ERG System for Neurotoxicity Risk Assessment

Roman Tkachuk[1], Bohdan Yavorskyy[2]

Abstract - **In this thesis the conceptual background for development of a neurotoxicity risk assessment electroretinographical system are given.**

Keywords - **Neurotoxicity, Assessment, Electroretino-signal, Adaptive signal processing, Kalman filter, System Effectivity.**

I. INTRODUCTION

Among the methods of neurotoxicity risk assessment for human health are electrophysiological ones. Particularly they are based on the recording and analysis of electric potentials from different elements of visual system are being stimulated by a light — e.g. electrooculography, electroencephalography, rheography etc. [I]. The electroretinography (ERG) can be effective one because it's non invasive, high sensitive and potentially early detectability of neurotoxicity [1]. Nevertheless, the value of the electric potentials are registered is rather small – from a few μV to approximately 0.5 mV, the potentials recording process is accompanied by considerable stochastic interference both of the internal and external origins. Besides, the ERG-signals recording time is limited by the period of the light adaptation loss as well as by the appearance of destabilizing factors in consequence of some discomfort for the patient. All these impose heavy demands on the methods of measurement, processing and analysis of ERS under their investigations and implementations in data bases of neurotoxicity risk assessment systems being built on the ERG data analyses.

This thesis contains information about theoretical and practical concepts of the ERG biotechnical system application for neurotoxicity risk assessment. We consider the common base for light stimulus, ERS, methods of signal processing and decision make representation and give the block diagram of an ERG system and analyze some obtained results.

II. BACKGROUNDS FOR METHOD OF ERG ASSESSMENT SYSTEM EFFECTIVENESS INCREASING

The main concepts is taken up in attention is cyclic stochastic nonstationarity, depending from retina properties under the light stimulus and finiteness of ERS [2]. So, from here, an idea of cyclic adaptation of recursive processing of the ERS under optimal estimation of ERG with a mix of ERS with internal and external noise was appears [3, 4], as well as a far spread of results of statistical theory of decision for estimation of confidence of the neurotoxicity risk assessment and building a data base of typical norms and toxicities ERG. From here by heuristics along with optimum signal processing and artificial intelligence theories under an engineering approach [5, 6] the schematic diagram (Fig. 1) was given.

[1,2] Ternopil State Technical University named after Ivan Pului, Ruska Str., 56, Ternopil, 46001, UKRAINE,
E-mail: vmp@tu.edu.te.ua

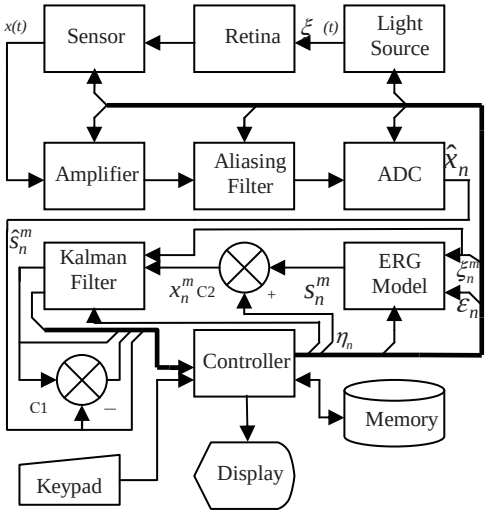

Fig.1 Schematic diagram of ERG system with intelligence properties ($\xi(t)$ — light stimulus, $x(t)$ — ERS, $\hat{x}_n$, $n=\overline{0,N}$ — ERS code sequence, ε_n, η_n — noises sequences, $\hat{s}_n^m$ — Kalman estimation of ERS under a standard model s_n^m, C1,C2 — summations; all parts of diagram are being under control)

III. CONCLUSION

The concepts of intellectual adaptation (of the light stimulus, electrodes system, representations of the mix of an electroretinosignal with external and internal noises, the recursive processing of the mix) had been put on allow us to obtain the effective, optimal, automation electroretinographical system for neurotoxicity risk assessment for human health.

REFERENCES

[1] Environmental Health Criteria 223. Neurotoxicity Risk Assessment for Human Health: Principles and Approaches// http://www.inchem.org/.

[2] T.D. Lamb, "Gain and kinetics activation in the G-protein cascade of phototransduction", *Proc. Nat. Acad. Sci. USA*, Vol. 93, January 1996, pp. 566-570.

[3]В.Б. Дудыкевич, Р.А. Ткачук, М.И. Паламар, "Адаптивное управление процессом измерения биопотенциалов зрительного анализатора", *Проблемы управления и информатики*, №2 1997, С.87-93.

[4]Р.А. Ткачук, Б.І. Яворський, "Метод побудови біо-технічної системи для оцінювання ЕРГ з підвищеними вірогідністю та ефективністю", *Вісник ТДТУ*, (14)3 2009, С. 102-110.

[5] S.J. Orfanidis, "Optimum Signal Processing", *Macmillan Publishing Company*, New York 1988, 590 p.

[6] R.G. Schalkoff, "Artificial Intelligence. An Engineering Approach", *McGraw-Hill Publishing Company*, New York 1990, 646 p.