

# Computer system for forecasting surgery on the eye muscles

Oleg G. Avrunin\*<sup>a</sup>, Dmitriy V. Kukharenko<sup>b</sup>, Sergii O. Romanyuk<sup>c</sup>,  
Aliya Kalizhanova<sup>d</sup>, Aynur Toygozhinova<sup>d</sup>, Konrad Gromaszek<sup>e</sup>

<sup>a</sup>Kharkov National University of Radio Electronics, 14 Lenina Ave., 61000 Kharkov, Ukraine; <sup>b</sup>Kremenchuk Mykhailo Ostrohradskyi National University, 18 Pershotrvneva St., 36000 Kremenchuk, Ukraine; <sup>c</sup>Vinnytsia National Technical University, 95 Khmelnytske Sh., Vinnitsa 21021, Ukraine; <sup>d</sup>Kazakh National Research Technical University after K. I. Satpaev, 22, Satpaev Street, 050013 Almaty, Kazakhstan; <sup>e</sup>Lublin Univeristy of technology, ul. Nadbystrzycka 38A, 20-681, Lublin, Poland

## ABSTRACT

For the successful surgery on the eye muscles it is recommended to use a computer system of preoperative planning of the surgical correction of strabismus. With using the computer system at surgery planning, ophthalmologist surgeon will be able to choose the best surgical treatment and surgery dosage for a particular patient.

**Keywords:** computer system, preoperative planning, oculomotor apparatus, adequacy of the model

## 1. INTRODUCTION

According to medical statistics 4-5% of children suffer from strabismus. Surgery remains the main way to eliminate strabismus. The essence of any strabismus surgery is to change the tone, i.e. potency of an eye muscles, or to change the place of force application. During the surgery planning, ophthalmologist surgeon relies only on its own experience. Empirical methods are not effective because of the great diversity and complexity of such a strabismus. Therefore, to further enhance of the strabismus surgery, the development of a computer system for preoperative planning of oculomotor system surgical correction is important<sup>1,2</sup>.

## 2. EYEBALL MODELLING

The three-dimensional model of the oculomotor system, preoperative planning module and the extra calculations module is developed for planning of the surgery on the eye muscles<sup>3,4,5,6</sup>. A method for determining the moments of forces on the surface of the eyeball model is proposed and it is described by the expressions:

$$\begin{cases} Mx_i = -Fy_i \cdot z_i + Fz_i \cdot y_i \\ My_i = Fx_i \cdot z_i + Fz_i \cdot x_i \\ Mz_i = -Fx_i \cdot y_i + Fy_i \cdot x_i \end{cases} \quad (1)$$

where  $Fx_i$ ,  $Fy_i$ ,  $Fz_i$  – projection of force vector acting in the  $i$ -point on the axis OX, OY and OZ, respectively, and  $M_{x_i}$ ,  $M_{y_i}$ ,  $M_{z_i}$  – moments of force relative to the respective axes after rotation.

The method for determination the coordinates on the surface of the eyeball model is developed. It is based on the description of spherical coordinates on the eyeball by the expression: