ERC SYNERGY GRANT WORTH €10M AWARDED TO ITALIAN NEUROSCIENCE RESEARCH AT THE UNIVERSITY OF CHIETI-PESCARA

*The **ConnectToBrain** project will develop a new tool for brain stimulation through extremely rapid magnetic pulses that adapts to the patient's particular brain state. The research will explore new therapies for a wide range of neurological pathologies characterized by alterations in connectivity between brain regions - from depression to stroke or to Parkinson's disease. The **ConnectToBrain** project received a 10 million Euros grant from the European Research Council (ERC) as part of the Synergy Grant initiative. The **ConnectToBrain** project will be implemented thanks to the synergistic integration of the research group of Professor Risto Ilmoniemi (Aalto University, Helsinki, Finland - coordinator) with the research groups of Professor Gian Luca Romani from the University "G. d'Annunzio " of Chieti-Pescara and of Professor Ulf Ziemann from the University of Tuebingen, Germany.*

The inner workings of the neurological system can be compared to a symphony orchestra. The various regions of the brain all “listen” to each other via internal neural pathways, not unlike musicians following the sound of all the instruments and the instructions of the conductor. Neurological conditions such as schizophrenia, stroke, or substance dependence impinge on the activity of the brain's neural connections and disrupt a person’s ability to function—making the orchestra play out of tune and time.

The **ConnectToBrain** project seeks to radically improve the techniques for brain stimulation in current clinical use. Currently, stimulation treatment involves activating single sites in the brain with magnetic pulses, one at a time, in sequences running into the thousands. The new technology that the **ConnectToBrain** project will implement, called multi-locus transcranial magnetic stimulation (mTMS), will be able to switch between individual stimulation points at intervals of only a few milliseconds.

‘The difference between the old and new technology is comparable to a concert pianist playing his/her instrument delicately with both hands, adjusting his/her timbre while listening to the music—rather than mindlessly strumming a single note while wearing ear plugs,’ says Aalto University Professor Risto Ilmoniemi.

The stimulation process will be controlled by intelligent software. The control algorithm will start stimulating selected sites in the brain and will then automatically and rapidly move on to change the focus depending on how the stimulated neural pathways react and transform. The technique also allows the system to couple to the ongoing electrical rhythms in the brain. ‘The algorithm has to be able to read and interpret the map of brain connections in real time, and to decide in just a tiny fraction of a second when and where to stimulate next. This is challenging because the measured signals are weak, and brain activity is very complicated. Machine learning techniques will help us optimise our algorithms for the task,’ says Gian Luca Romani.

By exciting the networks of neuronal pathways associated with conditions such as depression, the researchers hope that the algorithm can restore the pathways to a healthy state. Depression can restrict brain functions, and treatment aims to invigorate them. Conversely, in conditions such as epilepsy, certain brain functions need to be slowed down.

’First we need to learn more about brain dynamics and how to activate and strengthen neuronal connections that function poorly. We will need clinical trials combining and comparing magnetic stimulation with pharmaceuticals and traditional means of rehabilitation. Finally, we need to engage the research and clinical community in order to spread the knowledge of the new methodology,’ says Ulf Ziemann.

The costs associated with neurological diseases amount to 1000 billion Euros per year in Europe alone. The methods for brain stimulation therapy to be developed in the **ConnectToBrain** project are expected to save up to a billion Euros annually in Europe with considerable cuts to both cost of care and duration of sick leaves.

To carry out the project, the research group coordinated by Professor Gian Luca Romani will use the facilities of the ITAB Center (Institute of Advanced Biomedical Technologies) and of the Department of Neurosciences, Imaging and Clinical Sciences. The team will include Professor Vittorio Pizzella, Professor Laura Marzetti and other professors and researchers belonging to the Center. The funding granted to the project will also allow the recruitment of several young researchers, research fellows and doctoral students.