



ISVR

# NEWSLETTER

NUMBER

1

FEBRUARY

2014

## Inaugural Newsletter of the International Society for Virtual Rehabilitation

### Editorial

Welcome to the inaugural newsletter of the International Society for Virtual Rehabilitation! The aim of this newsletter is to help fulfill the mission of the Society by providing regular information on activities and topics of interest in Virtual Rehabilitation relevant to current and potential future members.

The newsletter consists of four regular sections: a technological and a clinical profile of experienced virtual rehabilitation researchers, a feature article and the latest news from the society. In this first issue we introduce the PERCRO laboratory and the Brazil Parkinson Association, and we provide some guidelines and information on how to approach Technology Transfer in the field Virtual Rehabilitation. We hope you find the inaugural articles interesting and welcome your suggestions for future topics

As this is the first issue, we are just beginning and are counting on your feedback and suggestions. We have a long list of possible future ways in which the newsletter could develop and grow, and we need your input so that we can best provide the articles and features that you would like to see.

We hope you enjoy this first issue - please let us know your feedback on [newsletter@isvr.org](mailto:newsletter@isvr.org)!

*Sergi Bermudez, Kynan Eng and Belinda Lange*

## IN THIS ISSUE



### Technology Profile

Perceptual Robotics Laboratory

Page 2 - 3

### Clinical Profile

Brazil Parkinson Association

Page 4 - 5

### Feature Article

Technology Transfer in Virtual Rehabilitation

Page 6 - 7

### ISVR News

Pages 8 - 9



## UPCOMING EVENTS

### Tenth World Congress on Brain Injury

March 19-22, San Francisco, California, USA  
<http://goo.gl/MFC4Oe>

### 7th Annual International Conference on Computer Games Multimedia and Allied Technologies

March 24-25, Singapore  
<http://goo.gl/gNxee3>

### IEEE Virtual Reality 2014

March 29-April 2, Minneapolis, USA  
<http://ieeervr.org/2014/>

### GameDays 2014, 4th International Conference on Serious Games

April 1-4, Darmstadt, Germany  
<http://goo.gl/HXcYLg>

### Laval Virtual

April 9-11, Laval, France  
<http://www.laval-virtual.org/>

### The National Association of Rehabilitation Research and Training Centers

April 23-24, Alexandria, VA, USA  
<http://narrrc.org/>

### The 2014 International Symposium on Collaborative Technologies and systems (CTS 2014)

May 19-23, Minneapolis, Minnesota, USA  
<http://cts2014.cis.edu.info/>

### 8th International Conference on Pervasive Computing Technologies for Healthcare

May 20-23, Oldenburg, Germany  
<http://pervasivehealth.org/2014/show/home>

### IEEE 27th International Conference on Computer Animation and Social Agents (CASA 2014)

May 26-28, Houston, Texas, USA  
<http://graphics.cs.uh.edu/casa2014/>

### 10th International Conference on Disability, Virtual Reality and Associated Technologies (ICDVRAT 2014)

September 2-4, Gothenburg, Sweden  
<http://www.icdvrat.org/>

## PERCRO laboratory

### Antonio Frisoli

Associate Professor of Mechanical Engineering  
Head of Human-Robot Interaction Area at PERCRO  
(Perceptual Robotics) Laboratory

Laboratory website:

<http://www.percro.org>

Research page of Antonio Frisoli:

<http://percro.sssup.it/~antony/>

### Where is your lab located?

Our lab is located in Pisa, in Tuscany Italy, within the Institute of Communication, Information and Perception Technologies (TeCIP Institute) of Scuola Superiore Sant'Anna.

### Can you give us a brief history of your lab?

The PERCRO laboratory was founded in 1993 by prof. Massimo Bergamasco. I am currently leading the area of Human-Robot Interaction that was born more recently in 2009 with a focus on wearable and rehabilitation robots, and is composed of a group of about 20 persons.

### Who is in your lab?

Currently the Human-Robot Interaction area involves 8 senior researchers: 1 professor, 1 assistant professor, 6 PhD students, 2 technicians, and several undergraduate students.

