

**Virtual Strabismus: Movements of the eyes simulated in 3 D
for educational purposes**

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**ВИРТУАЛЕН СТРАБИЗЪМ: 3 D СИМУЛАЦИЈА НА ОЧНИТЕ ДВИЖЕНИЯ
В ПРОГРАМА С УЧЕБНА ЦЕЛ**

Abstract

Virtual Strabismus is shareware program to stimulate ocular movements according to ophthalmic examination methods. Vertical and horizontal angles of strabismus are preselected and student performs the examinations either on the screen or by mouse click. The ocular movements imitate phorias, tropias and convergence excess. The download address is <http://www.med.uni-giessen.de/agma/schielpat/indexENG.htm>

Virtual Strabismus was programmed to help improve medical skills and thus provide patients with better treatment as well as shorter examination times.

Key words: covertest, 3D simulation tool, ocular movement simulation, binocular three/dimensional videooculography, VOG.

Резиме

Виртуелниот страбизам е програм кој ги симулира очните движења спрема методите на испитување кои се изведуваат во офталмологјата. Вертикалните и хоризонталните агли на страбизмот се претходно селектирани и студентот изведува испитување или на монитор или со кликање на маусот. Очните движења имитираат форија, тропија или екцес на конвергенција. Адресата на превземанье е

<http://www.med.uni-giessen.de/agma/schielpat/indexENG.htm>

Виртуелниот страбизам е програмиран за да помогне во подобрување на медицинските вештини со што би се подобрило и лекувањето на пациентите како и намалување на времето на испитување.

Клучни зборови: тест на препокривање, три-димензионална симулација, симулација на движењето на очите, бинокуларна тридимензионална видеокулографија, VOG.

Examination of the eyes' position is difficult to perform when the patient is not able to perform a constant fixation. Small movements for taking up fixations are sometimes difficult to observe at young children, who will not fixate monotone objects for a long period of time. A need was seen for a simulation in the training of students, residents and other related professions.

movement. So Listing's law was visualized and programmed for teaching purposes as a proof of concept. The download address of the shareware is: <http://www.med.uni-giessen.de/agma/listing> 50 downloads per month show that 3D simulations can help to understand motility of the two eyes, can support printed media and have specific advantages for describing motions in three dimensions. That encouraged us to proceed with other three-dimensional simulations.

Preliminary work

A three dimensional simulation of ocular motility must obey the law of Listing, that movements in two dimensions are accompanied by a third dimensional

Simulating eyes' movements

A further development for both eyes is called Virtual

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Strabismus, which allows one to simulate the major examination techniques in the treatment of squint. The program Virtual Strabismus may be considered as the binocular successor of Listing's simulation [1].

The main elements of the PC simulation Virtual Strabismus are two "eyes" on the screen, which simulate natural eye movements as accurately as possible. They remain fixated as long as the examiner interrupts fixation with a cover. The eyes on the screen react when the fixation is restored by taking away a black or a semitransparent cover. The cover itself is activated by mouseclick. The teacher makes a selection of squint angles and the student performs under supervision standard examinations on the surface of a monitor. In this way basic skills are trained and basic diagnoses are taught in order to save the patient. The address for the shareware version is <http://www.med.uni-giessen.de/agma/schielpat/indexENG.htm>

The program is primarily conceived for educational purposes. It can be used autodidactically but is more effectively used in parallel to classroom learning situation. Within classrooms a laptop in connection with a beamer is advantageous.

Secondary side effects are a more intuitive preoperative dialog with the patient, when postoperative angles must be discussed.

A video-like tool for an examination method in all important clinical centres world-wide

Another effect of the program is to serve as a three dimensional instrument to show the results of a modified videographic examination, which is a diagnostic technology transfer all over the world [2-4]. It delivers simultaneous online data about the 3D position of both eyes. The influences of the direction of gaze, of head-tilt or direction of gravity, and convergence can be measured with two videocameras behind semitransparent mirrors in a diving mask. Rotational positions are determined using an overlay procedure of prominent iris landmarks. Squint is the computed difference between position of both eyes in three dimensions [3]. A demonstration of

the results is the video-like sequence on the shareware is named rollmax.sqs. After loading the sequence a screen appears which reminds the user of a video player. The button with the black triangle starts the replay. The visibility of rotations around the line of sight can be elucidated with a click on the cross in the menu. The rotations displayed around the line of sight are provoked by the inner ear. These movements are physiological responses resulting from head movements [5].

Technical solution

OpenGL is a programming language, which has already proofed it's suitability for 3D simulations already and advanced to a standard tool for 3D purposes. The iris of the ball is identical to a spherical defect of the globe. The surrounding frame containing the toolbar, the sliders and data-fields were programmed using WxWindows, and acts as a controller for the simulated movements. The program is open to every method of positional analysis of the eyes.

Virtual Strabismus is a shareware program to simulate ocular movements according to ophthalmic examination methods. Vertical and horizontal angles of strabismus are pre-selected and the student perform's the examinations either on the screen or by mouseclick. The ocular movements imitate most forms of disorders concerning eye-movements.

How to get started

The boxes at the right side of the monitor may be used for a preselection of squint in two dimensions. After a numerical type-in, these values have to be confirmed by a click on the enter button. At the moment there is only one dimension for each eye in the software permitted.

A click on the symbols in the right part of the menu bar will cover the right or the left eye. The former deviating eye will perform a fixational uptake movement, when the fixating eye is covered.

Virtual strabismus may run in two modes: One mode is the phoria mode, the other mode is the tropia mode. The change between both modes may be achieved by a

click beside the eyes with the left mouse button
click onto the checkboxes in the menu bar. Edit:
then tropia or phoria.

The quickest way to simulate a cover test is to type
5.0 in the horizontal field of one eye. This input has
be confirmed with a click on the enter button.
Depending on the active mode (phoria or tropia) the
will now move to a convergent position or will
wait until the operator clicks on the covers in the
toolbar.

Conclusion

Virtual strabismus is a symbiosis of the desire for
better education levels and the possibilities provided
by new information technologies. It improves the skills
of the medical professional, and saves patients from the
stress of long examinations.

Movements are ideal for simulation as a basic
principle, whereas paper with it's two dimensions gets
it's borders.

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Support

Threedimensional videoculography is supported by
Deutsche Forschungsgemeinschaft, Project No. Ka 1366/
1-1 030/98.