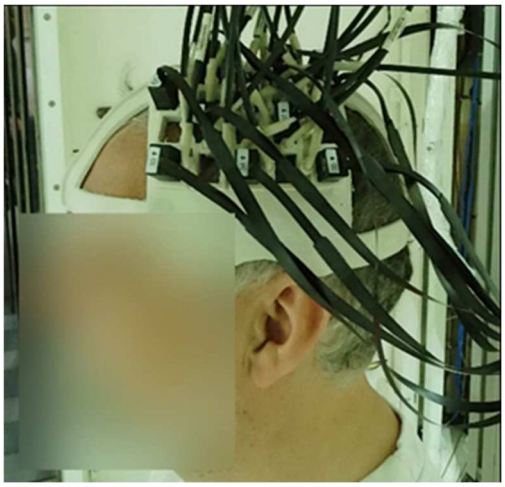

Neurovascular coupling (NVC) is the basic mechanism of providing energy from the blood circulating in the brain to the active brain areas. If a particular brain area is engaged in a task the involved neurons will signal this to the vessels and oxygen-rich blood will be supplied. To understand NVC better is important for the diagnostics of a range of diseases such as stroke, Parkinson´s, traumatic brain injury, etc.

Studying the NVC requires to measure neuronal activity and blood oxygen levels at the same time and compare obtained signal intensities and locations in the brain with each other.

In our project, we will develop a method based on two non-invasive brain imaging modalities to study the NVC: One is functional near-infrared spectroscopy (fNIRS), which measures the blood oxygenation level by detecting changes in low intensity light passing through the brain. The other is magnetoencephalography (MEG), which measures the magnetic fields generated by the current flow in a neuronal network. Due to new developments in sensing of blood oxygenation and magnetic fields we can combine MEG and fNIRS into a single setup as shown in the image. A subject is wearing a comfortable helmet like a structure and the magnetic and optical sensors are inserted into slots. The helmet is made by the modern technology 3D printing using a flexible material, which does not irritate hair or skin.

In biomedical engineering for clinical medicine typically a group of healthy subjects is measured. All subjects perform the same tasks such as listening to tones or viewing a screen with information to be read by them and pressing response buttons. These tasks induce network activity between, e.g., visual and motor areas of the brain. While the subjects perform the tasks the neuronal and vascular signals are measured by us. After the measurement we will compare the data and use advanced computational methods to describe the interaction between neuronal activity and the increase in blood oxygen levels. The values obtained from the computational analysis are then our results for NVC.

We will compare our results with previous studies from other groups using less advanced equipment and then it is expected that the new methodology allows a much simpler and more precise description of NVC. This method as developed here can then be used in clinical medicine for patient studies.