International Society *for* Virtual Rehabilitation

ISVR

NEWSLETTER

Editorial

November 2015 Newsletter 6

This month's newsletter features articles about two different types of virtual rehabilitation applications. The first uses VR as a means for providing feedback during training of pinch grip and hand movement using robotic devices. This work is being done in the Rehabilitation Engineering Lab in the Department of Health Sciences and Technology, ETH Zurich, by Dr. Roger Gassert and his multidisciplinary team. The projects focus on the development of upper limb training applications using force sensors and robotics combined with visual feedback provided from virtual reality interfaces.

The second describes a new lab recently set up at the Bouvé College of Health Sciences at Northeastern University in Boston, USA, by Danielle Levac. The lab, Rehabilitation Games and Virtual Reality (ReGame-VR) Lab, focuses on the evaluation of knowledge translation about the uptake and effectiveness of different types of VR systems, from those that have been developed specifically for rehabilitation purposes to those that can be adapted from commercially available gaming systems meant for entertainment. In the article, Danielle uses the term 'active video gaming' to refer to this type of therapy.

As a Society, it is not only important to communicate advances in virtual reality technology and its effectiveness in rehabilitation, but it is also important to develop effective terminology to communicate clearly between members across all levels of the virtual rehabilitation spectrum. This is not an easy task given the multidisciplinary nature of our membership. Virtual reality interfaces may or may not be set up as games. A virtual reality interface can be used to manipulate the environment in order to study behavior, like avoiding an unexpected obstacle during reaching or walking. When used as an enhanced practice environment, how many features of gaming (game score, game time, etc) need or should be incorporated into the practice environment? Aside from knowledge of success or failure, game-like practice environments need to contain feedback to the user in order to improve a movement or function. Determining what type and how much feedback is needed, is an area of active investigation. The question arises, should video gaming without feedback be considered as therapy? We are interested in your opinions and plans are underway to set up a task force of expert researchers, clinicians and industry representatives to provide guidelines about terminology and use of different types of VR.

The newsletter also highlights two new technologies under development. ReHapTix is developing a computer-based application to assess how well figures are traced on a tablet. This can be administered remotely and scored objectively. Kinestica has developed a new video-game based application using a 3 degree-of-freedom force sensor and other sensors. The system, targeting upper limb rehabilitation is called Bimeo, since it incorporates bimanual training activities.

In terms of activities of the Society, I would like to take this opportunity to encourage you to submit papers and attend the International Conference on Disability, Virtual Reality and Associated Technologies (ICDVRAT), to be held September 20-22 in Los Angeles, California. For futher information please see page 9 of the newsletter.

Wishing you and all of yours a happy and peaceful holiday season!

Mindy Levin President, ISVR

TECHNOLOGY PROFILE

Rehabilitation Engineering Lab

Roger Gassert
Associate Professor of Rehabilitation Engineering
Department of Health Sciences and Technology, ETH Zurich
http://www.relab.ethz.ch

Where is your lab located?

The Rehabilitation Engineering Laboratory is part of the Institute of Robotics and Intelligent Systems at the Department of Health Sciences and Technology of ETH Zurich, and is located at the main campus in the heart of Zurich, Switzerland.

How did it start, how long has it been around?

The lab was established in 2008 with the appointment of Roger Gassert as assistant professor, supported by the National Center of Competence in Research on Neural Plasticity and Repair. This research center promoted interaction between engineers, scientists and clinicians, and transformed Zurich into a leading environment for neuroscience and neurorehabilitation research.

Who are the members?

We are a highly interdisciplinary group with competences in mechanical and electrical engineering, human movement science, neuroscience and psychology. We collaborate closely with neuroscientists, clinicians, physiotherapists, rehabilitation clinics and end-users.

What research interests does your lab have?