The group has acquired a solid background in design and control of robotic systems, with particular reference to wearable robots such as exoskeletons and haptic devices. The group has a consolidated expertise in psychophysics of the human perception and biomechanics of human motion, with specific reference to the haptic sense. Such expertise is being employed for the development of novel haptic devices including large workspace devices,

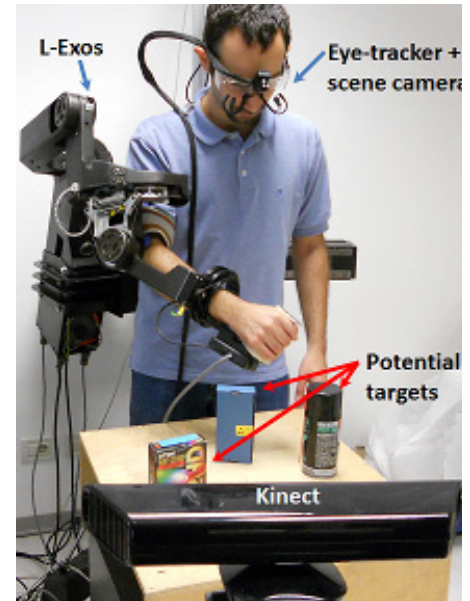
desktop devices and force feedback exoskeletons for rehabilitation and human power augmentation.

### What are your main research interests?

The Human Robot Interaction (HRI) group investigates theories and systems to design new man-machine devices that properly reflect human-centered design requirements. We investigate from a technological and perceptual point of view the mechanisms of Human-Robot physical Interaction, with the aim:

- To develop devices and robots that can intuitively and safely cooperate with humans
- To develop new man-machine interfaces for the interaction with virtual environments

In particular we develop robotic devices that can cooperate with humans in a safe and intuitive way during interaction in virtual environments. We have an established tradition in the design of wearable robots and exoskeletons



ALEX, a light exoskeleton for rehabilitation applications

for rehabilitation, human power augmentation and interaction with Virtual Environments.

### What problem does your system solve?

Our systems are of two types: wearable robots and desktop interfaces.

The HRI group develops new clinical robotic and virtual environment systems for the neuromotor rehabilitation in patients with motor impairments following central or peripheral neurological lesions, such as stroke and/or childhood paralyses, or orthopedic traumas. The use of robots integrated with virtual reality applications enables the delivery of intense and interactive clinical treatment with good repeatability. While serious gaming scenarios can provide motivation and indications for the execution of therapy exercises, innovative robot control algorithms allow the implementation of “assist as needed” paradigms that promote volitional effort from patients and so motor recovery.

# TECHNOLOGY PROFILE

(continued from page 2)

Wearable robots can be physically worn on human body, so they are able to accomplish an high level of integration with humans. In the area of virtual rehabilitation, exoskeleton devices can provide selective assistance at level of specific articular joints without imposing restriction to movement. Our robots are designed in order to be highly transparent and fully back-drivable, to make them highly compliant with human motor control schemes.

Desktop devices can be used by the patient without need of wearing it, so they might be more easily deployed. In the simplest configuration they can provide only relief of weight, such as in the case of arm support trackers, or robotic assistance at the level of a grasped handle.

## What makes it unique?

Unique combination of virtual reality applications with light exoskeleton devices.

We are currently designing new generation of light devices that can be worn on fingers (fingertip devices) to provide touch feedback in highly immersive virtual environments without break of presence illusion (<http://www.wearhap.eu/>). These new devices will come in the form of thimbles that can be worn on fingers, to make tangible the contact with completely virtual objects and might be exploited for rehabilitation of hand grasping.

## How does it improve on existing systems?

The performance of our exoskeletons make them very transparent to patients, both in terms of perceived forces and in terms of allowance of full body natural movements. Our designs are moreover reliable and safe.

