PhD in Bioengineering

Final Defense

POLITECNICO MILANO 1863

PHD BIOENGINEERING – THESIS FINAL DEFENSE

PHD Student Sara Arlati

Advisor Prof. Giancarlo Ferrigno

Co-Advisor Prof. Marco Sacco

SAVE THE DATE

PHD Student Giulia Buizza

Advisor Prof. Guido Baroni

Co-Advisor Prof.ssa Chiara Paganelli

THESIS:

Virtual reality-based multidomain interventions for older adults with Mild Cognitive Impairment

15.12.2020
h. 16:00
Aula Seminari
«BIO1»
Online Teams

THESIS:

MULTI-PARAMETRIC IMAGING FOR PARTICLE THERAPY:
INTEGRATING MACRO & MICROSCALE MODELS

COMMITTEE MEMBERS

Prof. Sue Cobb	Prof. Geoff Parker	Prof. Raffaele Dellacà
University of Nottingham	Centre for Medical Image Computing University College of London	Politecnico di Milano Dipartimento DEIB

SCHEDULE OF THE DAY

16:00 – 16:15	Committee Meeting
16:15 – 17:15 17:15 – 18:15	PhD Student Sara Arlati PhD Student Giulia Buizza Thesis presentation - Discussion
18:15 - 18:30	Committee meeting
18:30	Award Ceremony

POLITECNICO MILANO 1863

Politecnico di Milano
Dipartimento Elettronica
Informazione e Bioingegneria
Via Ponzio 34/5
20133 Milano

BOARD

PhD in Bioengineering

PhD Chairman
Prof. Andrea Aliverti
andrea.aliverti@polimi.it

PhD Secretariat
Phd-BIO@polimi.it
phone +39 02 2399 3632

Final Defense

PhD in Bioengineering

POLITECNICO MILANO 1863

PhD student: **ARLATI SARA – XXXI Cycle**

Thesis title: **Virtual reality-based multidomain interventions for older adults with Mild Cognitive Impairment**

Advisor: Prof. Giancarlo Ferrigno
Co-Advisor: Prof. Marco Sacco

Abstract:

Mild Cognitive Impairment (MCI) is a neurological condition resulting in the impairment of one or more cognitive domains that does not affect the performance of activities of daily living. MCI may evolve toward dementia, but in some cases, it reverts back to a normal cognitive status. Research has shown that multi-domain interventions could be effective in improving cognitive outcomes in populations with MCI, and that Virtual Reality (VR) may represent a promising means to administer such interventions, since it increases the individuals' motivation to train, and thus their compliance to the treatment.
In such a context, the general aim of this work was investigating the feasibility and the potentialities of VR technologies in increasing users' Sense of Presence and thus the potential effectiveness of VR-based cognitive programs, while balancing for their possible side-effects. The whole work has foreseen a pathway going from the design and development of 2D environments, to the assessment of the feasibility of interventions exploiting totally immersive VR devices.
2D environments were tested for feasibility in two trials. In the former, despite few limitations, the intervention resulted in a significant reduction of oxidative stress, i.e., a biomarker predicting Alzheimer's disease. In the latter, it was recorded a significant improvement in long-term memory in groups who underwent cognitive training. In both cases, the intervention was largely accepted, and many participants reported a subjective improvement of their quality of life.
Programs based on immersive technologies, instead, were tested mainly for their acceptance. The first intervention foresaw a dual-task training program occurring in a CAVE; the second, the use of head-mounted display for the administration of cognitive training. Both resulted in a good engagement of participants, and almost no side-effects. These technologies were thus considered worthy of further investigations in clinical studies aimed at reducing the progression of dementia symptoms in older adults facing age-related cognitive decline.

Final Defense

PhD in Bioengineering

POLITECNICO MILANO 1863

PhD student: **GIULIA BUIZZA – XXXIII Cycle**

Thesis title: Multi-parametric imaging for particle therapy: integrating macro & microscale models

Advisor: **Prof. Guido Baroni**
Co-Advisor: **Prof. Chiara Paganelli**

Abstract:

Charged particle therapy (CPT) has favorable physical and biological properties but, due to clinical and technical limitations, they are not fully exploited. Imaging is being increasingly employed in the clinical practice to provide patient-specific information which, combined with modelling strategies, can address clinical questions, such as patient stratification or outcome prediction. The aim of this project was to explore the combination of multi-parametric imaging with modelling approaches, going from macroscopic to microscopic scales, to put forward the development of personalized treatments for CPT.
Starting from macroscopic models, Radiomics and Dosiomics were employed to stratify patients according to the risk of treatment failure. Then, quantitative imaging biomarkers were extracted from diffusion-weighted (DWI) and perfusion-weighted MRI for tumor characterization. Given the biological effectiveness of CPT, models probing sub-voxel phenomena were subsequently explored. Specifically, DWI was used to personalize tumor control probability models and to derive markers of tumor microstructure for patient stratification and early response assessment. To support these results, a technical assessment of the acquired DWI data as a reliable source of biomarkers was also carried out. Finally, an in-silico study was refined for characterizing the electromagnetic properties of a proton beam for range verification. All these studies pave the way to future work that will more directly account for patient-specific information and for the peculiar CPT biophysical properties.