We apply robotics, wearable sensor technologies and non-invasive neuroimaging to the exploration, assessment and restoration of sensorimotor function. Our goal is to gain a better understanding

Patient using ReHapticKnob to train finger function

of the mechanisms underlying sensorimotor impairment and recovery following neurological injury, and to develop and clinically evaluate tools to support the recovery process. We further develop assistive technologies for the compensation of remaining deficits, both motor and sensory. Virtual reality is an important tool in many of these developments, e.g. as a means to control and manipulate visual feedback, or to create motivating and challenging therapy environments in robot-assisted or sensor-based rehabilitation.

What problem does your system solve?

Robotics has been established as a promising tool to complement conventional therapy with increased intensity and dose following neurological injury. It has been shown to be as good as intensive conventional therapy, but not better. We believe that there is potential to improve robot-assisted therapy in order to further promote recovery.

Developments in robot-assisted therapy have mostly focused on the lower and the proximal upper extremities. However, most of our daily interaction with the environment happens at the level of the hand, and involves both motor actions and somatosensory consequences. Additionally, assist-as-needed strategies can be improved through continuous and objective assessment of both motor and somatosensory impairments, which can also serve to adapt therapy difficulty on the fly, in order to maximize engagement of the patient.

To address these aspects, we have developed the ReHapticKnob, a robotic system to train grasping and forearm rotation.

(continued from page 2)

What makes it unique?

The ReHapticKnob is an end-effector based robot, resulting in a compact design with low inherent dynamics and strong actuation. The output, which is in contact with the patient, consists of two exchangeable finger pads that can translate relative to each other (grasping) and rotate together (pronation/supination). Force/torque transducers allow for precise assessment of magnitude and direction of interaction forces. Together with position sensing, this allows for advanced assessments of both motor and somatosensory function, such as range of motion and just-noticeable difference in position or stiffness.

Thanks to these unique features, the ReHapticKnob can render virtual objects with a wide range of mechanical properties, from free motion and deformable objects all the way to rigid contact. Virtual reality is used to provide visual feedback of object interaction in addition to the somatosensory feedback provided by the robot.

How is it better than other existing systems?

The mechatronic features of the ReHapticKnob together with advanced interaction control allow for novel modes of interaction with the patient, ranging from minimal resistance, which is important for assessments, to passive movement therapy in severely impaired patients.

Following the neurocognitive therapy approach, we have developed seven therapy exercises that take advantage of these features. Neurocognitive therapy focuses on solving a cognitive task by integrating motion and the sensory consequences of that motion. As such, it can also be applied to severely impaired patients, e.g. to judge posture or displacements which

are induced by the robot while the patient is passive. Typical exercises for patients with remaining motor function may involve reproducing a movement, or grasping objects of different length or stiffness and discriminating different levels of these parameters.

The haptic rendering performance of the ReHapticKnob also makes this system suitable for basic neuroscience research, e.g. to investigate precision grip control.

Tell us about the development process?

The development of the ReHapticKnob builds on 10 years of experience in robot-assisted therapy of hand function, starting with the HapticKnob in 2007. The latter was designed in collaboration with physiotherapists and researchers in Singapore, where it was clinically evaluated on 15 chronic stroke survivors.

During this trial, we realized the importance of integrated sensing and the potential to perform online assessments, which could be used to select and adapt the difficulty level of exercises in order to maximally engage patients. This, together with the fact that interaction with the environment is dynamic and involves

ReHapticKnob showing finger pinch force feedback in virtual box manipulation scenario

somatosensation in addition to movement, lead to the development of the ReHapticKnob.

The neurocognitive therapy exercises were developed in close collaboration with the Clinica Hildebrand Centro di riabilitazione Brissago, Switzerland, and were evaluated in a pilot study with 5 patients. This paved the way for the ongoing clinical trial.

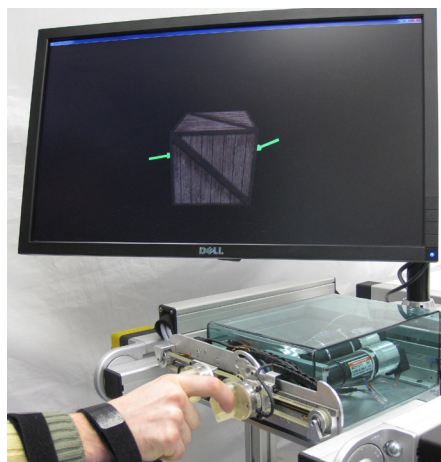## At what level of readiness is the technology now?