## Tell us about the development process.

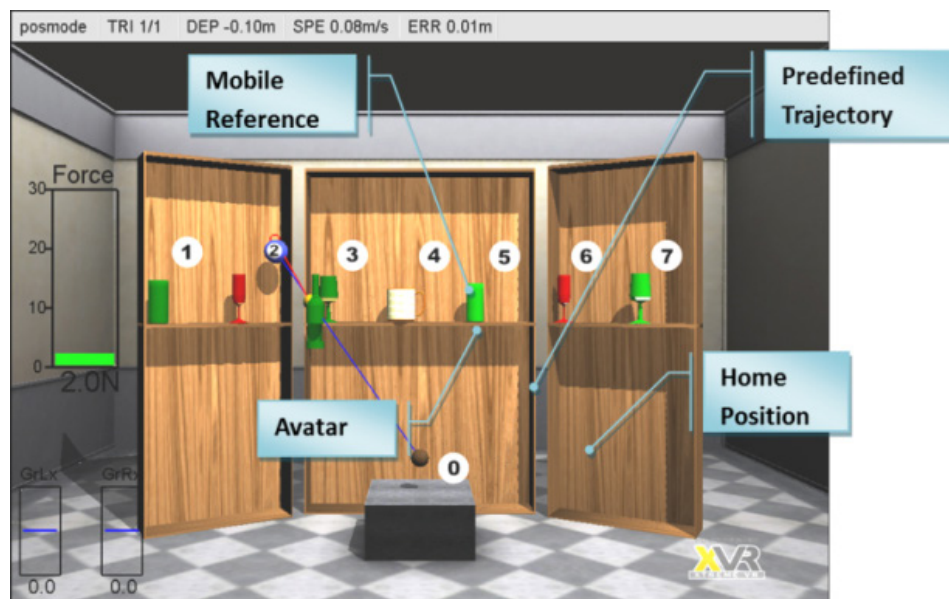
Typically we start from the analysis and formalization of users' requirements, concept design with realization of physical or virtual mock-ups, CAD modeling and design, assembly and testing. The applications are typically developed together with a medical team, in order to agree on the nature and type of exercises to propose, the parameters to be adjusted and changed, the different levels of difficulty of the proposed exercise, and the feedback on performance to be provided back to the patient.

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

We are currently ready to commercialize our systems for rehabilitation applications, see for example the new design of ALEX upper limb exoskeleton.



The ALEX upper limb exoskeleton



Example of VR training environment

## Is it available to the community? How can one get access to it?

In case you are interested to any of our systems, please contact directly Antonio Frisoli at [a.frisoli@sssup.it](mailto:a.frisoli@sssup.it). Our spin-off company will be able to propose you a solution.

## Acknowledgments

**Massimo Bergamasco**, Full professor of applied mechanics, founder of PERCRO lab  
**Fabio Salsedo**, chief senior researcher, HRI area, PERCRO

**Prof. Bruno Rossi**, **Dr. Carmelo Chisari**, Neurorehabilitation unit, University Hospital of Pisa

## Additional information

Our former PhD Student Dr. Claudio Loconsole, winner of the World Student Simulink Challenge with a video on our L-Exos

<http://www.youtube.com/watch?v=4GKrkiavW9g>



# CLINICAL PROFILE

## Brazil Parkinson Association

### Jose Eduardo Pompeu

Associação Brasil Parkinson (Brazil Parkinson Association)

Brazil Parkinson Association:  
<http://www.parkinson.org.br>

#### Where is your clinic located?

We are using virtual reality to improve motor and cognitive function in neurological patients and elderly people at the Associação Brasil Parkinson (Brazil Parkinson Association) in São Paulo, Brazil and at the Laboratory of Motor Learning of the Physical Therapy course of São Paulo University, Brazil.

#### What patient populations do you serve? How many per year?

The two locations serve approximately 100 patients per year. Specifically for our protocols involving virtual reality, we see 20 patients with Parkinson's Disease at the Brazil Parkinson Association and

20 people with stroke and elderly people at São Paulo University per year.

#### What VR rehab system(s) do you have installed?

We use the Microsoft Kinect system and the Nintendo Wii Fit Plus as non-immersive virtual reality tools.

#### What benefits do you gain from using this VR rehab system?

Through our clinical and research experience, we have observed that patients have shown improvements in:

- a. Balance, gait and cognition

- b. Adherence to rehabilitation
- c. Motivation
- d. Quality of life
- e. Performance on daily living activities

#### What problems did/do you have with using these systems?

These systems were not created to be used with neurologic patients or elderly people. Some games have a high level of difficulty and patients are not able to play. We have some difficulties to calibrate the balance board in patients with tremor or hemiparesis. We have just the scores of patients in order to assess their performance and the systems do not offer the possibility to select the tools for assessment. The



Patient with Parkinson's disease training one of the Adventures! games (Kinect, X Box)

# CLINICAL PROFILE

(continued from page 4)

Nintendo Wii Fit Plus has balance assessment, but it is performed at a random way and this causes difficulties to use it in our research. The games of the Microsoft Kinect System don't have a motor assessment component. The systems are not flexible and doesn't allow for the manipulation of some variables, for example the type and amount of feedback. Another specific problem with the Nintendo is the manual control that does not require physiologically correct movements, so patients could learn how to "cheat" with simple movements. For example, the Wiimote permits users to play tennis just using wrist movements.

