Upright aNd Inverted polygon microscope (UNI-SCOPE)

Tao Xu[a], Yongxiao Li[a], Woei Ming Lee *[a, b]

[a]Research School of Engineering, College of Engineering and Computer Science, The Australian National University, Canberra ACT 2601, Australia
[b]The ARC Centre of Excellence in Advanced Molecular Imaging, The Australian National University, ACT 2601 Australia
Corresponding Author * steve.lee@anu.edu.au

ABSTRACT

Cellular imaging in living animal has opened up a wide range of avenues to study cells in its microenvironment. High speed laser scanning microscopy possess the ability to observe fast real-time biological phenomena such as cell movements, cell division, cells death. Due to the anatomical difference of difference organs in small animals, there is a need to engineer a flexible microscope that can readily adapt to different imaging position. For video-rate imaging, the design of a flexible microscope depends mainly on scanning devices. Existing multiphoton microscope platforms (i.e. Thorlabs Bergamo® II Series) uses a rotating objective mount to conform of the specimens. This is possible because of the compact resonant mirror scanners. However, for varying imaging speed using a polygon microscope, this approach is not feasible due to high rotating speed. As such, we developed a dual objective microscope system that can achieve both upright and inverted, we termed it as UNI-SCOPE. The integrated platform can achieve flexible scanning speed of up to 120 FPS with an overall footprint of 450mm*600mm*450mm. Using a dual objective approach, users can tailor the platform to the imaging sample.

Keywords: Laser Scanning Microscopy, flexible, portable, high-speed scanning

1. INTRODUCTION

One of the aim advantages of laser scanning microscopes (LSM) is high optical efficiency and readily adaptable for the confocal or multiphoton microscope. However, scanning speed of the majority of the LSM possess fixed scanning speed. For example, Thorlabs Bergamo® II Series. Thorlabs Bergamo® II Series use fixed 8kHz and 12kHz Resonant-galvo-galvo and galvo-resonant scanners for high-speed imaging with a maximum of 45 FPS with pixel distribution of 512 by 512. Amongst most mirror scanner, the polygon mirror stands out as one that is flexible and can achieve varying scanning speeds. In this work, we developed a commercial flexible polygon scanning mirror microscope called UNI-SCOPE. The UNI-SCOPE is a full solution that optimised the dynamic rotation speed of a polygon mirror system which controls the final frame rate[1] using C++ program and compact programmable circuits. On top of that, UNI-SCOPE is a dual objective laser scanning system, which allows users to image sample in 2 or more imaging directions depending on the sample orientation. We show that our new scope achieves 512 by 512 from 10 FPS to 120 FPS that is fully controllable using the C++ program P-Scope. The P-Scope was written by C++, which always use in commercial product or industry environment. The P-Scope GUI and captured image are shown in Figure 1. We are trialling the new PSCOPE operating environment with our commercial partners.

Biophotonics Australasia 2019, edited by Ewa M. Goldys, Brant C. Gibson, Proc. of SPIE Vol. 11202, 112021I · © 2019 SPIE · CCC code: 0277-786X/19/$21 · doi: 10.1117/12.2539970

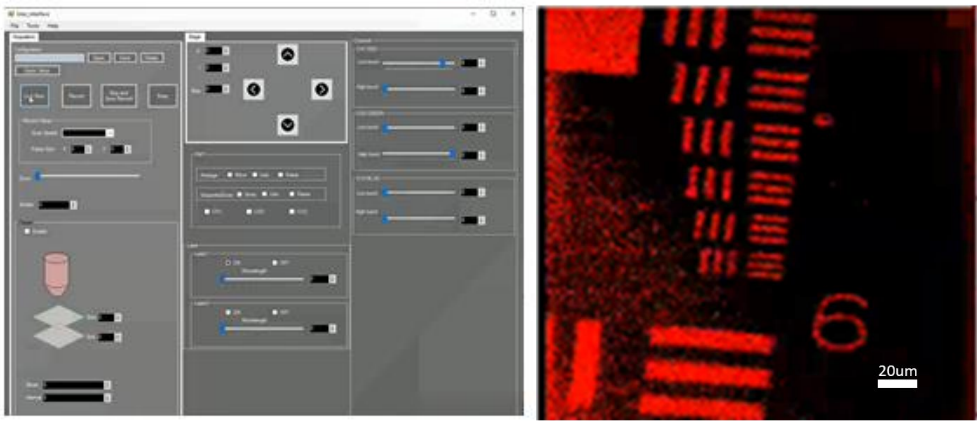

Figure 1 P-scope GUI and corresponding images capture with resolution target.

Figure 2(a) and Figure 2(b) show 3D model of the new UNI-Scope using with separate objectives, one of objective is upright (can be rotated) and another one is inverted.

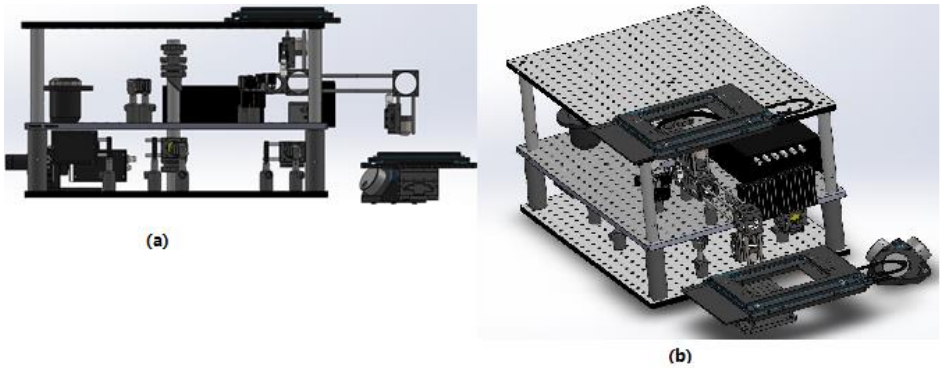

Figure 2 3D model of the UNI-Scope

REFERENCE

[1] Li, Y., Brustle, A., Gautam, V., Cockburn, I., Gillespie, C., Gaus, K. & Lee, W. M. "High speed multiphoton imaging," SPIE BioPhotonics Australasia, International Society for Optics and Photonics, 100130K(2016).