The ReHapticKnob is currently being evaluated in a randomized controlled trial at the Clinica Hildebrand. This clinical trial pursues three goals: (i) to show feasibility of clinical integration of the system, (ii) to demonstrate equivalence of therapeutic effect with conventional neurocognitive therapy, and (iii) to investigate the ability of the device to automatically adapt therapy difficult to the impairment level of the individual patient.

In the context of an upcoming European project we will continue our work on the development and clinical validation of automated assessments, and carry out further neuroscience studies on grasp control with the device.

Is it available to the community? How to have access to it?

Currently, only one system is available for our clinical trials and basic neuroscience studies. We are working on the development of a low-cost version for independent therapy in the clinic and at home. In the long-term, we foresee an industry transfer to make this technology available to clinics and patients.

Video: https://goo.gl/ASGwt3
Website: http://goo.gl/IO41Fg

CLINICAL PROFILE

Rehabilitation Games and Virtual Reality (ReGame-VR) Lab

Dr. Danielle Levac, BSc. PT, MSc., PhD
Director of the Rehabilitation Games and Virtual Reality (ReGameVR) Laboratory
http://nuweb9.neu.edu/regamevrlab/

Where is your lab located?

The Rehabilitation Games and Virtual Reality (ReGame-VR) lab is located in the Bouvé College of Health Sciences at Northeastern University in Boston, MA, USA.

How did it start, how long has it been around?

I established the lab when I joined the faculty of the Physical Therapy, Movement and Rehabilitation Sciences Department in January 2015. I came to this position from a postdoctoral fellowship with Dr. Heidi Sveistrup and Dr. Mindy Levin at the University of Ottawa during which I continued to build on my PhD research at McMaster University exploring the use of virtual reality and active video gaming in neurorehabilitation.

Who are the members?

I've been building on existing collaborations and establishing new relationships as we determine the lab research agenda. Collaborators include Stephanie Glegg, Dr. Amy Lu, Dr. Dagmar Sternad and Dr. Judy Deutsch. I am happy to have an excellent research assistant as well as students in Northeastern's College of Engineering and Doctor of Physical Therapy program involved in various projects.

What research interests does your lab have?

The ReGameVR lab focuses on promoting the sustainable, evidence-based integration of VR and active video gaming (AVG) systems into rehabilitation. We explore how VR-based therapy can improve motor learning, balance, functional mobility and participation in children and adults with neuromotor impairments. We use motor learning paradigms to understand how virtual environments can exploit key motor learning principles known to be critical for rehabilitation (such as motivation, task-oriented training and multisensory feedback) and create transfer-oriented practice conditions. We also partner with hospitals, clinics and schools to evaluate the effectiveness of VR and AVG treatment programs (such as Jintronix and Timocco) to promote functional recovery from neurological impairments. Finally, we produce and evaluate the effectiveness of accessible knowledge translation resources for clinicians interested in integrating VR/AVGs within clinical practice. Our mission is to produce clinically-relevant, high-quality evidence in the field of virtual rehabilitation.

How is your research relevant to clinical practice?

The field of VR research is expanding rapidly in tandem with its use in clinical practice. However, there is a definite need to explore and evaluate the mechanisms by which VR may effectively promote motor learning and why it could be chosen over an alternative treatment option. A specific aim of my research program is to generate evidence for these key 'active ingredients' through both experimental paradigms and knowledge syntheses.

