TRUE REHAB DISSEMINATION PLAN

TRUE REHAB is a research project that aims at contributing not only to the field of rehabilitation, but also to those of robotics and control. The main impact will be on rehabilitation science, as the successful completion of this research can provide a way for applying a complex recovery scheme on patients using broadly available robotic arms. To ensure that the outputs from the research inform practice and thereby maximize the benefit to patients and rehabilitation workers, the following dissemination strategy has been developed.

Throughout the initial discussions of the team of the project, we have identified two main target audiences for which we want to disseminate the results of this project: The scientific community and the medical experts. We also plan to disseminate results for the general public, however this has been identified as only a secondary target audience.

Scientific communication

To address the scientific community, we foresee five journal publications to be generated, with a similar output of conference submissions. The publications will be related to the main working packages. All results will be published as open access publications to increase visibility of the research.

Muscle parameter identification

The first publication would cover the combination of musculoskeletal model and optimization. The target is to publish this work in the *Computer Methods in Biomechanics and Biomedical Engineering Journal of Biomechanic*s. Its draft should be prepared by the end of Jan 2021 for it to be also submitted to the Congress of the International/European Society of Biomechanics.

For this publication we should first capture the muscle activation and kinematics, using EMG sensors and the derived biomechanical model of the arm with the selected muscle regions. A specific algorithm will be designed for the data processing. The results that will be presented are the subject specific muscle parameters and a comparison between optimization approaches.

Real-time inverse dynamics

The second publication will cover the second part of the first work package, about applying the inverse dynamics of the robot in real-time.

Once subject specific muscle parameters are available, they can be used to quantify the force produced by each muscle during motions in real-time. This will be possible by calculating the inverse dynamics under known kinematics as captured by the *depth camera system*. These dynamics will be put to test with the robot, with results that would quantify the efficacy and real-time attribute of the process.

The human-robot interaction is expected to alter the human-robot system, and therefore might affect the accuracy of the inverse dynamics calculation for the specific muscle forces. The adapted inverse dynamics calculation will be delivered as a publication in the same biomechanics journal by September 2021.

Optimal trajectories

In order to achieve desired muscle involvement, we will require our medical partners' insight and feedback to define the nature of the rehabilitation tasks and the conditions for the desired trajectories. We will determine together with rehabilitation workers the destination medical conditions to operate the robot with and then apply optimization methods for allocating force production of the targeted muscles.

This work will be disseminated as a rehabilitation engineering journal publication *in Transactions on Neuroscience and Rehabilitation Engineering journal* and as a conference presentation, with the draft to be finished by January 2022.

Sliding mode control on rehabilitation

A control algorithm we will work on is the sliding mode nonlinear control. Different robust designs are available to choose from for attaining the desired performances. After thorough consideration, the control specific algorithm will be developed and the robot's evolution will be tested in an integrated manner with previous work packages.

The results will be reported in journals like *Control Engineering Practice,* or *IEEE Transactions on Biomedical Engineering journa*l with its submission expected to be in December 2021.

Results of the case study

The final publication will present the results of the clinical case study that will be facilitated with the help of our medical partners. This will help us prove that this rehabilitation scheme can be applied on patients. In this respect, the experiments will only involve tests with rehabilitation tasks that will be monitored over the time of the clinical trial.

We will define the protocol of the study and exclusion criteria at the beginning of this project and initiate the recruitment of patients well before the actual measurements, (starting from month 15) to ensure a bigger pool of volunteers participating. The measurements will be performed at the end of the project. The time predicted for the actual validation study is 4 months (May – August 2022), which includes the preparation of the system for the measurements, the actual measurements and the analysis of the results.

The results could also be packaged as a demonstration to be present at events such as *Proinvent, Techsylvania, or the European Robotics Forum* where the research's results could be disseminated in a more interactive and dialogue-prone way to audiences from other research domains or to non-academic public.

Medical experts communication

Our second primary target audience is the medical community, and more specifically the rehabilitation specialists. Based on discussions with the team of the project, we have decided to not only disseminate results to this audience, but to also involve them in the research process. This will allow us to steer our technical solution so that it fits their needs and to identify potential opportunities or threats that we should be aware of. Furthermore, it will create a trust relationship that will boost the chances of later adoption of our research results. To create and maintain this relationship, we are planning the following actions

Briefing about the project

As a first step, we have already been in contact with several rehabilitation specialists in order to present our work and receive a first round of feedback. So far we have validated the proposition of this project and we are currently at the phase of identifying a specific group of patients that would suit more for our investigations. So far we have contacted specialists from our network, however we are considering contacting a more

broad number of people (e.g. The Romanian Society of Medical Rehabilitation https://www.srrm.ro/).

Demonstrations

To keep the interest of the specialists, we are planning recurrent demonstrations of our technical implementation. This will allow us to display progress and explain better the way of operation of our robotic rehabilitator. It will also allow us to strengthen our relationship with the medical community and improve our final solution. We are planning several such demonstrations aligned with the other deliverables. Meaning that we will organise a round of demonstrations each time we have generated new work to demonstrate. This is expected to happen every 6-9 months, there are therefore 3-4 demonstrations planned.

General public

Even though the general public is only identified as a secondary target group, we still believe that it is valuable to disseminate our work to them. This is important not only because it can increase the motivation of the volunteers of the study (since they will better understand the research project), but also for people not connected in any way with the project.

For this reason, we are maintaining a website hosted at the server of our research group (http://rocon.utcluj.ro/true-rehab). The website is used as the main dissemination channel for the general audience, and all the information about the progress and findings of the project will be found there. To make it more appealing and easier to understand, we will focus on using images and videos for explaining complex ideas and avoid using technical jargon. In the cases this is unavoidable, we will provide enough background material to assist the general audience in navigating through the information presented.

We expect a publication of a small article on the website whenever we have small progress, which will keep the audience returning for more information.