

PIEp – "Optical Stimulation of Neural Tissue"

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Why

The neural prosthetic devices of today show many promising features in order to construct a working electronic-tissue interface. The use of such an interface could be in prosthesis for patients suffering from amputees, Parkinson's disease or blindness. One of the main drawbacks for the device being developed and used today is the poor longtime stability inside tissue.

The aim of this project is to develop a new interface based on optical stimulation. Stimulation of neural tissue using optical radiation instead of the more traditional electrical stimulation have advantages, like higher specificity of the stimulation, possibility of non contact stimulation and the ability to stimulate inside the tissue without penetration. This interface could be used for the development of a visual prosthesis.

What

The light that is used is from a laser diode in the infrared spectrum. This is because infrared light has a penetration depth that suits a prosthetic device for neural stimulation. This has also been verified by other groups. Mainly, other groups have focused on optical stimulation of the cochlea, but also peripheral nerves. Our focus will be the human cortex, and more specifically the visual cortex, once the method is verified.

How

We will investigate optical stimulation in three steps. The first one is to stimulate single cells in culture using electrophysiological recording of the response. Step two will be stimulation of rat cortex in an in-vitro study in order to study the tissue response. The third step will be the human cortex in-vitro. Testing on human tissue is possible because we have ethical permission to use tissue from cancer neurosurgery at the Karolinska Hospital. What we want to show in the three different steps is first of all that the technique works in our laboratory, then trying to stimulate nerve cells inside the tissue and measure the depth of penetration of the stimulating light. Another major question to answer is the truth about the stimulation mechanism that so far is unknown, even though local heating of the tissue is believed to play an important role.

The last step would be to construct a device that in simple terms converts light from a camera to an electrical signal that controls the laser for stimulation.