One of my main interests is in the integration of commercially available and rehabilitation-specific VR systems within clinical practice. The huge variety of VR systems combined with the limited information available about integration into practice can be a challenge for therapists. Physical and occupational therapists need support in the form of knowledge translation learning resources to develop their skills in using VR. In collaboration with Stephanie Glegg at Sunny Hill Health Center for Children in Vancouver, BC, we are building on a postdoctoral research project funded by the Ontario Stroke Network to develop and evaluate online KT resources to meet this need. We have just completed an online survey of Canadian clinicians' VR experience and learning needs related to integrating VR into practice and will shortly begin recruitment in the US and internationally. Survey findings will inform KT resource content to be housed on www.vr4rehab.com. This site will be home to a range of online resources (including www.kinectingwithclinicians.com) to assist clinicians in keeping current with emerging research evidence on VR for rehabilitation, in developing new
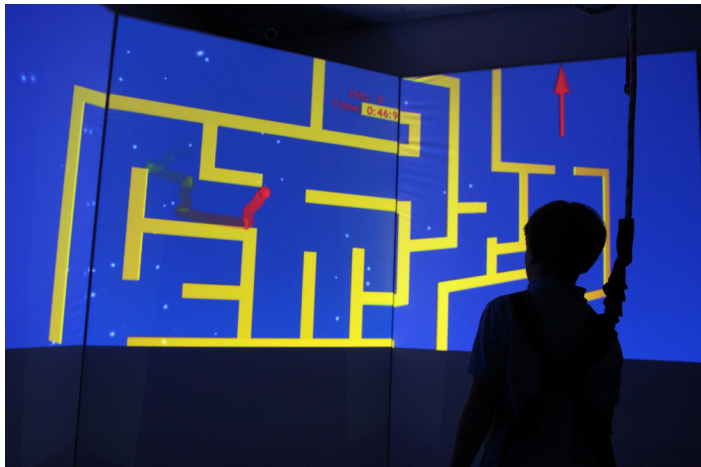
Children engage in virtual environments in the ReGame-VR lab

knowledge and skills in applying VR to practice, and in accessing networking and learning opportunities in the field. Ultimately, accessible evidence-based resources will support effective integration of VR and video gaming systems in a variety of practice settings.

What do you see as the most important challenge for VR rehab research and development?

The field of virtual rehabilitation is at an exciting crossroads where abundant high quality evidence is emerging and low-cost rehabilitation-specific systems are commercially available. In addition to continuing to demonstrate that virtual environments can be feasible and effective treatment options in neurorehabilitation, researchers are challenged to create evidence that the practice conditions of learning in a virtual environment can enhance motor learning and neuroplasticity over and above practice in a conventional physical environment. Another important challenge is the issue of transfer of learning from virtual to physical environments. How can attributes of VR systems, as well as the motor learning strategies used by therapists during VR-based therapy, facilitate this transfer and lead to improved functional real-life skills when VR/AVGs are used in hospital, clinic and home environments? Thirdly, there is a real need to better understand the role of motivation and engagement within VR-based therapy, both in terms of the mechanisms by which motivation and engagement may lead to motor learning and the ways in which therapists can sustain motivation over lengthy intervention periods. Finally, VR researchers need to more clearly detail the content of their interventions within peer-reviewed publications so that clinicians can better understand and replicate the treatment programs.

RECENT BOOKS ON VIRTUAL REHABILITATION

Technologies of Inclusive Well-Being: Serious Games, Alternative Realities, and Play Therapy
Anthony Lewis Brooks, Sherryl Brahnam and Lakhmi C. Jain
Springer-Verlag Berlin Heidelberg, New York, Dordrecht and London, 2014
http://www.springer.com/us/book/9783642454318#aboutBook
This book is the first single volume that brings together the topics of serious games, alternative realities, and play therapy. The focus is on the use of digital media for the therapeutic benefit and well-being of a wide range of people–spanning those with special needs to the elderly to entire urban neighborhoods. This book brings together these topics to demonstrate the increasing trans/inter/multi-disciplinary initiatives apparent today in science, medicine, and academic research–interdisciplinary initiative that are already profoundly impacting society.

