MSc Internship project proposal 2022

"Virtual Reality therapies for visual restoration."

We are looking for a 5/6-month intern, for a project starting next year. Please find more information below:

Who we are:

Campus Biotech is a Swiss center of excellence in biotechnology and life sciences research focusing on three domains: Neuroscience & Neurotechnology, Digital Health and Global Health.

The Virtual Reality Facility (https://hnp.fcbg.ch/home/virtual-reality/at the Fondation Campus Biotech Geneva (FCBG) is part of the Human Neuroscience Platform, and provides researchers with state-of-the-art equipment and expertise in the field of immersive interaction and motion analysis in virtual reality for experimental research and clinical applications (e.g. cognitive and affective assessment, cognitive and behavioral therapy, neurological rehabilitation, gait and upper limb neuro-prostheses).

Project description:

Vision is one of our primary senses and is used continuously to gather information during functional activity. Damage to the primary visual cortex (V1) or its immediate afferents after a stroke, results in dense scotomas (fields with altered vision), termed hemianopia/quandranopia. Post-stroke visual deficits are severely disruptive to almost every aspect of the patient's daily life, affecting mobility, reading, and driving. 15 million people suffer stroke worldwide each year and approximatively 30% of them will have to cope with various kinds of visual loss. Despite the increasing number of patients and the relevance of these impairments on daily life, there are currently no clinically proven therapies for visual restoration.

However, there is evidence suggesting some capacity for perceptual learning in the blind field. Using extensive training on computerized visual tasks, several research groups showed that it is possible to "relearn" complex visual motion processing without an intact visual cortex. However, the associated degree of visual field recovery is still not satisfying and needs further advancements to have an impact on patients' daily life. Hence, there is a great need of developing novel, innovative treatment strategies to enhance the functional recovery from these deficits.

Virtual reality has been successfully applied in the motor domain as an alternative to conventional stroke physiotherapy, providing virtual environments and multisensory inputs to re-train stroke patients. The technic has not been leveraged to the same degree for the rehabilitation of visual field defects. However, we expect that the use of virtual reality in hemianopic patients will allow a higher number of exercise repetitions with individualized intensities, and will potentiate perceptual learning thanks to the quick feedback possibilities and the multisensorial stimulation. This new therapeutic approach will overcome the limitations of the existing training approaches, which are stationary, uncomfortable, sometimes unreliable and not engaging for patients. It will account for the fact that neurorehabilitation is a long-term task which require weeks to months of practice. By improving motivation and compliance, this approach will help long-term recovery from devastating visual field defects- Establishing individually and parametrically adjusted visual scenarios: The student will take part in establishing different real-life visual scenarios of the everyday life in a stepwise approach, i.e., with parametrically enhanced visual information to be decoded in the blind visual field of the patient. These scenes will have to be individually adjusted to fit with each patient's visual field.

- **Establishing individually and parametrically adjusted visual scenarios**: The student will take part in establishing different real-life visual scenarios of the everyday life in a stepwise approach, i.e., with parametrically enhanced visual information to be decoded in the blind visual field of the patient. These scenes will have to be individually adjusted to fit with each patient's visual field.

- **Building an interactive system**: To enhance perceptual learning, the patient will receive feedbacks on his/her performances during enriched visual task based on navigation or reaction times to certain visual stimuli.

- **VR and eye tracking coupling**: In terms of technological development, the project will have to incorporate an eye tracking system to control for eyes position throughout the visual exploration. Ideally, this approach may offer a way to diagnose patients who may be suffering from hemianopia more effectively and without the need of traditional vision exam machines (i.e., perimeter).

- **Multimodal interventional strategy**: A more long-term goal is to develop a system that would be usable with non-invasive brain stimulation (NIBS), to test whether enriched visual environment combined with NIBS further boosts visual field recovery. This work will contribute to develop an innovative multimodal interventional strategy for visual recovery. We have acquired first evidence that multifocal NIBS might improve such visual behavior in healthy (Salamanca-Giron et al. 2021, NeuroImage) and patients (10 stroke patients enrolled so far).

Project planning:

- Create the visual environment: with the help of VR engineers, the environment will be developed to maximize ecological conditions and patient's characteristics.
- Develop and test the different intensities of visual stimulation
- Combination with eye tracking. Intensive testing of accuracy on normal sighted participants
- Proof of principle on a stroke patient

Profile required:

- Mastery of the Unity engine
- Mastery of the development language: C#
- A first VR experience
- Knowledge of 3D software: Blender or 3ds Max
- Knowledge of real time optimization constraints
- Knowledge of versioning tools (Git)
- Excellent communication and teamwork skills
- Fluency in English (oral and written)
- Excellent autonomy

The "Plus":

- Knowledge of eye tracking

The internship is for MSc level students performing their 5/6 months final research project in 2022. The position is full-time at FCBG in Campus Biotech. Ideally, the internship would start between February and May.

Please send your resume and cover letter to vr@fcbg.ch.

If you have any visuals to show or project we can browse, don't hesitate to add them as well !

We look forward to receiving your application.

The VR Team at FCBG