## Are you involved in clinical research using VR rehab systems? Can you describe them?

In my postdoc, we are investigating if the games of Kinect Adventures! can improve balance, gait, cognition and quality of life of patients with Parkinson's disease. In this study, patients are performing 14 sessions of 60 minutes in which they practice four games. They are assessed pre- and post-training and after 30 days of the end of the training using posturography, mini Bestest, PDQ-39, Montreal Cognitive Assessment, and other clinical scales. Another study has the aim of assessing the effects of the Nintendo Wii Fit Plus

on balance, gait and cognition of people with stroke. We are also developing a new tool to assess the motor and cognitive demands of the games. Finally, we are creating new games for rehabilitation using the balance board of the Nintendo Wii Fit.

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

The most important challenge for VR rehabilitation is the high cost of the systems and one solution is the use of the new generation of video game consoles like Kinect and Nintendo Wii. Another possibility is to create specific games with the option to adjust of the level of difficulty and with assessment of the performance of patients regarding the motor strategies used by the patients during the games. For example, there are some studies about the use of the balance board of the Nintendo Wii Fit to assess the limits of stability and the oscillations of the center of pressure of the patients in some conditions. Other studies used the Kinect to assess functional reaching. Thus, I think that we are just starting to learn about the effects of the use of virtual reality system on rehabilitation and in few years, all clinics and rehabilitation centers will use this technology in order to control the training environment, to select the correct stimulus and the level of stimulation in safe and controlled conditions. In Brazil, we have some difficulties to create interdisciplinary teams with engineers, computer scientists, physical therapists, occupational therapists, psychologists and game developers due to the high cost of all of these professionals.



Microsoft Kinect Adventures!



## Technology Transfer in Virtual Rehabilitation

Kynan Eng

Sooner or later, a question that many applied researchers ask themselves is: *When will people use my work in everyday life?* For many of us in Virtual Rehabilitation, the answer is rapidly becoming: *Within my career span, if I can work out how to make it happen!* This article lists a few of the key questions to consider before setting off along the long road of getting your work out of the lab and into everyday use.

### **Will I get rich in three years?**

This outcome is unlikely for two main reasons. The first reason is that many promising technologies are discarded for reasons unrelated to the merit of the technology, but rather related to factors such as market access, device usability and organizational constraints (e.g. how hospitals' internal processes work). The second reason is that the medical device industry moves much more slowly than internet startups, mainly due to the medical device certification process. You should look to at least a 5-10 year horizon before you start to see a real impact of your work in daily clinical life.

### **I have a working prototype of a cool new rehabilitation technology. How much extra work do I need to do to get it to the market?**

Unless you are writing a simple software app, the answer is usually several multiples of the work you and your funding agencies have already invested. The prototype you have will require a lot of work before it can be used in everyday clinical life where every minor glitch can lead to user rejection. To prove that your product is reproducible, usable, safe and functional, you need to perform many extra tasks including design for manufacture, documentation in every language where you intend to sell, design documentation, supply chain management, customer service planning, device certification and clinical studies. On top of this comes sales and marketing, which

is a significant percentage of any medical device company's total budget.

### **I still want to do it. How do I convince people to support me? Do I need a business plan?**

Imagine you were an investor; then try to clearly answer some questions about your product. The questions investors typically ask include:

(a) Who will pay for my product? Who will use it? Who makes the decision to buy it? In healthcare this is a complex issue due to factors such as insurance coverage, product usage requirements from both therapists and patients and hospital budgeting processes.

(b) What benefit does each stakeholder - the patient, the therapist, the hospital administrator - obtain by using my product? Are the benefits clinical, financial, prestige? Do these benefits justify the cost (time, money, convenience) for each stakeholder individually?

(c) What is the urgent problem faced by your stakeholders that makes it imperative that they buy your product right away? If they delay, will they waste a lot of money or will people be harmed? The more urgently needed your product is, the easier it will sell.

