Towards Remote 3D Pathological Diagnosis System Using LUCID, a Tissue-Clearing Reagent, and HandySPIM, a Novel Compact 3D Imaging Device

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Abstract. We introduce LUCID, a tissue clearing reagent suitable for pathological diagnosis that we have developed, and HandySPIM, a selective plane illumination microscope developed with a new concept. These two technologies enable affordable and convenient three-dimensional imaging of biological information, and will also make remote three-dimensional pathological diagnosis techniques possible in the future.

Keywords: Tissue Clearing Reagent · Selective Plane Illumination Microscope · Remote 3D Pathology

1 Introduction

LUCID is a tissue-clearing reagent that enables three-dimensional (3D) imaging of biological specimens. Notably, it offers higher transparency compared to other reagents, and it allows for immunostaining and nuclear staining. Furthermore, biological samples cleared with LUCID can be preserved for up to 10 years, making it suitable for pathological diagnosis. However, 3D imaging requires expensive imaging equipment, making it impractical for cost-conscious pathological examinations.

2 Materials and Methods

To address this challenge, we developed a compact and user-friendly Selective Plane Illumination Microscopy (HandySPIM), which uses a 5–20 μm thick glass thin film as a waveguide to form a two-dimensional sheet of light, serving as the excitation light.

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3 Results

The resolution of HandySPIM in the thickness direction depends on the thickness of the glass film; a thicker film allows for the verification of three-dimensional structures without moving the sample. Additionally, the cost of HandySPIM can be as low as 1/30th to 1/50th of that of commercially available SPIMs.

4 Discussion

By combining LUCID and HandySPIM, and further integrating network and information processing technologies, remote 3D pathological diagnosis can be achieved at a low cost. This makes it feasible for implementation even in small hospitals and clinics, where significant improvements in the accuracy of pathological diagnoses, time reduction, and cost savings are highly anticipated.