



Thesis Project Form

Title (tentative): Development and validation of an innovative modular platform to explore the physiological substrates of upper limb motor rehabilitation, based on: augmented virtual reality, inertial sensors, proprioceptive stimulation, engineered devices for manual dexte

Thesis advisor(s): Bonzano Laura, Marco Bove, Ambra Bisio, Costanza Iester

E-mail: laura.bonzano@unige.it

Address: Largo Daneo 3 (ex via De Toni 5), 2° piano

Phone:

Description

Motivation and application domain

Virtual reality (VR) creates immersive environments simulating real-world scenarios. Augmented reality elements, like proprioceptive stimulation, enhance sensory feedback, influencing motor execution. Combining action observation and proprioceptive stimulation promotes motor cortex plasticity. Inertial Measurement Units (IMUs) track upper limb movements, while functional Near-Infrared Spectroscopy (fNIRS) measures cortical activity. Engineered devices assess manual dexterity, providing insights beyond clinical tests.

General objectives and main activities

The project aims to explore the physiological substrates of upper limb movements in different experimental conditions, to gain insight into the processes of voluntary movement, observation and imitation, and into the effectiveness of the system in the motor rehabilitation field.

The main activities will involve the development of a protocol combining VR, IMUs and fNIRS. An experimental phase will require data acquisition and analysis.

Specific activities will include: Develop a virtual environment simulating realistic rehabilitation scenarios; Implement inertial sensors to capture the full range of motion, providing detailed data on individual movements; Develop algorithms for the analysis of data collected from the different devices; Analyze concomitant cortical activity; Assess manual dexterity with its sensorimotor and cognitive aspects.

The final aim is to provide an immersive and highly interactive rehabilitation environment for patients with motor impairments.

Training Objectives (technical/analytical tools, experimental methodologies)

The candidates will deal with proficiency in VR development environments, the experimental setup, learn how to properly use the specific devices, and deepen methods to analyze biomedical data.

Place(s) where the thesis work will be carried out: Laboratorio per lo studio dell'€™integrazione sensorimotoria e dell'€™esercizio (Viale Benedetto XV 3 e Centro Polifunzionale Scienze Motorie, Corso Europa 30). Ermit srl (Via Francesco Rolla, 13).

Additional information

Maximum number of students: 4