# Tissue Scale Tiling Lattice Lightsheet

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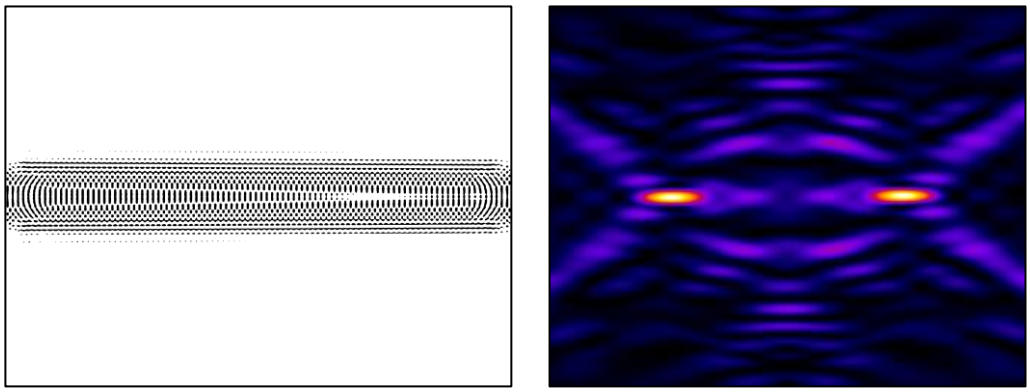
**KEY WORDS:** Tiling lattice lightsheet microscopy, spatial light modulator, large tissue

In our prior work [1], we presented a novel method to implement tiling lattice lightsheet (TLLS) in a lattice lightsheet microscope (LLSM) without changing its optical design. A binary phase map imposes the necessary defocus term for a lattice lightsheet (LLS) to shift the corresponding optical lattice along its propagation direction, resulting in a sufficiently thin TLLS that can tile across a large specimen while maintaining its optical sectioning ability. Yet, when we further extend the TLLS from covering multi-cell [1] to thick tissue, binary SLM's insufficient diffraction efficiency leads to a distorted excitation beam.

To remove the alias artifacts, we explore the TLLS's binary pattern parameter space via numerical simulations and experiment validation, suggesting a plausible tuning protocol when applying TLLS for tissue scale specimens. In this case, we use expanded (through expansion microscopy) renal cortex slice as our system demonstration.

We exploit the fact that our phase-only spatial light modulator (SLM) has restricted angular range, which forms superposition of both converging and diverging lens terms, manifest as a pair of TLLS. A pair of TLLS forms simultaneously along the propagation direction has the potential to double the acquisition speed compares to a typical axially swept lightsheet microscope due to its symmetric nature. By utilizing the fast switching binary spatial light modulator in a regular LLSM setup with updated TLLS patterns that synchronize to camera rolling shutter scanlines, we can effectively achieve dual-slit lattice lightsheet setup without additional modification in regular LLSM.



**(Left)** 45-beam lattice pattern, with 80 um defocus term
**(Right)** Simulated YZ axial profile.

**REFERENCES:**

1. Gao, L., et al., *Lattice light sheet microscopy using tiling lattice light sheets.* Optics Express, 2019. **27**(2): p. 1497-1506.