REHABILITATION STARTUPS
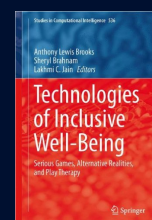
ReHaptix

Dr. Marie-Christine Fluet
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ReHaptix
Advanced Rehabilitation Technologies

What are you offering?

ReHaptix is developing an app, which comprises a series of tests to objectively evaluate upper limb motor function in patients with arm disabilities. Patients can perform the tests autonomously at home on a tablet. Performance parameters are calculated and displayed on the screen directly after the execution of the tests. The app allows tracking the evolution of arm motor function and see how effective the rehabilitation training is. It motivates patients and empowers them about their recovery. Furthermore, patients can share their results with their healthcare professional that can adapt the treatment or medication.

What is unique about your product?

Our app has been developed specifically for patients suffering from arm disabilities due to a neurological disease or injury. Our tests are inspired by real clinical tests, which are usually performed in the clinic by highly trained professionals. However, the clinical tests results are subjective and can vary depending on the person performing the evaluation. In the app, algorithms are calculating objective performance parameters. The tests of the app are currently under clinical validation in order to evaluate the validity and reliability of the results. We are also collecting a large database with performances of healthy subjects, which allows the comparison of patient performance with performance of healthy subjects. Furthermore, the app can serve as a communication tool between the patients and their healthcare professional.

How does your product help patients and therapists?

Patients can perform at home tests similar to those performed by healthcare professionals in the clinic. The app offers the possibility to repeat the assessment more often and therefore better follow patients' progress and monitor their response to various therapeutic approaches. Patients can monitor their progress, which motivates them to continue their training and empowers them about their recovery. Patients can also share their results remotely with the healthcare professional. It reduces the time therapists have to spend on assessment, which leaves them with more time to provide therapy. The therapy programs can effectively be adjusted to the patient's needs, potentially leading to a faster recovery.

How can one obtain your product and how much does it cost?

The tests can be accessed through a browser on the ReHaptix website (www.rehaptix.com). Only a tablet and an internet connection are required. A personal account in which all trials are saved can be purchased for 10 CHF per month.
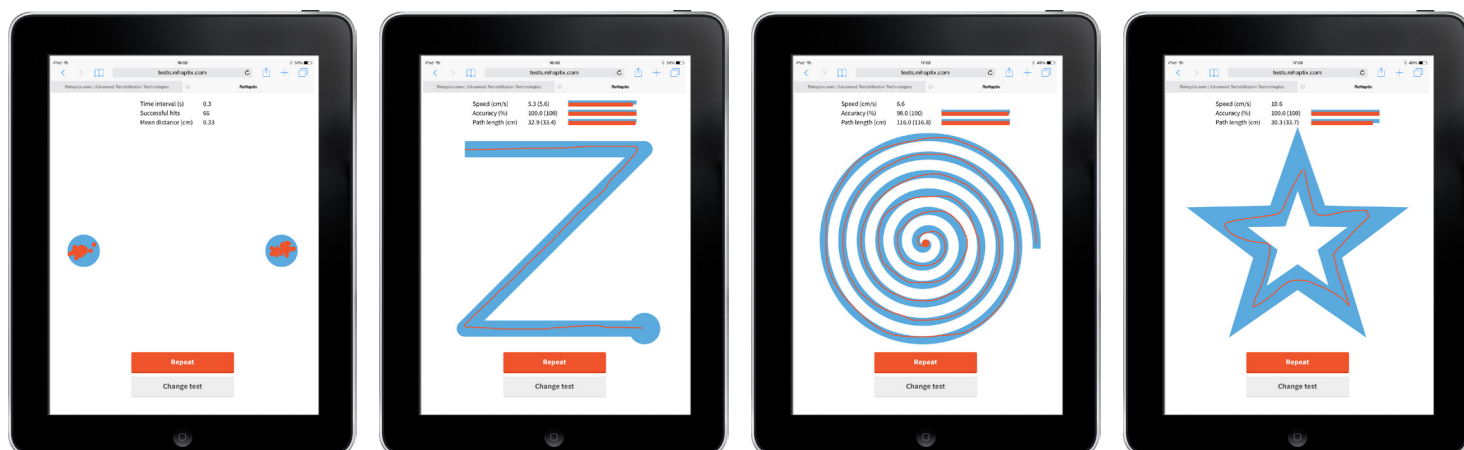
REHABILITATION STARTUPS

Kinestica

Andreja Drevensek
CEO
andreja@kinestica.com
www.kinestica.com

What product are you offering?

