Real-Time Suppression of Stimulus Artifact by Subtraction of Adaptive Artifact Estimate

for Electrical Stimulation of Neural Tissue and Simultaneous Recording

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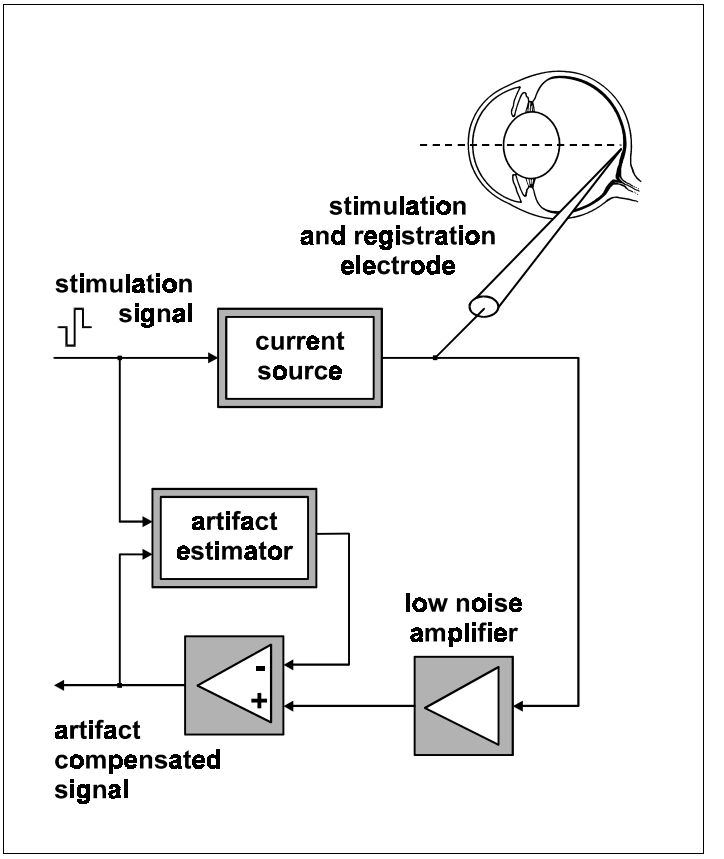
Goal. With extra-cellular stimulation of neuronal tissue and simultaneous registration of the neuronal response using the same or a nearby electrode, a major problem is the superimposed stimulus artifact. It is caused by the stimulation current producing a voltage drop along stimulation electrode and surrounding tissue. This voltage drop is often orders of magnitude (up to 10^4) higher compared to the neuronal response signal to be measured. Hence, the data recording is negatively affected by the limited input range and amplitude resolution of the data acquisition system. For example, when signals are recorded with large superimposed stimulus artifacts, the neuronal signal may disappear in (quantization-, semiconductor-) noise of the recording device. Thus, for a high quality recording of neuronal responses the suppression of artifacts is desirable.

Methods. The fundamental idea consists in the subtraction of the stimulus artifact before it can overload the preamplifiers and the data acquisition system. Hence, the possibility arises to record neuronal activity already during the stimulation period which is especially useful when stimuli of longer duration and higher complexity are applied.
In order to suppress the stimulus artifact we firstly generate an artifact estimate based on a previously recorded neuronal response**,** using a linear and a nonlinear model of tissue and electrode, respectively. In a second step the estimated artifact time course is subtracted from the primary response before further amplification and data quantization and recording.

Results. First results applying a linear model during stimulation of retinal ganglion cells in anesthetized cat were promising.

Conclusion. Our method for suppression of the stimulus artifact allows to stimulate neuronal tissue and record stimulus evoked activity simultaneously by the same microelectrode.



Schematic diagram. *The artifact estimator generates an artifact estimate which is subtracted in real-time from the primary response. We applied this device to simultaneously stimulate and record from retinal ganglion cells.*

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