(d) What will the customer need to change in their current work process to introduce my product? Inertia is powerful - if your product requires a hospital to change the way it allocates its staff, to build a new room or to send everyone on a training

course, you need to show how the benefits of your product make this extra investment worthwhile.

(e) Why hasn't anyone already solved this problem, i.e. what is my unique selling proposition (USP)? Do I have a great new technology that is patented, secret or hard to copy? Is my network of experts better than everyone else's?

Your answers to these questions must be as specific and fact-based as possible. The statement "my product saves therapists' time and they like it" is not as good as "during three months of daily use in four clinics by 10 therapists, my product saved an average of two hours per therapist per week, allowing the hospital to earn an extra \$125/therapist in patient treatment time per week with no increase in reported therapist stress levels".

Once you can answer all of these questions, you can start on your business plan. There are many templates and instructions available, as described for example in Forbes (<http://goo.gl/XvBxmK>). Several methods and tools for visualizing business plans exist, for example Lean Canvas (<http://leanstack.com/>) and Live Plan (<http://www.liveplan.com/>).

### **What about intellectual property? Should I patent my invention? Should I trademark my company name?**

You must first clarify your intellectual property (IP) situation and your rights to use it.

# Feature Article

(continued from page 6)

Depending on your local regulations, the work you wish to commercialize may be owned by you, your university, someone else or by some combination of owners. Then you should determine whether or not you have patentable IP, as defined for example by the United States Patents and Trademarks Office (<http://goo.gl/15XAf>). If you do have patentable IP, it should be seen only as one part of your overall business plan. Patents are useless if you can't afford to enforce them, and can be circumvented by new technology. A standard patent application can take 3-5 years to be granted and it can cost USD 50k or more over that period, depending on where (which territories) you want to register it. There is no such thing as a worldwide patent, although links between most countries' patent offices exist via the Patent Cooperation Treaty in the World Intellectual Property Organization (PCT in WIPO, <http://goo.gl/n4tHCM>). Trademarks follow the global Madrid system (<http://www.wipo.int/madrid/en/>) and can also cost tens of thousands of dollars once you start considering all of the territories in which you want to sell.

## How should I handle certification?

Medical device certification can take at least 1-2 years to complete. Anything with therapeutic value may be considered to be a medical device, and may therefore be subject to device certification rules. Almost every developed country has its own medical device registration and certification rules. The biggest in terms of market size are the USA Food and Drug Administration (FDA, <http://www.fda.gov>) and the European CE Medical regulations (<http://goo.gl/Le6MBk>). Many other countries base their systems on CE or FDA rules. Broadly summarized, a CE/FDA medical device is classified depending on whether it is a passive

tool with limited patient contact (Class I), an active tool which adds or removes energy to/from the body (Class II), or is designed to be implanted (Class III). Each class specifies the safety tests and the level of documentation required. A critical aspect of the certification process, particularly for new technologies, is that you must document the design and validation process of your product as well as the safety-relevant aspects. You can expect the process to involve expensive consultants and to cost tens of thousands of dollars, and you may also need to certify your entire company to ISO 13485. Some notable exceptions can be found in the recently published US FDA guidance on medical apps (<http://goo.gl/cvYBp>).

