In order we could experience anything, countless neural populations in the whole nervous system must co-operate with high temporal precision of the fraction of one millisecond. When such co-operation takes place, we are talking about *synchronized activity*, which allows for information processing in parallel on multiple levels of the human brain. Thanks to this phenomenon, bioelectrical activity of millions of photoreceptors in our eye and nerve cells in higher visual brain structures can result finally in the perception of beautiful red rose. Even if it is only a painting in the town gallery, we can sometimes “smell” its sweetness, or we can “see” someone beloved to us, who in some way is associate with this astonishing flower. Everything what happens in our brain in such moment is a result of synchronized activity of immense number of distributed neural populations. Unfortunately, in such disorders as schizophrenia or autism abnormalities in oscillatory activity of neurons may play key role in their pathophysiology. Abnormal synchronization processes have been associated also with Alzheimer’s and Parkinson’s diseases, to name just a few. Thus, there is a question – if there is a way to exogenously modulate ongoing internal neuronal processes in the human brain. The answer to this question can be one of very promising non-invasive neurostimulation technique, i.e. alternating current stimulation (ACS), which harnesses very weak oscillatory currents applied transcranially to impact ongoing oscillatory activities of the living brain. However, despite of growing popularity of this method in many fields of neurophysiology and psychology, it is not understood well enough. Nevertheless, it is used in neurorehabilitation of optic neuropathy and post-stroke deficits, as well as in the studies involving arithmetical problem solving and creative thinking, to name just a few. There is a lack of basic research, which would address more fundamental questions about this technique, and try to establish a bridge between neurophysiological mechanisms of ACS and its psychological effects. Only then ACS can be used in a reliable way in much more complex studies.

In this project I want to meet these needs and verify how very weak transorbital ACS of different frequencies will affect visual information processing in the human brain in the context of critical fusion frequency, as well as detection, discrimination and adaptation processes. Answering those questions will result in the creation of solid fundaments, on which more complex questions can arise in the future. In the process of seeking the answers, I am going to conduct an experiment with the participation of 105 healthy people divided equally into seven groups. Each of them will perform psychophysical tasks in virtual reality, in order to evaluate how their brains deal with visual information processing. This evaluation will be partially done with the use of high-resolution 128-channel EEG system. The participants from five groups will be also stimulated with the use of ACS during preformation of the visual task. Beside of main experiment, I will also conduct meticulous computer simulations of current flow and distribution in the healthy human brain in order to evaluate various parameters of ACS and stimulation electrodes number and localization, which will result in the creation of standardized templates for future experimental paradigms.

Research tasks included in this project are important mainly for two reasons. First, ACS is a truly very promising technique, which can modulate ongoing synchronized activity in the human living brain. Thus, it is so crucial to understood precisely how and when it works, so we could use it in much more focal and reliable way. Second, possible use of ACS in therapy of, e.g. schizophrenia or autism, requires much more basic and tested standardized knowledge, than it is now available. It is obvious, that especially in clinical use knowledge about “what we are doing” is crucial.