We obtained a three-dimensional structural data set of a Golgi-stained whole mouse brain at the neurite level with our developed Micro-Optical Sectioning Tomography (MOST) system, which directly demonstrates the whole-brain structural connectivity at the neurite level in a standard format. Our results demonstrated a resolution of micro meter in three dimensions across the whole brain, which was not provided by other techniques.

Based on the data set, we can segment, mark and three-dimensionally trace the neurites of neurons and even construct a digital whole mouse brain with a voxel size of 0.33\( \mu \)m by 0.33\( \mu \)m by 1.0\( \mu \)m. It is likely that individual neurons or typical structures of the whole brain will be recognized in a complex background and that it will be possible to analyze architectural features with limited computing resources. The MOST has the potential to be used to get high-resolution atlas of other model animals’ brain or even human brain. However, a successful high-resolution atlas is determined by not just the imaging system, but also many other special or unique techniques, which is a kind of high comprehensive systemic engineering. Many technical details are the bottleneck of restricting the development, such as the labeling of the whole brain, chatter during the high speed sectioning, image registration, automatic segmentation and marking for the mass image dataset.

In this presentation, we will clarify the unique features of the Micro-Optical Sectioning Tomography (MOST), which is a novel microscopic optical imaging technique aiming at providing a submicron resolution by sectioning. Differences in operation mechanism, approaches as well as the outstanding performance of the MOST are presented in comparison to the systems developed by other groups. We will share the experience of developing the MOST and the high-resolution mouse brain atlas and analyze the difficulties for obtaining a bigger size brain, such as human brain atlas with the compatible spatial resolution. We will also discuss the potential optical techniques and methods and present the challenges to be urgently solved for neuroscientists and information scientists. We demonstrate that a fluorescence MOST is a unique and powerful tool for studying the microstructure and connectivity of the brain at high resolution.