices have been started, WG4 position paper submitted.
- Training School co-organized in Salamanca with IEEE and Spanish National project Hyper, 80 student participants, 15 teachers, 70% from Action countries, Topic: Emerging Technologies for Neurorehab.
- Workshop in Southampton (50 participants), assessment focus refined, identified need for quantitative robotic/technologic methods for body function and activity assessment. Neuroimaging as surrogate markers for early prognosis and for clinical decision-making.
- 9 STSMs approved by MC to take place in the months April-May 2012: 7 STSMs are from ESR and 5 STSMs were granted to women. Topics: clinical (2), assessment (3), Neuroscience (2) motor control (2)
- 2 FP7 projects concluded with important results regarding target/goal directed robotic rehabilitation, and multimodal approaches. 9 new multi-national/ EU RTDs have been started.
- Action partners organized 6 joint workshops at international conferences, published 196 articles related to Action topics, 66 as joint publications.
- Joint international networks: a concerted action plan was established with ICoRR and an intention of joint collaboration with IISART in the area of health economics and education has been decided

## I. Management Report prepared by the Grant Holder



### I.A. COST Action Fact Sheet

- **COST Action TD 1006: European Network on Robotics for NeuroRehabilitation**
- **Domain Biomedicine and Molecular Biosciences**

- **Action details:**

**CSO Approval:** (02/12/2010)

**End date:** (03/05/2015)

**Entry into force:** (04/04/2011)

**Extension:** (day/month/year)

- **Objectives** (from DB as in About COST)

The aging of the European population will inevitably accelerate the demand for effective rehabilitative therapies to ameliorate the motor deficits caused by major age-associated neurological syndromes such as stroke. Robots for neurorehabilitation offer a significant advantage in addressing this need. They can extend substantially the capacities of therapists who work with patients suffering from motor impairments. Typical robotic devices can convey instructions to patients on how to perform specific movements, can assist and guide the execution of motor actions, and can objectively assess movement capabilities. The growing variety of robotic devices used in primary research and clinical practice offers a rich framework for expanding their use in an expanding number of different patient groups. The main objectives of this Action are firstly to develop new, efficient and patient-tailored robot-assisted therapies by coordinating basic and applied research perspectives. Secondly, the Action will provide a clear structured overview about existing and emerging robot-assisted therapies to clinicians and therapists, so they can increase the availability of effective, standardised clinical practice across Europe. The Action will be carried out by an interdisciplinary team of leading researchers from robot engineering, clinical motor neurorehabilitation, computational neuroscience and motor neuroimaging.

- **Parties:** list of countries and date of acceptance

Belgium (09/03/2011)	Hungary (10/08/2011)	Netherlands (31/01/2011)
Germany (25/01/2011)	Malta (18/08/2011)	Spain (25/01/2011)
Italy (04/03/2011)	Slovenia (12/07/2011)	France (01/03/2011)
Serbia (14/03/2011)	United Kingdom (25/01/2011)	Israel (25/01/2011)
The Former Yugoslav Republic of Macedonia (07/06/2011)	Finland (25/01/2011)	Romania (12/05/2011)
Denmark (08/06/2011)	Ireland (18/08/2011)	Switzerland (23/02/2011)

- **Intentions to accept:** list of countries and date

Greece (N/A)

Luxembourg (N/A)

Turkey (N/A)

- **Other participants:**

(Institution Name, Country, Town)

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• **Working Groups** (*list of WGs and names and affiliations of participants*)

**WG 1: Clinical Application of Rehabilitation Robots (18 members)**

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Co-coordinator Dr. Federico Posteraro, Auxilium Vitae Rehabilitation Centre, Borgo San Lazzaro 5, 56048 Volterra - Pisa, Italy

**WG 2: Technology Development for Rehabilitation Robots (19 members)**

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Co-coordinator Prof. Herman van der Kooij, University of Twente, Drienerlolaan 5, 7500AE Enschede, Netherlands

