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Abstract

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Quality assurance of digital image analysis by stereological estimation using stratified sampling

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In the quest for high-capacity image analysis, for instance for screening of drug components and within the emerging field of digital pathology, companies and laboratories turn to automated, digital image analysis. In essence, it is favourable to acquire ever-more powerful computers to lower turn-around times rather than employ more personnel to perform manual or computer-assisted stereology. While high-capacity automated image analysis may provide consistent results very quickly, it remains of utmost importance to ensure that it delivers accurate and precise results, and to maintain the possibility for quick evaluation of individual outlier cases.

It has previously been suggested to change the role of, say, an expert pathologist from estimating quantities to instead evaluate the accuracy of the applied image analysis methods. If this is furthermore done by inspecting the same objective events that form the basis of stereological methods, the evaluation efforts can be lowered by employing more efficient sampling schemes. Unfortunately, the simpler sampling schemes proved to still be too time-consuming while the more efficient proportional sampling turned out to be insufficient.

We investigated quality assurance of digital image analysis based on recent works in stereological estimation using a stratified sampling approach which can be seen as a combination of simple and proportional sampling. Presented here is a proof-of-concept of efficient unbiased image analysis evaluation, including sampling scheme parameter determination and potential pitfalls in image analysis evaluation. We conclude that estimation by stratified sampling enables manual verification of automated whole slide images in a way that is easily integrated into image analysis pipelines like digital pathology workflows.