Virtual Neurophysiology Labs for Students' Practical Courses: cLabs-Neuron and cLabs-SkinSenses.

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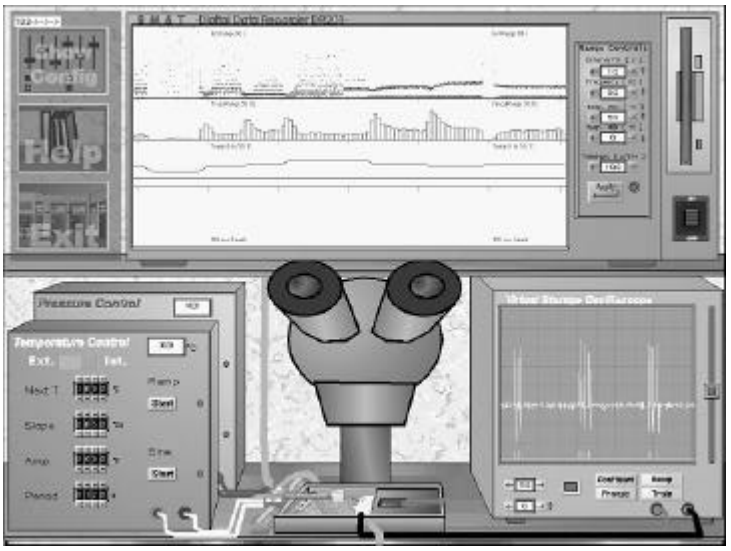
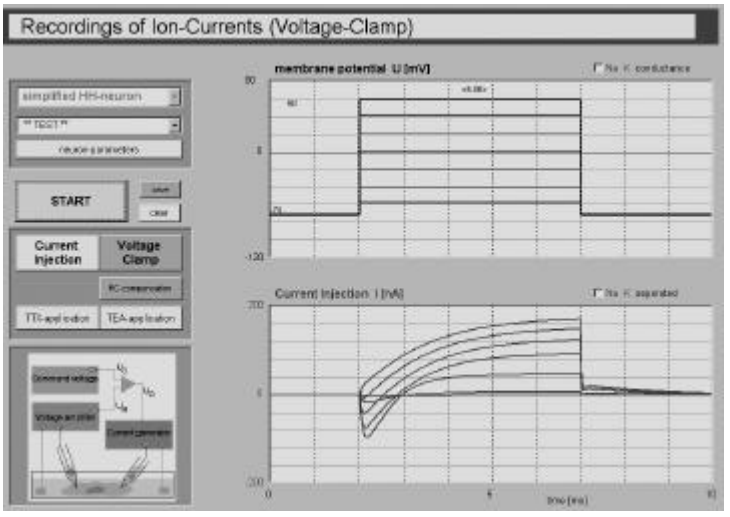
Since several years, teaching programs of the “Virtual Physiology” series (SimNerv, SimPatch, SimMuscle, etc.) are successfully used in practical physiology courses in hundreds of medical, biological and related faculties all over the world. These programs are virtual realizations of classical experiment in students’ education. More recently, we have develop an advanced series of virtual computer labs ("cLabs") which also includes experiments which would be too difficult to be physically carried out within the context of a student’s coursework, but are realizable in silico.

It is the tutors impression that the students find it interesting and stimulating to work with these programs and that the virtual experiments can essentially help to attain a better understanding of physiological functions. These impressions were additionally confirmed by an evaluation of “SimNerv” which simulates recordings of compound action potentials according to the classical experiments with the frog’s sciatic nerve.

Such positive evaluation results together with numerous enthusiastic replies from other users have stimulated us This is the situation, for example, for single fibre recordings from sensory afferents and for intracellular current/voltage-clamp recordings which have been realized as virtual computer laboratories called "cLabs-SkinSenses" and "cLabs-Neuron", respectively.



"cLabs-SkinSenses" is made in the tradition of the "Virtual Physiology" programs. It provides a virtual lab where the students can record the neuronal impulse activity of single-fibre preparations from different types of mechano- and thermosensitive skin receptors. It is the students’ task to identify the unknown, randomly distributed receptors on the basis if their impulse patterns in response to ramp-shaped or sinusoidal thermal and mechanical stimuli of pre-selectable amplitude, slope or frequency. The action potentials are displayed on a virtual oscilloscope. Interspike-intervals and peri-stimulus-time-histograms (PSTH) are plotted together with the stimuli on a virtual chart recorder (see figure) and can be stored for subsequent data analysis. Additional modules offer the possibility to look at real data (published, for example, in Braun et al., Nature 367: 270-273, 1994) or to run computer programs which have been developed for scientific aims, i.e. for a better understanding of the dynamical interactions of possible ionic mechanisms of the transduction processes (e.g. Braun et al., Biosystems 71: 39-50, 2003).



Another program, "cLabs-Neuron", offers virtual laboratories for single-channel and whole-cell voltage- and current-clamp experiments - also under application of specific ion channel blockers like TTX or TEA. Compared to "SimPatch", which is a very realistic representation of a voltage-clamp lab, "cLabs-Neuron" has an easy to overlook screen design (see figure) which makes experimentation also possible for technically inexperienced students. The programs come along with detailed tutorials and manuals for practical exercises including protocol forms. The neurons are simulated with simplified Hodgkin-Huxley-type algorithms and a "Neuron-Editor" allows the teacher to generate neurons with different properties. "cLabs-Neuron" also includes computer animations and simulations to teach basic Neurophysiology, e.g. the gating of voltage-dependent ion-channels. "cLabs-Neuron can be used for practical exercises as well as for lectures and seminars and its modular structure with detailed tutorials makes them well suited for home-studies, too. Part of the animations and simulations are available for experimentation at the cLabs homepage www.clabs.de.

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