**WG 3: Theoretical Models of Motor Recovery (7 members)**

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Co-coordinator Prof. Vittorio Sanguinetti, University of Genoa, Dept Informatics, Systems, Telematics, Via Opera Pia 13 16145 Genoa Italy

**WG 4: Neurophysiological Mechanisms of Motor Recovery (11 members)**

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## I.C. Overview activities and expenditure

### Meetings

Meeting Type	Date	Place							Cost	Total
MC Meeting + Workshop	02/07/2011	ETH Zurich							12306.90	
WG1 Meeting	25/11/2011	COST Office Brussels							5052.85	
MC Meeting + Workshop	18/03/2012	University of Southampton							20259.94	
										<b>37619.69</b>

### STSM

Beneficiary	Date	Place							Cost	Total
None, 8 STSMs approved for April-May 12										<b>0</b>

### Workshops

Title	Date		Place						Cost	Total
	From	To								
Workshop Zurich	02/07/2011	02/07/2011	ETH Zurich						Incl. in meetings	
Southampton COST Workshop and Symposium	19/03/2012	20/03/2012	University of Southampton						Incl. in meetings	<b>0</b>

### General Support Grants

Beneficiary	Date								Cost	Total
										<b>0</b>

### Schools

Title	Date		Place						Cost	Total
	From	To								
Training school 1	18/09/2011	23/09/2011	Summer School Salamanca (jointly with IEEE and Hyper Spanish project)						5780.06	<b>5780.06</b>

### Dissemination

Title	Date	Place							Cost	Total
None										<b>0</b>

### Others

None										
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**Action Total : 43,399.75**

## **II. Scientific Report**

### **II.A. Innovative networking**

The main objective of the action is to enable the development of innovative, efficient, and patient-tailored robot-assisted therapies for neuromotor recovery, incorporating the latest findings from clinical neurorehabilitation, rehabilitation robotics, computational neuroscience and motor neuroscience.

- *Innovative knowledge*

In a first workshop in Zurich (46 participants, adjacent to the International Conference on Rehabilitation Robotics ICORR 2012) the four working groups defined in a brainstorming exercise which WG specific topics are important and what input the WG needs from the other WGs. Throughout all four WGs concerted robotic therapy outcome measures were identified to be of key importance.

The second workshop in Southampton (50 participants) continued with the analysis of clinical robotic assessments in the framework of ICF. It was concluded that robotic or more general 'advanced technological' assessment tools can be used for the assessment of *body function* to replace the currently used clinical motor function scores that lack of sensitivity and accuracy. However, new and potentially of high impact is the combination of motor control models with robotic technologies for the assessment of *activity*. Current SoA are clinical scores and motor tests using observation and stopwatch. Here the Action has identified a clear need that our network can fulfil by its guideline activities and future robotic research roadmap. The assessment of *participation* and *external factors* will remain done by pathology specific questionnaires as e.g. the FIM or SCIM measures. WG4 activities complemented the assessment focus with the analysis of surrogate markers obtained from neuroimaging techniques for early prognosis and decision-making. A COST review paper has been submitted to 'Neurorehabilitation and Neural Repair' journal.

- *Significant scientific breakthroughs*

As one of the examples the recently concluded FP7-ICT-231724 project HUMOUR produced following key achievements:

- i) formulation of a general framework (based on game theory) to model human-human and human-robot interaction based on experimental evidence in human-human interaction;
- ii) development of a model of the recovery process in a stroke survivor undergoing robot-assisted exercise that is able to predict its long-term outcome (Casadio & Sanguineti, TNSRE, in press);
- iii) successful results of robot-assisted training based on analysis of EEG activity.

The above results as well as results produced in the FP7-ICT-215756 MIMICS on the multimodal motion rehabilitation with interactive cognitive systems have impacted the traditional open loop robotic rehabilitation (actuation only and task repetition) with an interdisciplinary view. These new approaches have first impacts in the rehabilitation robotics industry where the combination of motor and sensory stimulation exercising is now emerging and the loop with the patient in the middle is closed.

