

Novel Machine Learning Approaches to Study Infection and Disease through Biomedical Images.

ML and DL are revolutionising our abilities to analyse biomedical images. Among other host-pathogen interactions may be readily deciphered from microscopy data using convolutional neural networks (CNN). We demonstrate in several studies how the definition of novel ML/DL tasks may aid in studying infection and disease phenotypes. Specifically, ML/DL algorithms may allow unambiguous scoring of virus-infected and uninfected cells in the absence of specific labelling. Accompanied by interpretability approaches, the ability of CNN to learn representations, without explicit feature engineering, may allow for uncovering yet unknown phenotypes in microscopy. Furthermore, we demonstrate novel ML/DL approaches to simplified 3D microscopy acquisition using conventional 2D hardware. Finally, we demonstrate how generative AI can be applied to tasks like image reconstruction and resolution enhancement in fluorescence and brightfield microscopy. Taken together, we show novel approaches to established algorithms in Computer Vision and Data Science. Applied to microscopy data, these approaches allow for the extraction of observations from datasets large enough to not be suitable for manual analysis. We argue that this shows that reformulating conventional ML/DL tasks to answer biological questions may facilitate novel discoveries in Infection and Disease Biology.

References

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