RAMDOM-ACCESS TWO-PHOTON IMAGING BASED ON A DIGITAL MICROMIRROR DEVICE

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We present a compact laser scanning two-photon excitation (TPE) microscope for random-access imaging based on a low-cost digital micromirror device (DMD) that scans the laser beam in X, Y and Z axes at the DMD pattern rate, i.e. 4.2 ~32.5 kHz. The optical configuration of the TPE microscope is presented in Figure 1. The X, Y, Z scanning is achieved by programming binary hologram patterns [1] to a DMD-based femtosecond beam shaper [2]. Axial scanning along the optical axis can be achieved by using the hologram patterns of a spherical wavefront of varying focal lengths. Lateral scanning can be achieved by changing the tilted phase term in the Lee holography [1]. Compared with conventional TPE microscopes, our new TPE microscope has the following advantages: (1) simple and compact optical arrangement; (2) suitable for random access imaging, i.e., no line scan constraints, (3) increased pixel dwell time, and (4) low cost.

Figure 1: Optical path of a TPE microscope based on a DMD; M1, M2: high-reflectivity mirrors; L1-L4: lenses; DM: dichroic mirror; PMT: photomultiplier tube.