However the scientific basis on how to close the loop is still thin and requires more research on which this Action can have high impact. As starting point Action TD1006 concerted review papers are being prepared in all four WGs. They will serve as first basis for a set of recommendations for the assessment and for the specific use of robot mediated therapies. These recommendations will enable better-coordinated and therefore more impactful clinical studies.

- *Tangible medium term socio-economic impacts achieved or expected*

The International Industry Society of Advanced Rehabilitation Technologies (IISART) has expressed strong interest in an objective analysis and recommendations for current and future robot assisted therapies. WG1 members supported by members of other

WGs have started with a systematic review on clinical relevance of robotic therapies that will be used as basis for position papers of the field and will be disseminated to all stakeholders in neurorehabilitation. This activity is additionally supported by ICoRR (International Consortium on Rehabilitation Robotics) to facilitate a worldwide impact.

- *Spin off of new EC RTD Framework Programme proposals/projects*

Participation in new EC RTD Proposals	Participation in new National Proposals	No of new multinational or EC RTD projects	No of new national projects
40 (estimated)	100 (estimated)	9	26

Table 1: New National and joint EC RTD projects of the Action members

The action members started 2 multinational and 7 new joint EC RTD projects. This reflects a good interaction among the partners. However, most of the projects are STREPS and there is need of one or two larger IPs addressing new research focuses in robotic rehabilitation and advanced assessment methods needed in the field.

- *Spin off of new National Programme proposals/projects. (List)*

Action members started in the reporting period 26 new national projects. This includes projects funded by regional and national public entities and also private foundations. Most action partners have a mix of national and international funding that helps to coordinate the overall funding and their related projects.

## **II.B. Inter-disciplinary networking**

- *Additional knowledge obtained from working with other disciplines within the COST framework.*

Some of the new members of this action were members of the NEUROMATH action, that was focusing on in new models of brain activity and new methods to measure the brain activities. The interest of these members has moved to applications of the developed models and methods in clinical problems like the neurorehabilitation of stroke patients or spinal cord injuries. Specific case is our TD 1006 COST action where additionally robots are involved in the therapy. The use of metrics of the brain activity in designing testing and improving clinical rehabilitation protocols is of high priority in FP7 and in the e-inclusion cluster like the Action relevant projects like e.g BETTER, MUNDUS, MindWalker.

Robotics in Neurorehabilitation by its nature combines interdisciplinary teams consisting of therapists, medical doctors, engineers, and neuroscientists. This is also reflected in many of the Action members that have double degrees in complementary disciplines.

- *Evaluation of whether the level of inter-disciplinarity is sufficient to potentially provide scientific impacts.*

WG4 has brought together several disciplines and areas of expertise to consider the neural correlates of successful rehabilitation and how it can be augmented with robotics in a number of conditions. This would not have occurred without the Action framework.

The recently concluded FP7 project VIATORS developed variable impedance actuators enabling control of impedance as with human muscles. The COST action participants modelled human control and learning strategies and transferred them to robots, with applications to interaction control in industry and human-robot interaction control in rehabilitation. This shows nicely how the interdisciplinary collaboration of roboticists and human motor control experts impact scientifically industrial robotics and rehabilitation.

Initiated by the Italian COST action MC member the Italian Robotic Neurorehabilitation Research Group (IRNRG) where more than ten Institution are involved interdisciplinary has recently submitted to Journal of Rehabilitation Medicine a systematic review on clinical evaluation scales for lower limb robotic rehabilitation evaluation.

- *Evaluation of whether the level of inter-disciplinarity is sufficient to potentially provide socio-economic impacts. (Specific examples)*

Already in current state the Action members have a high level of interdisciplinary. As example specific rehabilitation robots developed by the group at University of East London have treated >100 acute/subacute patients in last 2 years outside of research trials i.e. in general practice by therapists independent of the developers and are also used by another Action member in Italy that has both clinical and technical competences. Another example can be found in two planned and approved STSMs that send technical staff to members with clinical competences to clinically implement a combined training and assessment system for neurorehabilitation. At least one Action member is participating in the FP7 BRAID project that specifically analyzes socio-economic impacts of ageing and ICT developments. We consider the contribution of these aspects to the action as important and will seek for more collaboration with other COST actions in the future.

## **II.C. New networking**

- *Additional new members*

At the Kick-off meeting the action started with 12 participating countries, 10 with approved MoU. This number has been increased to currently 21 from the MC approved member countries, 18 have accepted the MoU so far.

- *Total number of individual participants involved in the Action work. (Number of participants. Give % of female and of Early Stage Researcher participants)*
- *Involvement of Early Stage Researchers in the Action*

At the date of generating this report none of the 9 approved STSMs have started yet. However, 8 of these STSM will fall into the first financial year. Results of these STSMs will be reported in the next year scientific report. By statistics, from the approved STSMs 7 are from ESR and 5 are granted to women. Therefore the COST goals on gender balance and involvement of ESR are fulfilled.

- *Involvement of researchers from outside of COST Countries.*

No researchers from Non-COST countries have been approved by the CSO. Both at the COST Training School in Salamanca and at the Symposium in Southampton well-known researchers from Non-COST countries (mainly from USA) were invited by the local organizers as external experts in the field. The main purposes were networking and increasing the outreach of the Action. At ICORR 2011 conference in Zurich the Action presented the network to the international research community and a concerted action plan was established with ICoRR and an intention of joint collaboration with IISART in the area of health economics and education has been decided.

- *Advancement and promotion of scientific knowledge through publications and other outreach activities. (Number of publications and other outreach activities that resulted from COST networking through the Action. Complete list should be given in an annex)*

No of networking partners	No of networking countries	No of organized joint workshops	No of single partner publications	No of joint publications
90	21	8	130	66

Table 2: Outreach of the network: Partners, conference workshops (6), COST workshops (2), total publications (196).

- *Activities and projects with COST network colleagues.*
  - The training school in Salamanca that was jointly organized with IEEE and the Spanish National project Hyper has attracted 80 PhD students and 15 world class teachers. 70% of the students came from action member countries. In a questionnaire 98% of the students responded to recommended the training school to their colleagues for its high level of speakers and the hands-on workshops.

- At the ICORR 2011 conference (450 attendees) action members organized three out of 7 workshops. The conference had been hosted by a MC member <http://www.ICORR2011.org/>.
- At the IROS 2011 conference in San Francisco a COST action specific workshop has been organized by action MC members <http://www.tuat.ac.jp/~venture/iros/index.htm>.
- 7 of the 9 STSMs that will take place in the next two months (April/May 2012) will establish new collaborations among COST action participants. Two STSM support a continuation of bi-national collaborations, one had begun thanks to a Pavle Savic PHC program.
- Three action members are founding members of IISART and are actively promoting the action to the international industry and health economy.

Nine new projects with COST network colleagues that have been started: are listed in appendix G. In total the network participated in around 30 projects consisting of two or more partners from multiple countries. This number shows a good interaction among the partners.

- *The capacity of the Action members to raise research funds.*

The funding situation of Action members has increased compared to the year before as more projects have been started than were ending. Table 1 listing 35 new projects reflects this. Some of the action members are actively participating in the definition of a FET-Flagship and the Ageing Horizon2020 PPP. In case the finalist FET-Flagship Robotic Companions will be selected as one of the two future focuses the Action would definitely profit from this and could count on sustainable funding resources.

***Appendices:***

Appendix A: Results Zurich Workshop

Appendix B: Reports Southampton Workshop

Appendix C: Report Salamanca Training School

Appendix D: Publications Action TD1006 members (April 2011- April 2012)

Appendix E: Joint TD 1006 members publications (April 2011- April 2012)

Appendix F: 2011/2012 New National Projects Action TD1006 members

Appendix G: 2011/2012 New Multi-national and EU Projects Action TD1006 members

***III. Previous scientific report(s)***

This is the first report. Part II of past periods' reports do not exist