

SinCUT Model for Single Image Translation in Microscopy Applications

Fiza Khan¹, Baidong Wu¹, Zengbo Wang¹

School of Computer Science and Engineering, Bangor University, LL57 1UT, UK

ABSTRACT

Introduction

Deep learning-based image-to-image translation methods, such as CycleGAN [1] and CUT (Contrastive Unpaired Translation) [2], have shown the ability to map images between source and target domains (e.g., horse to zebra). These methods enable the translation of optical images across imaging modes while preserving content. However, in many cases—particularly in high-resolution imaging—acquiring a large number of experimental images is challenging, costly, and time-intensive. As a result, a single-image translation capability in microscopy applications is highly desirable.

Methods

Building on the CUT model, which uses a patch-based approach to align positive patches within the learned feature space more closely than negative patches [2], SinCUT extends this concept by leveraging sub-patches from a single image and has been demonstrated for general single-image translation. While SinCUT has shown promise in general single-image translation tasks, its application to microscopy imaging remains unexplored. In this work, we evaluate the performance of SinCUT in translating microscopy images across different optical imaging modes. SinCUT efficiently achieves high-quality image translation in both paired and unpaired scenarios, significantly reducing training time and improving translation accuracy. Despite being trained on only a single image pair, SinCUT demonstrates the ability to accurately translate unseen data while preserving image content and quality. For instance, the model successfully translates images from brightfield (BF) mode to darkfield (DF) mode and from brightfield to differential interference contrast (DIC) mode, as illustrated in Figure 1.

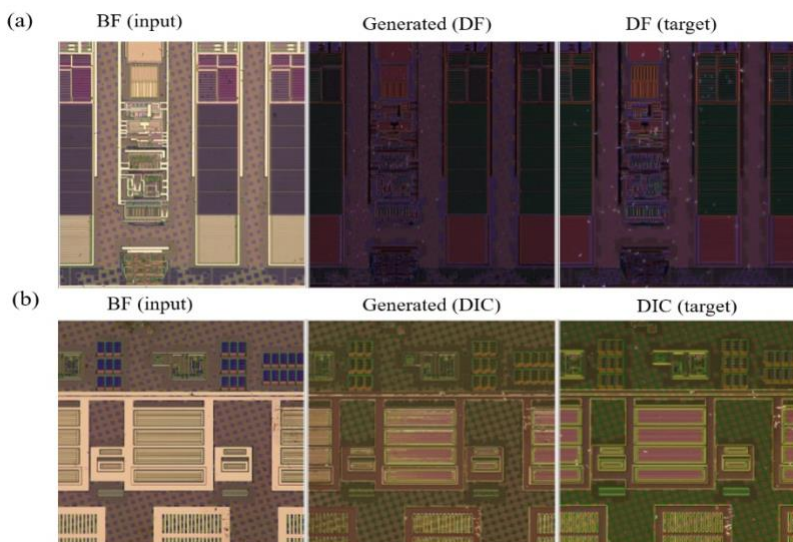


Figure 1: SinCUT model for microscopy image translation. (a) Translation from brightfield to darkfield mode, and (b) from brightfield to DIC mode.

References

- [1] CycleGAN Project Page. Available at: <https://junyanz.github.io/CycleGAN/>
- [2] CUT (Contrastive Unpaired Translation) GitHub Repository. Available at: <https://github.com/crvu854/CUT>