UDC 005

VIRTUAL MICROSCOPY – STATE OF THE ART

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Virtual microscopy is on the way to revolutionize microscopy and especially diagnostic pathology [1]. The change from glass slides to virtual slides opens a complete new way of diagnostic inspection of histological slides. Pathologists may view lots of slides in different magnifications, on different locations and staining parallel instead of one glass slide in one magnification on one location. The improvement of the quality of virtual slides is in the focus of this abstract.

Keywords: virtual microscopy, international scanner contest.

Virtual microscopy is a computer-based technology that offers the full range of traditional microscopy and more [2]. A virtual slide is a digitally captured glass slide which is comprised of high-resolution images. The digitization is performed using so called slide scanners. The frontend for the presentation is called virtual microscope. A virtual microscope may be composed of a client and a server program. A wide range of digital microscopes and virtual microscopy applications have been developed and used in numerous scenarios in education and research within the last decade. However the breakthrough in diagnostic anatomic pathology is still lacking. Three developments are important for the future: the development of new functionality in virtual microscopes (e. g. parallel viewing of different stains after registration), the integration of virtual microscopy and pathology information systems and the development of fast high-quality scanners. In this paper we focus on the scanner development and especially on the development of computer programs which can assess the quality and the speed of scanning devices. Within the 1st and the 2nd international Scanner Contest we established a way of benchmarking for slide scanners

Material and methods

The 2nd ISC 2012 contained 5 domains to evaluate different capabilities of participating systems [3]. Six vendors took part in the contest. Each vendor was free to choose which of the available domains to attend:

High throughput:
Sets of 35 slides of different origin randomly mixed had to be scanned automatically under daily-use conditions. Preparation and scanning time have been measured and a focus-corrected speed was calculated.

Quality:
The same 10 slides had to be scanned by each vendor in a limited time with best quality. Blinded quality evaluation was done by experienced pathologists applying a 9-tired scoring system.

Fluorescence:
Two artificially stained monochrome slides (quantum dots) had to be scanned in a limited amount of time. Contrast, contrast-noise ratio, signal-noise ratio and sharpness were measured to compare results.

Image analysis:
Twenty spots located on a Ki67 stained breast cancer TMA had to be scanned automatically. Subsequently participants had to quantify the amount Ki67 positive tumor cells in selected regions. Results were compared to manual quantification by a reference panel of pathologists.

Technical:
Two artificial slides, an IT 8.7/1 color target and a calibrated micrometer raster, had to be scanned. Resulting virtual slides were analyzed for color fidelity and geometric distortions.

During the contest we were able to evaluate 7 scanning systems (Metafer-VSlide SFx80, NanoZoomer HT 2.0, Pannoramic Desk, Pannoramic 250, TISSUEScope 4000, UltraFastScanner UFS, VS120 S5) from 6 par-

ticipants (3DHistech, Hamamatsu, Huron, Metasystems, Olympus, Philips) attending to 32 tests that all have been passed successfully.

Results

The results are very complex. An overview can be found under http://scanner-contest.charite.de. As an example we present here the results in the assessment of colour. We recorded several problems with the color fidelity (Fig. 2) and color resolution. We used an IT8.7/1 colour target mounted on a glass slide (Fig. 1) . The colour difference calculation was performed in concordance to CIEDE2000 [4].

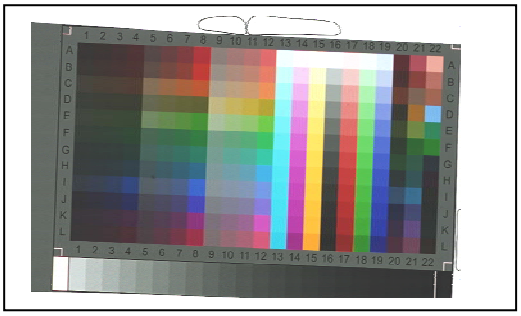

Fig. 1. IT8.7/1 colour target

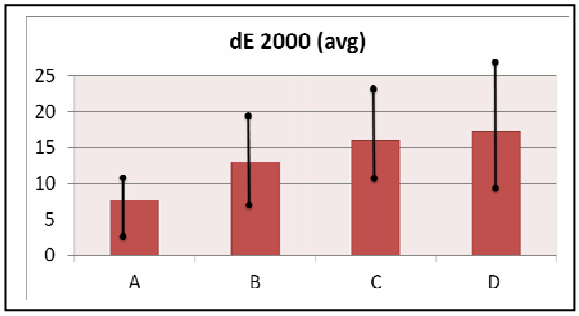

Fig. 2. Results of the analysis of the color fidelity for all patchen on the target

With respect to the influence of deviations in colour to the interpretation of the results of biomarkers the colour fidelity must be improved. When we restrict our analysis to the colours present in H&E stains which are more or less 90% of the clinical histopathological slides the results are qualitatively equal but quantitatively a little bit better.

Conclusion

The International Scanner Contest 2012 has a great benefit for the digital pathology community, because it offers a standardized and comprehensive means of evaluation and therefore a way for manufacturers to improve their devices and customers to choose the best device for their respective needs. The test domains represent requirements in routine pathology as well as education and research. Nevertheless vendors as well as pathologists requested additional domains, e. g. to determine capabilities of workflow integration, for the 3rd International Scanner Contest in 2014

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Виртуальная микроскопия — передовая технология.

Виртуальная микроскопия находится на пути к революции в микроскопии, в особенности в диагностической патологии [1]. Переход от предметных стекол к виртуальным открывает совершенно новый способ диагностического исследования гистологических препаратов. Патологоанатомы могут просматривать множество образцов в различных увеличениях, в разных положениях и с разным контрастированием параллельно, а не одно стекло с одним увеличением в одном положении. Цель данной работы — улучшение качества виртуальных слайдов.

Ключевые слова: *виртуальная микроскопия, международный конкурс по сканированию.*