Developments in Optics and Communications 2014

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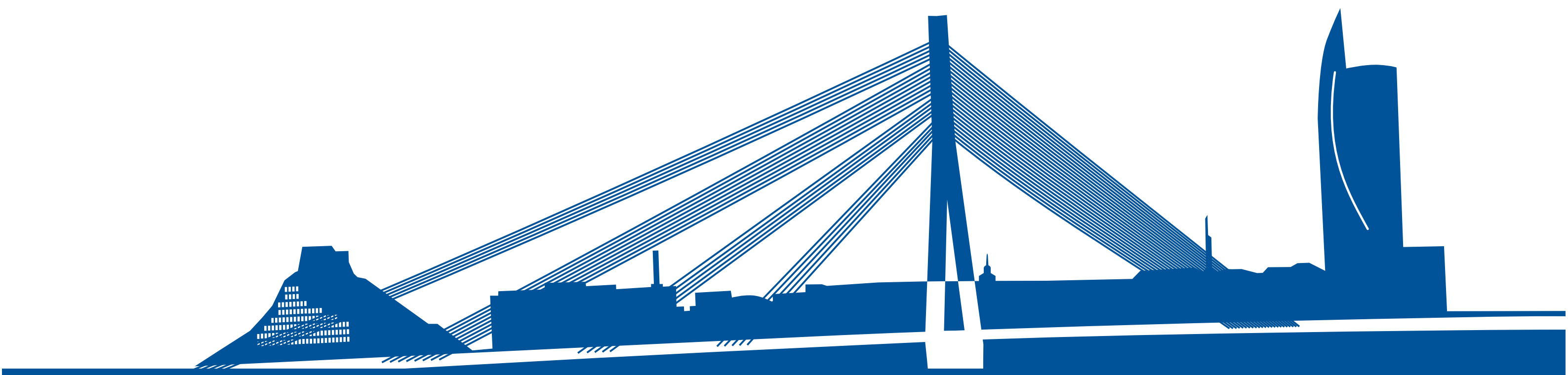
The "**Integrated Initiative**" of European Laser Infrastructures
in the 7th Framework Programme of the European Union

Book of Abstracts



Riga, Latvia, April 9 – 12, 2014

Paper-based and computer-based versions of a visual search task in school-age children

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Visual search is often used to study attention. Baranov-Krylov et al. have demonstrated that attention system appear to mature completely by the age of 15 [1]. Douglas et al. did not find any significant differences in paper-based and computer-based versions of a visual search task, although some individuals experienced some difficulties when performing a computer-based version of a test [2]. As far as paper-based and computer-based version of a test demands different visual load, it is essential to understand it's possible effect on attention and visual search task.

Therefore we gave two versions of a visual search task, which consisted from Landolt square stimulus, to school-age children in three schools in Riga, Latvia. A paper-based version of a test was performed by 126 children (68 boys, 58 girls, age 6-13), and computer-based version by 66 children (29 boys, 37 girls, age 7-15). Computer-based version of a visual search task was held at a distance of 40 cm, meanwhile paper-based version – 30-40cm. For both test versions were recorded time needed to complete the test, number of counted elements and errors.

The results demonstrate that paper-based version of a visual search task is completed significantly faster comparing with a computer-based version (p 0.05, ANOVA). What is more, the visual search task is performed faster with age, fitted by logarithmic regression, for both versions of the test. That could demonstrate that attention is maturing with age. When looking at the errors, there is a tendency for more errors when performing the computer-based version of the test, because more accuracy is needed due to the hand movement involvement.

This work has been supported by 2013/0021/1DP/1.1.1.2/13/APIA/VIAA/001.

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Visual acuity and adaptation to optical defocus

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It is known that prior exposure to a certain defocus level improves subject's tolerance to blur. [1] Blur adaption processes in the visual system reflect sensitivity and contrast adjustments at multiple stages of visual coding, in the retina and the visual cortex. [2,3] Purpose of this study was to determine effect of myopic defocus adaption to visual acuity, depending on adaption duration and to compare adapted visual acuity in both eyes.

We adapted participants to 2 different optical defocus levels (+1.0 D and +2.0 D). Visual acuity for each eye was measured before adaption, after 15 min and 30 min adaption periods.