Kinestica has developed Bimeo, a sensor based rehabilitation system designed to aid arm rehabilitation of neurological patients. The system makes therapy motivating and rewarding for patients and facilitating for therapists. Patients are engaged in a motivating rehabilitation environment. The Bimeo merges virtual reality gaming with proven rehabilitation methods to provide patients with activity of daily living type exercises, while specific tasks are designed for objective motor function assessment. Clinician can monitor patient's progress and personalize the therapy program according to patient's needs. Rehabilitation process becomes more effective and consecutively shorter.

What is unique about your product?

To the best of our knowledge Bimeo is the only rehabilitation system that combines bimanual/ bilateral training with virtual reality. The patient is encouraged to use the more affected arm, supported by the activity of the less affected arm. To measure interactions between both arms, Bimeo is employing 3 DOF force sensor. Combined with inertial measurement units and proprietary algorithms the system objectively assesses patient's performance for each therapy session. Besides bimanual training the Bimeo offers a wide variety of training modes. Training modes are set up in seconds using quickly interchangeable therapy attachments. Intuitive software and wireless sensing units empower therapists with a hassle free operation. Clinician can monitor patient's progress and personalize the therapy program according to the patient's needs.

How does your product help patients and therapists?

Patients benefit from motivating virtual reality enhanced rehabilitation. By playing specially designed games, the therapy is more engaging for the patients and consequently the rehabilitation is more effective and shorter. Patients are provided with a real time feedback on their performance. Performance scores are stored into a database and patients are able to see their progress through the entire rehabilitation process. Bimeo provide therapists with objective insight into patient's state and progress. Objective assessment enables them to adjust therapy according to each patient's need. Multiple training attachments allow therapists to employ the Bimeo for patients with different pathologies. It is easy and safe to use. Bimeo setup takes less than a minute. There is no need for long calibration procedures. Bimeo calibration is completed in a few seconds. Whit multiple Bimeo systems a single therapist can assist multiple patients simultaneously.

How can one obtain your product and how much does it cost?

Bimeo Pro can be obtained through our distribution network or directly at our company. The cost of the Bimeo depends on the package customer chooses. Basic Bimeo Pro package starts at 1.500 eur. With Bimeo Home the patients will be able to train in the comfort of their homes.

ISVR Society News

The website at http://www.isvr.org acts as a portal for information about the society. We are keen to to enhance the community aspects of the site as well as to to make it the first port of call for people wanting to know what is going on in the field of virtual rehabilitation and its associated technologies and disciplines. Please do visit the site and let us know details of any upcoming events or conferences or news items you would like us to feature on the site. We intend to add further features in the coming year including member profiles; a directory of journals who publish virtual rehabilitation related work; and a list of Masters and PhD level theses completed or currently being undertaken in the field. As well as sending us details of events and news for display, we would welcome suggestions from members about what else they would like to see on the site, or ideas for how we can further develop the virtual rehabilitation community through it.

Please mail webdec@isvr.org with any information/ideas using ISVR INFO in the subject header.

Membership information
Membership of ISVR is open to all qualified individual persons, organizations, or other entities interested in the field of virtual rehabilitation and/or tele-rehabilitation. Membership (regular or student) entitles the member to receive a reduced registrations at ISVR sponsored conferences and affiliated meetings (see webpages for more details). There is also an active ISVR facebook page, which is another source of useful information, currently with 1023 members.