## I can handle all of this. Where do I find resources to help me achieve my goal?

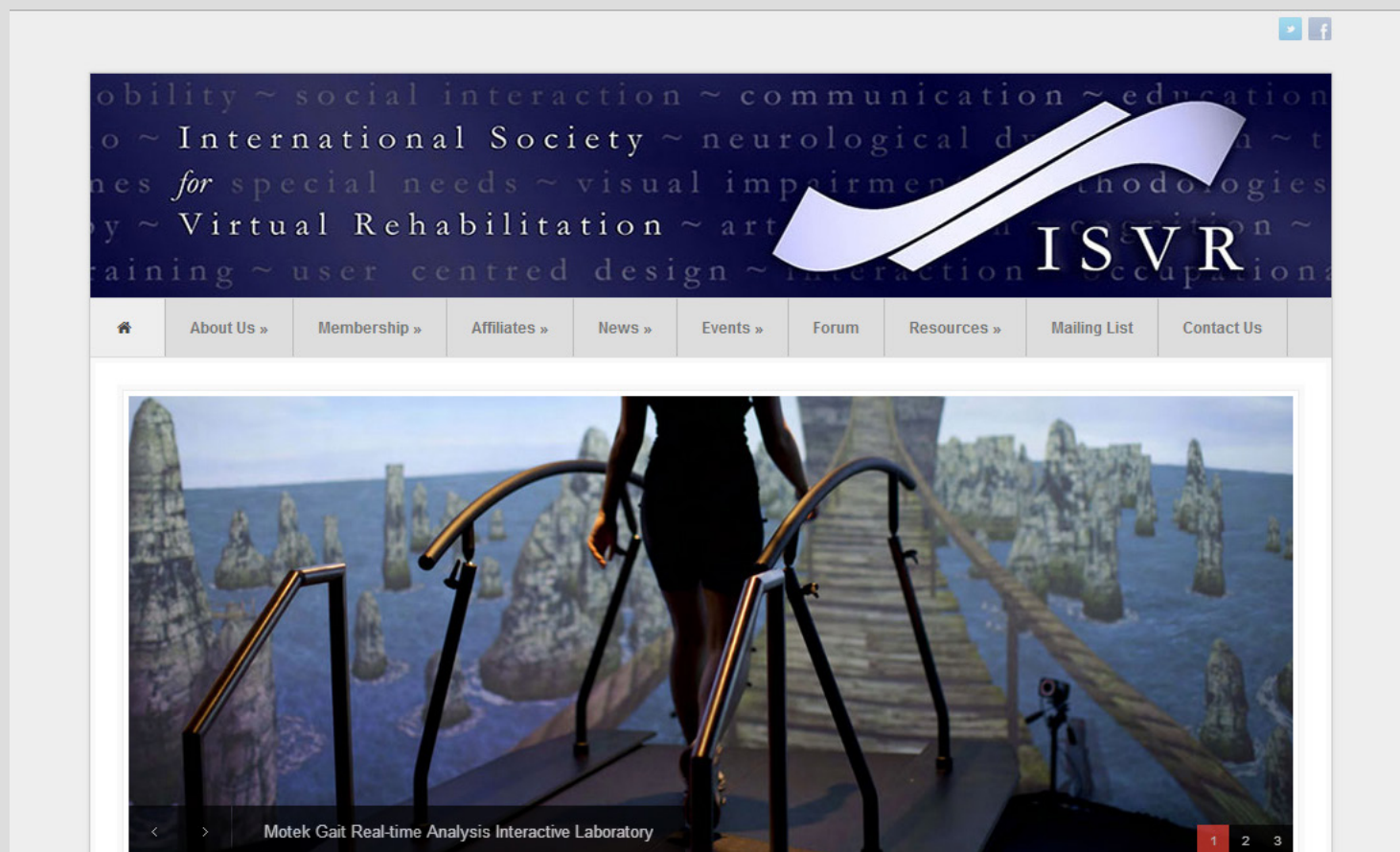
At the start you first need to see what you can get for free. "Free" support from your university or hospital in terms of time, grants, lab space and students is extremely valuable if you can reconcile your product development goals with your research and clinical obligations. You then need to decide whether you wish to found your own company or to work with an existing company. This decision is often a trade-off between the autonomy of running your own show versus gaining access to the existing company's resources. If you decide to set up your own company, the support you can access depends very much on the country in which you operate. The top-ranked countries in the Global Innovation Index (<http://globalinnovationindex.org>) such as Switzerland, Sweden, the United Kingdom, the Netherlands and the United States have coordinated startup support programs covering business coaching, cash

competition prizes and investor access opportunities supported by government, university technology transfer offices, business development foundations and investor clubs. Professional investor groups typically fall into angel (total funding below approx. USD 2M) and venture capital (above USD 2M) categories. Crowdfunding platforms such as Kickstarter (<http://www.kickstarter.com>) may also be applicable to part of your business plan. There is of course a plethora of books and online resources; some of the best known in startup circles are the books and talks by Guy Kawasaki (<http://goo.gl/2rpl>).

One thing you should definitely do is to find a coach with business experience, preferably in a related field. A Gallup poll found that potential entrepreneurs with mentors were more likely to start a business (<http://goo.gl/aqOLII>). The mentor needs to commit time for regular discussions over a period of several months, which they may do for enjoyment, payment and/or shares. If you live in a region with structured business coaching programs then this is a good place to start.