Study showed that visual acuity improved after first and second adaption period (See Fig.1.) for both defocus levels (+1.0 D $p=0.01$, +2.0 D $p=0.08$) .There were not statistically significant differences in visual acuity improvement between both eyes.

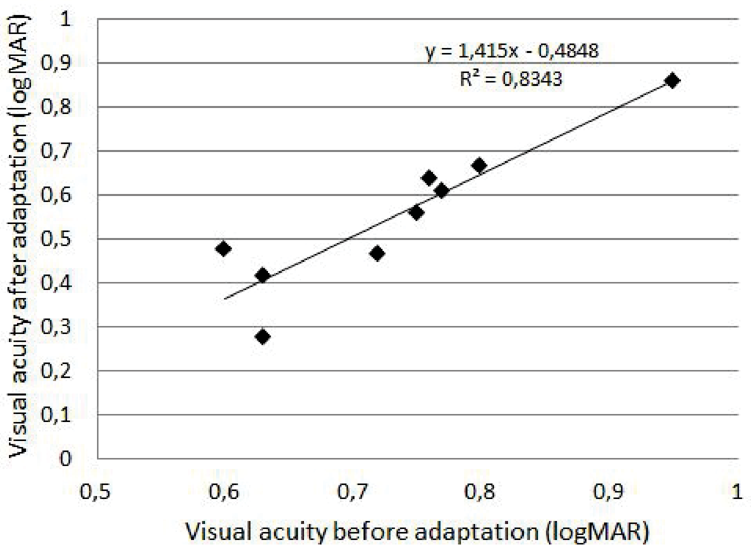

Figure 16: Leading eye visual acuity before and after 30 min blur adaptation

Acknowledgements
Supported by ESF Nr. 2013/0021/1DP/1.1.1.2.0/13/APIA/VIAA/001

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Picture segmentation applications in optometry and vision science

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Today information about processes and different phenomena is represented via image, which is very useful for us because it is easiest way to understand basic idea. But unfortunately representing information in this way we often lose opportunity to look at these data analytically. In this research we propose picture segmentation algorithm which is designed to identify regions within picture which share similar properties.

Algorithm consists of set of functions: function for splitting image into manageable pieces, function that allow switch between subsegments within larger segments, function that allow optimise pixel counting process, function that identify which segments found by previous functions share similar features.

Basic idea of algorithm is to split and merge segments of image till all picture is divided/merged in finite count of segments.Our algorithm deviates from other algorithms in this group, because usually each segment is divided into four succeeding segments if it necessary or till segment size reach predefined value. Our algorithm is designed in way that allow split image in to pieces that are manageable for ordinary computer and only then exposed to deeper analysis. When specific part of image is divided/merged into segments action is moved to next part of the image till whole image is analysed. At the first step we choose not to split image into quarters, but instead we look for square which fit within picture with side length is power of two. Main idea of spitting picture into squares with side length power of two is that all subsegments also will be power of two, which might by beneficial for further analysis.

This algorithm has applications in optometry and vision science. We propose that using this algorithm is possible to identify human pupil from picture and calculate its area, also we can analyse how human pupil area changes in course of time if we have set of pictures. Picture segmentation algorithms have applications in color science. Using these algorithms it is possible to identify objects within color vision test plates and measure their sizes and detect color, brightness which might give inside of color vision test plate designs as never before. In future we are looking forward to integrate functions like multithresholding which could identify criteria for splitting/merging picture before segmentation algorithm takes action. Using idea of multithresholding we can tell apart different segments at early stages of analysis which can reduce effort when it comes to identify objects within picture.

This work is supported by: 2013/0021/1DP/1.1.1.2/13/APIA/VIAA/001

How do eyes lie?

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Eye movement behavior is a rich source of information that contains not only a location, amplitude and duration, but also has a specific sequence, or so called scan path. Eye movements recording during the visual preference task is one of the most common methods to study social attention and specific cognitive functions. Since the presentation of novel laboratory paradigm to investigate the social communication through eye movements [1], it was understood that the underlying mechanisms remain unclear. Probably, the eye movement strategies and specific properties during the preference task can be associated not only with cognitive functions, but also with eye movement neurology and control system.

