Gindlhuber *et al.*: *Intrinsic Activity*, 2023; **11**(Suppl.1):A2.19
doi:10.25006/IA.11.S1-A2.19
published online: 22 September 2023

INTRINSIC ACTIVITY

27th Scientific Symposium of the Austrian Pharmacological Society

Vienna, 29–30 September 2023

MEETING ABSTRACT

A2.19

Artificial intelligence in automated image analysis for drug screening

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Background: With technologies' steady advance, high-content screening based on completely automated microscopes generating an endless stream of data has become the method of choice to screen compound efficacies, not only in companies but universities as well. Hand in hand with these capabilities, research questions have evolved accordingly, reaching from multiplexed 200+ colour images, 3D scans of whole mice to chasing waves of Ca^{2+} ions across organelle membranes. The answer, more often than not, is thought to be found in artificial intelligence (AI)-based image analysis, a trend supported by imaging companies and independent analysis service providers alike. However, many researchers are yet unaware of what lies behind these 'educated' programs and what they really could allow us to do.

Methods: Common image analysis questions have been evaluated with or without AI tools to provide a critical comparison of adaptive, algorithm-based and AI-based image analysis results. To this extent various image acquisition techniques have been employed to generate the raw data, such as fluorescent microscopy, histological slide scanners and light tomography. The automated analysis programs were generated in the two open-source environments FIJI and Python.

Results: Our setting as a research unit of the Medical University of Graz grants us access to samples generated as part of the clinical routine and samples arising from basic scientific research. For samples arising from clinical routine work, AI-based analysis offered specificity and adaptability to context-specific interpretation, which we were not able to attain from conventional mathematical models. However, the limited sample size of most fundamental research projects, as well as changing parameters / setup configuration and the lack of a possible ground truth to generate a training set in the first place led to unstable performance or made the approach inapplicable in the first place. A more common use for AI in smaller-size experiments was found in data curation like image segmentation, de-noising and other image preparation steps profiting from a universally applicable base and specific training to each individual imaging system.

Discussion: Whilst AI has become more readily implemented in everyday imaging applications, especially de-noising, analysis programs solely relaying on it are few and far between. Reasons can be found in intrinsic heterogeneity of generated data, which necessitates extensive training and/or frequently changing experimental parameters. However, if training sets are non-limiting and the sampling procedure is standardized, these programs tend to surpass even trained personell, highlighting their potency in the clinical setting of digital pathology. Nevertheless, the cumbersomeness of manual feature extraction and lacking documentation about happenings in the backline are problems which need to be improved upon in the future.

Acknowledgements: The authors would like to thank the Core Facility Imaging from the Centre for Medical Research, Graz, for their support.

Keywords: artificial intelligence – high-content screening – image analysis

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