## Anything else?

Startup companies are high-risk endeavors which demand high levels of commitment. In some ways, running a startup company is not that different from running a lab in the brutal modern academic world of long-term soft funding, competitive grants and tenure interviews. So you may already have many of the skills needed to make it work! The risks are balanced by the fun and immense personal rewards in seeing your work go from a single buggy prototype to a valued part of everyday clinical life.



The website at <http://www.isvr.org> acts 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 [r.j.mccrindle@reading.ac.uk](mailto:r.j.mccrindle@reading.ac.uk) 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 (ICDVRAT, the next to be held in Gothenburg, Sweden, in September 2014; and ICVR, to be held in 2015 in Valencia, Spain) and affiliated meetings (see webpages for more details). The current membership of the ISVR is 84 members (74 regular members, and 10 student members). There is also an active ISVR facebook page, which is another source of useful information, currently with 932 members.





## President's Message

"I am delighted to see the first issue of the ISVR Newsletter present some wonderful examples of different technologies and applications used for rehabilitation in our community. The level of innovation and commitment to pushing forward technological development and demonstration of impact on quality of life is a hallmark of the people in our field. Last year our Society Conference was ICVR 2013 and this was very successful conference as you can see in the article below. I would like to thank all those involved in the conference and especially, the local organising committee who worked so hard to get everything ready and to ensure that all ran smoothly: Emily Keshner, Tiffanie Jackson, Geoff Wright and Erin Vasudevan. The Society Conference this year is ICDVRAT 2014 and will be held Gothenburg in September. See [www.isvr.org](http://www.isvr.org) or <http://www.icdvrat.reading.ac.uk/> for further information and I hope to see you there.



Clearly, the transition from idea to implementation is not an easy journey as Kynan explains in the feature article. However, it is the strength of our community and our support for one another that fosters this forward progress. I hope you find the newsletter interesting and that we will be inundated with more articles demonstrating the innovation and success of our community and the people that it serves."

Sue Cobb

### ICVR 2013 Conference

ICVR 2013 was held in Philadelphia on August 26-29, 2013. With 138 participants from 19 different countries, it was a great success! Following a stimulating day of workshops, the conference opened with a welcome reception where attendees feasted on traditional Philly cheesesteaks and pretzels. Attendees also had the opportunity to mingle with participants of the Eleanor Saffran Cognitive Neuroscience Conference. Both conferences were supported by a grant from National Institutes of Health-National Institute on Deafness and Communication Disorders. The conference committee also want to acknowledge the invaluable support of professional, academic, and industry sponsors: ISVR, Bright Cloud International, Hocoma, Motek Medical, Motion Analysis, IEEE Engineering in Medicine and Biology Society, Rutgers University, Kessler Foundation, and Temple University. This conference also boasted significant support from National Science Foundation for the registration and expenses of 40 students and post-doctoral fellows. Having this support meant a much greater number of students and fellows were able to attend the conference than in the past. Two platform sessions were devoted specifically to student and fellow presentations. Awards for the best student platform presentation was given to Anna Graefe and the best post-doctoral fellow platform

to Orit Elion. These sessions were followed by a poster session to view the 31 posters and 2 Demos. Awards for best student poster went to Megan Huber and the best post-doctoral fellow poster award went to Mohammed Al-Amri. In addition, MOTTEK sponsored an award for innovation by a student that was given to Roberto Llores Rodriguez. The Hocoma best paper award was awarded to Anita Liu. We had 10 exhibit booths and each was filled for lively interaction between exhibitors and participants. The gala included a cruise on the Delaware River with Spirit Cruises in Philadelphia.

A special plaque was presented to Greg Burdea to recognize his outstanding service to both ICVR and the International Society for Virtual Rehabilitation. The conference closed with a discussion by an expert panel, including Joyce Fung, Sue Cobb, Leora Cherney, Tamar Weiss, and Mariano Alcaniz, on the topic of Future Directions for Translation of Virtual Technology into the Clinical Arena. Their presentations sparked a lot of audience participation about the role of clinicians in technology transfer. We hope to continue these discussions at our future conferences. Finally at the closing ceremonies, Mariano Alcaniz presented the venue for the next ICVR conference...Valencia, Spain. Videos of the keynotes and closing ceremony can be viewed at: <http://goo.gl/NqjUQo>.



Maria Schultheis, Emily Keshner, and Mohammad Al-Amri



Norman Badler