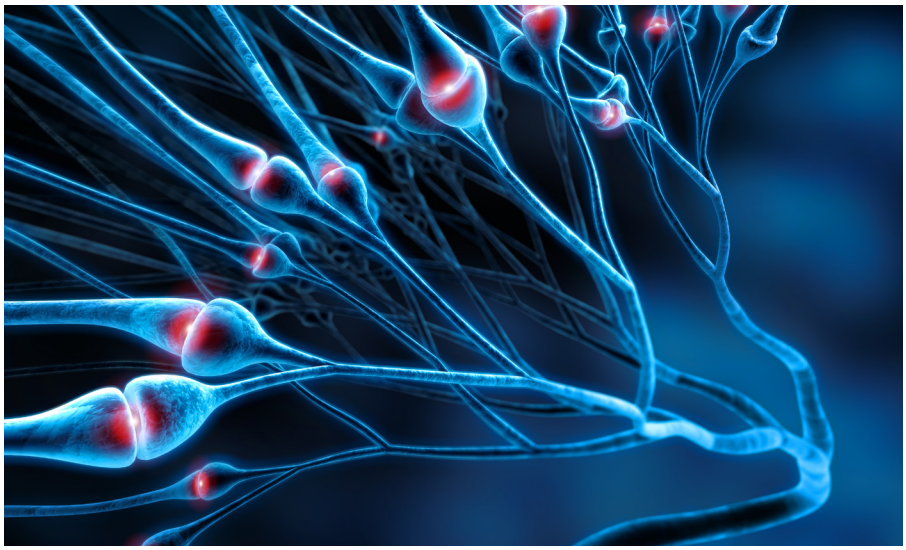

CASE STUDY

At Work in the Lab:

Advancing Neurotechnology and Biomedical Electronics

The NMI - Natural and Medical Sciences Institute at the University of Tübingen, Germany is involved in application-oriented research at the interface between the life sciences and material science. Its Neurophysics group develops and characterizes hybrid nerve/chip systems. These include extracellular recordings of dissociated neuronal cultures, retinas and cultured brain slices with the highest spatial and temporal resolution, electrical stimulation of single cells and neuronal tissue/retina, damage measurements in neuronal tissue/detection of electroporation as well as modelling and measurement of contact properties of neuronal tissue and planar electrodes.

The Challenge

The primary challenge for the Neurophysics group was to obtain recordings DURING stimulation and to get the data at a sufficiently good signal-to-noise ratio. In the field of Neurotechnology and Biomedical Electronics this is especially important to identify optimal stimulation to be used in future neuro prosthetic applications and the “electrical imaging” of cells and tissues to distinguish between normal and abnormal functions relevant for biomedical applications.

The Solution

Due to their needs for high density and number of stimulation and recording electrodes being identified together with the Multi Channel Systems (MCS) team early on, the NMI was one of the earliest adopters of the CMOS-MEA5000-System. The system met their need of simultaneously recording while stimulating cells and also offered exceptional data quality due to its outstanding signal quality at the lowest possible noise.

Because of the high density of recording electrodes, the Neurophysics group was now able to identify neurons more precisely. The additional high density of the stimulation electrodes enabled the research group to apply a larger variety of stimulation protocols while recording (Corna et al. 2021). A sensor reset feature also solved their prior problem of a lack of ability to combine optogenetic photo stimulation and recording (Reh et al. 2021).

The Outcome

Since its installation the NMI Neurophysics group has benefited from precise neuron identification, an increase in appliable stimulation protocols and the ability to combine their high-resolution neuronal network research with an optogenetic toolkit for light pattern stimulation. Additionally, the team appreciated the timely and courteous reception of their feedback by the MCS team which was then implemented into hardware and software, further improving the system that they had already been using. Additional benefits reported include:

> "In our hands the CMOS-MEA5000-System worked reliably since its introduction into market. The CMOS MEA chips themselves are robust, when treated with care. Three students completed their PhDs using the system (in combination with photo stimulation) and all of them published first-author papers."
>
> *– Univ.Prof. Dr.rer.nat. Günther Zeck previously Head of the Research Group "Neurophysics" at NMI and currently Professor of Biomedical Electronics and Systems at the Faculty of Electrical Engineering and Information Technology, Technical University of Vienna*

- Exceptional spatial resolution, closing the gaps, for more accurate recordings at sub-cellular pitch
- Complete picture of the data with the highest active channel count available
- Synchronous recording/stimulation with an interspersed rec/stim channel CMOS array
- Powerful recording and analysis software featuring Independent Component based spike analysis (ICA) for better results

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September 2021