The aim of this work is to define the properties of eye movements and scan paths during the preference task. In the experiments, sets of pictures were presented to an individual for a limited amount of time. The pictures were chosen with similar semantic meaning. Eye movements were recorded and analysed later. For the first time, individual wad a free will to choose the favourite picture. For the second time, the individual was asked to mislead the other person who will try to determine the preferred picture, looking at the recorded scan path.

The results show that individuals are able to change the looking behavior according to the given task. Interestingly, when an individual was asked to „hide" his choice, the individual made significantly more saccades and the duration of fixations decreased. These and other experiments' results will be presented. Moreover, the possible mechanisms underlying the specifics of eye movements during preference task will be discussed.

This work has been partly supported by 2013/0021/1DP/1.1.1.2/13/APIA/VIAA/001.

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Peripheral visual acuity correlation with central visual acuity

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Peripheral visual acuity in population varies highly [1], also it is remarked that under normal conditions peripheral visual acuity has wide variation between subjects[2].
In myopic subjects, when ametropia is axial, and retinal stretching is present, the distance between photoreceptors increases, therefore visual acuity compared to emmetropic subjects is limited [3].
As myopic subjects have increased axial length of the eye, both central and near peripheral (15 degrees around fovea) visual acuity is decreased, therefore correlation between highest possible central visual acuity and near peripheral visual acuity may be observed.

Methods

The spherical equivalent of ametropia is found for each subject and subjects are fitted with full aperture trial lenses that are fixed in constant vertex distance to obtain constant spectacle magnification on retina.
Central visual acuity is measured with program FrACT 3.7.1 (*Freiburg Visual Acuity and Contrast Test*) using Landolt C optotype. Peripheral visual acuity is measured using a specifically designed program [4].

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Acknowledgment

Authors (2,4) are supported by ESF No. 2013/0021/1DP/1.1.1.2.0/13/APIA/VIAA/001

Development and approbation of semiautomatic infrared retinoscope

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Modern life requires a great amount of near vision load, which negative influence on vision is necessary to reduce. To study the influence of the random dot stereoscopic images on state of accommodation of the eye, we developed semiautomatic retinoscope for precise evaluation of accommodative load. Optical system contains infrared power LED of 850 nm peak wavelength, semitransparent mirror, condensing objective and CCD matrix 41. Principles of functioning are transferred from classic manual retinoscope. Servo motor (3) ir driven by microcontroller and mimics the ticker motion to provide the illumination motion over the retina of the eye. The moveable chassis of the system applies to enable the point of neutralization.

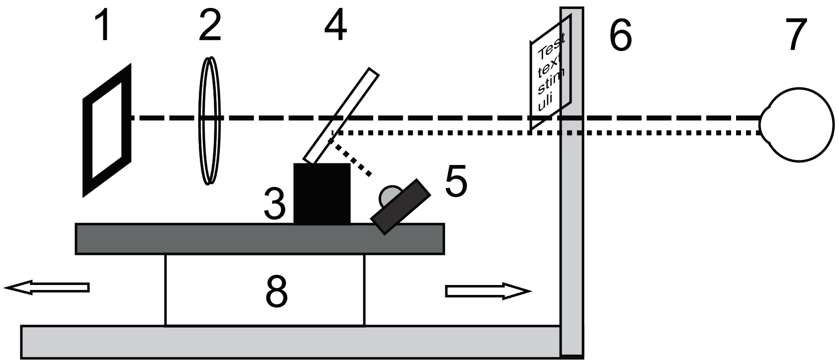

Figure 41: Schematic drawing of developed retinoscope and optical path: 1- CCD matrix with electric circuit, 2- focusing optics, 3- servo motor, 4- semitransparent mirror, 5- IR LED, 6- accommodative stimuli, 7- subjects eye, 8- system stand with moveable chassis.

Seven subjects aged 20 to 25 years with binocular vision (>200 arc sec) participated in our research. For all subjects ametropy was corrected to visual acuity 1.0 dec units and accommodation positive and negative reserves identified as more than 2.0D. Accommodation response was measured with developed retinoscope before the exposition to the random dot stereograms, after 5 min viewing and after 30 min of relaxation. Convergent RDS shifted accommodation by 0.119 D and after 30 min the shift decreased to 0.02 D. Divergent RDS reduced the accommodation by -0.101D and became only -0.006 D after 30 min.

Acknowledgement

Research is supported by ESF project No. 2013/0021/1DP/1.1.1.2/13/APIA/VIAA/001.