Title (tentative): A practical implementation of a VR setup to gait disturbances in patients with Parkinson’s disease

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### Description

#### Motivation and application domain

Freezing of Gait (FoG) is the most debilitating symptom of Parkinson’s disease (PD). Several studies attempted to describe FoG but with poor results. The main difficulty is related to the laboratory environment. During a biomechanical acquisition PD patients perform better than in an ecologic environment and do not show many FoG episodes. VR can be an effective tool to immerse participants in specific situations in order to induce freezing-like behaviour in a controlled environment.

#### General objectives and main activities

The aim of the thesis is to develop a virtual reality environment, specifically designed for inducing FoG in PD. The VR environment will be used in a study aiming to characterize the cortical and subcortical electrophysiological activity during gait and its failure in subject with PD. The measurements will be performed in a gait laboratory and they will combine: (i) biomechanical evaluation IMU (Opal, APDM Inc, Oregon, USA); (ii) surface EMG recordings of the soleus muscle and tibialis anterior bilaterally (zebris EMG Bluetooth, zebris Medical GmbH, Isny im Allgäu, DE); (iii) hdEEG (BrainAmp ExG, Brain Product) and (iv) Subthalamic nucleus LFPs recordings (Newronika). The VR setup should be fully integrated with the instrumentation present in the gait laboratory.

#### Training Objectives (technical/analytical tools, experimental methodologies)

1) Use of Unity 3D game engine to design and build VR environments. Use of the SDKs to develop applications for HTC Vive and Samsung Gear VR headsets.
2) Design of 3D environments to allow people navigation.
3) Implementation of a VR environment, specifically designed to induce FoG in PD to be used with VR headsets, like the HTC Vive and/or the Samsung Gear.
4) Experimental sessions with both healthy people and PD patients.

### Place(s) where the thesis work will be carried out:

(i) DIBRIS, University of Genova; (ii) Centro Parkinson e Disturbi del Movimento ASST G.Pini- CTO (CTO) in Milan with the collaboration of “Fondazione IRCCS Ca’ Granda Ospedale Maggiore Policlinico; (iii) Department of Neurology, University Hospital and J
Maximum number of students: 1