Summary

Visual evoked potentials (VEPs) are electrical potentials generated by averaging the epochs of an electroencephalogram recorded on the surface of the scalp in response to an optical stimulus. A rapid change in the checkerboard pattern displayed by the stimulator is used to elicit pattern-reversal visual evoked potentials (VEPs). Today, the most commonly used CRT or LCD monitors do not allow immediate reversal of the entire pattern. The aim of this dissertation is to construct a new VEP stimulator whose characteristics approximate the instantaneous reversal of the whole structure, to measure its technical properties and to compare them with the displays used in the electrophysiology laboratory. The second aim is to verify in experimental subjects whether the improvement in the speed of pattern rendering on the screen of the newly designed stimulator is reflected in the shape or timing of the evoked potentials.

As part of this dissertation, a VEP stimulator was designed and constructed using independently controlled white square LEDs in two prototypes, in a 12 x 12 and 12 x 48 display matrix. By measuring with an optical probe and an oscilloscope, their technical parameters were compared with LCD and CRT monitors used in the electrophysiology laboratory of the Institute of Pathological Physiology, LFHK. The comparison of these stimulators was carried out by measuring VEP with a reversible structure on ten experimental subjects at an observation angle of 15´ and 30´ and the amplitudes and latencies of the N70, P100 and P140 waves, and in addition the parameter "P100 wave width", commonly recorded during VEP examinations, were compared.

Evaluation of the measured values showed that the LED stimulator showed significantly better parameters (by three orders of magnitude) in the rate of rise and change of display, steady state and brightness stability (80% brightness rise in 3 µs). VEP measurements for wave amplitudes N75, P100, and N140 showed no significant differences between the measured stimulators. The peak times of the N75, P100, and N140 waves evoked by the LED stimulator are shorter than those of the LCD stimulator (significantly for all waves and viewing angles of 15´ and 30´) and the CRT stimulator (significantly only for the N75 wave and viewing angle of 30´).

As part of the dissertation investigation, we have shown that the newly designed LED stimulator is a more suitable alternative to the now obsolete CRT screens for the examination of visually evoked potentials than the currently used LCD stimulators. The LED stimulator also appears to be superior to the CRT stimulator, but further research on a larger sample of subjects, with improved brightness homogeneity and full screen size of the LED stimulator will be required for significant results.

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