Call for Contributed Articles
- If you are a technology expert in virtual rehabilitation or you have experience in the clinical use of virtual rehabilitation technologies, and would like to be featured in an upcomming ISVR newsletter issue
- If you would like to submit a contributed article relevant to the ISVR community
- If you have any news, summaries of recent conferences or events, announcements, upcoming events or publications

We are looking forward to your contribution! Please contact us at newsletter@isvr.org.

Connect with us

Join our mailing list: http://isvr.org/join-our-mailing-list/

UPCOMING EVENTS

18th International Conference on Physical Therapy and Rehabilitation Sciences
January 28 - 29, 2016, Dubai, United Arab Emirates
http://www.waset.org/conference/2016/01/Dubai/ICPTRS

11th World Congress on Brain Injury
March 2 - 5, 2016, The Hague, The Netherlands
http://www.internationalbrain.org/news/save-date-eleventh-world-congress-2016/

20th European Congress of PHYSICAL and Rehabilitation Medicine
April 23 - 28, 2016, Estoril, Portugal
http://www.esprm2016.com/en/

World Congresses For Neurorehabilitation
May 10 - 13, 2016, Philadelphia, Pennsylvania, USA
http://10times.com/world-congresses-for-neurorehabilitation

10th EAI International Conference on Pervasive Computing Technologies for Healthcare
May 16–19, 2016, Cancun, Mexico
http://pervasivehealth.org/2016/show/home

11th International Conference on Disability, Virtual Reality & Associated Technologies
September 20 - 22, 2016, Los Angeles, California, USA
Pre-Conference Workshop on Pain Management - September 19, 2016
http://www.icdvrat.org/

ISVR Society News

**11ᵀᴴ International Conference On Disability
Virtual Reality and Associated Technologies**

**Los Angeles, California, USA
September 19-22, 2016**

WWW.ICDVRAT.ORG

ICDVRAT 2016 - September 19-22, 2016

The ICDVRAT conference Series provides a forum for international experts and researchers to present and review how advances in the general area of virtual reality can be used in the area of disabilities and rehabilitation. High quality papers are sought in which technical innovation is backed up by evidence of original and practical implementation, or which promise practical implementation in the very near future. Presentations which include video material and/or experimental systems are particularly welcome. Facilities for presenting such material will be available at the conference. The research presented at the conference will be published in a peer reviewed Proceedings which will be made widely available through the ICDVRAT Online Archive at www.icdvrat.org/archive.htm.

Topics:

Virtual and enhanced environments	Sensory impairment	Communications aids
Motor rehabilitation	Medical systems	Tools for architectural/CAD design
Clinical assessment	Input devices, sensors and actuators	Product design, testing and prototyping
Cognitive rehabilitation	Multi-user systems for user interaction	Training tools for rehabilitation
Communication and language	Computer access	Augmented reality applications
Ambisonics and audio environments	Virtual humans	Human factors
Haptic devices	Balance, posture and mobility	Rehabilitation robotics
Physical rehabilitation tools	Robotics and Sensors	Human-computer interfaces
Remote/Telecare	Wearable devices	Mobile health applications

General:
Papers accepted for the conference require the registration of at least one of the authors as a Full Delegate or Full Student Delegate to the conference.

Full Papers Review & Plenary Presentation:
Authors should submit Full Papers (6–8 pages) by February 29, 2016, with notification of the outcome of peer review given by May 15. Accepted papers may be further revised in light of reviewer comments for final submission by June 15, 2016. All Full Papers will be presented in the conference plenary sessions. Papers that are not accepted as Full Paper (podium presentations) will also be considered for inclusion as Short Papers (poster presentations), subject to a reduction in length.

Short Papers Review & Posters Presentation:
Short Papers (limited to 4 pages) may also be submitted directly, for peer review, by May 15, 2016, with notification by June 20, 2016. There will only be a limited opportunity for revision after reviewer comments. All Short Papers will be presented in Poster Sessions over the course of the conference, together with a short Podium Presentation Summary of all Short Papers.

See http://www.icdvrat.org/ for more information.