

1. Record Nr.	UNINA9911020039303321
Autore	Reynaud Emmanuel G
Titolo	Light Sheet Fluorescence Microscopy
Pubbl/distr/stampa	Newark : , : John Wiley & Sons, Incorporated, , 2024 ©2024
ISBN	9783527803934 3527803939 9783527803903 3527803904 9783527712779 3527712771 9783527803910 3527803912
Edizione	[1st ed.]
Descrizione fisica	1 online resource (419 pages)
Altri autori (Persone)	TomancakPavel
Disciplina	502.82
Soggetti	Microscopy Confocal fluorescence microscopy
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Nota di contenuto	Cover -- Title Page -- Copyright -- Contents -- Foreword by Ernst H. K. Stelzer -- Preface -- Chapter 1 Let There be Light Sheet -- 1.1 Historical Context of Light Sheet Microscopy - Ultramicroscopy -- 1.2 Light Sheet Imaging Across the Twentieth Century -- 1.3 And here Comes the Flood -- 1.4 The Building of a Community -- References -- Chapter 2 Illumination in Light Sheet Fluorescence Microscopy -- 2.1 Introduction -- 2.2 Axial Resolution and Optical Sectioning in Light Sheet Microscopy -- 2.2.1 The Point Spread Function in Fluorescence Microscopy -- 2.2.2 The Point Spread Function in Light Sheet Fluorescence Microscopy -- 2.3 Light Sheet Dimensions -- 2.3.1 Gaussian Optics Description of Beam Focusing (x,z Axes) -- 2.3.2 Methods of Light Sheet Production (y Axis) -- 2.4 Practical Light Sheet Generation -- 2.4.1 Static and Pivoted Light Sheets -- 2.4.2 Scanned Light Sheets -- 2.5 Degradation of the Light Sheet in Tissue -- 2.5.1

Absorption of the Light Sheet in Tissue -- 2.5.2 Refraction of the Light Sheet in Tissue -- 2.5.3 Scattering of the Light Sheet in Tissue -- 2.6 Challenges and Benefits of Light Sheet Modes -- 2.6.1 Parallelization of the Light Sheet -- 2.6.2 Image Artifacts Arising from Light Sheet Illumination -- 2.6.3 Homogeneity of Light Sheet Illumination -- 2.6.4 Robustness and Simplicity of Light Sheet Generation -- 2.6.5 The Merits of Static, Pivoted, and Scanned Light Sheets -- 2.7 Multiphoton Excitation -- 2.7.1 TwoPhoton Light Sheets -- 2.7.2 TwoPhoton Light Sheet Dimensions -- 2.7.3 Comparison with OnePhoton Light Sheet Microscopy -- 2.7.4 Comparison with LaserScanning Multiphoton Microscopy -- 2.8 MultiView Illumination -- 2.9 HighResolution Imaging -- 2.9.1 Geometric Limitations for HighResolution Imaging -- 2.9.1.1 Oblique Light Sheets -- 2.9.1.2 Reflected Light Sheets. 2.9.2 Diffractive Limitations for HighResolution Imaging -- 2.9.2.1 Bessel Beams -- 2.9.2.2 Axially Swept Beams -- 2.9.2.3 Photophysical Approaches -- 2.10 Conclusions -- References -- Chapter 3 A Small Guide on How to Mount a Sample in a LightSheet Microscope -- 3.1 Introduction -- 3.2 A Few Basic Rules -- 3.2.1 Rule 0 - Don't Panic! Become Enthusiastic! -- 3.2.2 Rule 1 - Keep it Clean -- 3.2.3 Rule 2 - The Light Comes Sideways -- 3.2.4 Rule 3 - The Theory does not Apply to your Sample -- 3.2.5 Rule 4 - Sample Geometry Matters -- 3.2.6 Rule 5 - Know Your System Well -- 3.2.7 Rule 6 - How Does Your Sample Move? -- 3.2.8 Rule 7 - What Was Lost? -- 3.2.9 Rule 8 - Consistency is Key -- 3.3 The LightMatter Conundrum -- 3.4 Hydrogels -- 3.4.1 Preparation -- 3.5 Glues -- 3.6 Sample Holders -- 3.7 Clearing -- 3.8 Cleaning, Labelling, and Storing Samples -- 3.9 An Example: Timelapse Live Imaging of Threedimensional Cultures -- 3.9.1 Environmental Control: Temperature, pH, Oxygenation -- 3.9.2 Perfusionbased Environmental Control -- 3.9.3 Sample Holders for the Live Imaging of Threedimensional Cell Cultures -- 3.9.3.1 Agarose Beakers -- 3.9.3.2 FEPfoil Sample Holders -- 3.9.4 References -- 3.10 A Bit of Literature -- 3.10.1 Reference Guides -- 3.10.2 Your Favorite Models -- 3.10.3 Others -- 3.10.4 Protocol Videos -- Bibliography -- Chapter 4 Detection in a Light Sheet Microscope -- 4.1 Introduction -- 4.2 Image Formation in LSFM -- 4.2.1 WFM Scheme -- 4.2.2 LSFM Scheme -- 4.2.3 Practical Design Examples of an LSFM -- 4.3 Advanced Detection Schemes -- 4.3.1 Spectrally Resolved -- 4.3.2 Contrast Enhancement (Confocal Line) -- 4.3.3 Aberration Correction (Adaptive Optics) -- 4.3.4 Fast Volumetric Imaging -- 4.3.4.1 Inverted SPIM -- 4.3.4.2 Remote Focusing Using Tunable Lens -- 4.3.4.3 OPMSCAPE -- 4.3.4.4 Wavefront Coding -- 4.4 Conclusions -- References. Chapter 5 Light Sheet Microscope Configurations -- 5.1 LSFM Architectures -- 5.1.1 Multiple Objective Lens Configurations -- 5.1.2 Single Objective Lens Configurations -- 5.1.3 Opposing Objective Lens Configurations -- 5.2 Recording ThreeDimensional Image Data -- 5.2.1 Moving the Sample -- 5.2.2 Moving Detection and Illumination -- 5.3 Configurations that Expand on Specific Capabilities -- 5.3.1 First Light Sheet: Increasing Sample Viability -- 5.3.2 Imaging Easier: Increasing Flexibility -- 5.3.3 Imaging Deeper: Increasing Penetration Depth -- 5.3.4 Imaging Wider: Increasing the Effective Field of View -- 5.3.5 Imaging All Around: Increasing the Isotropy -- 5.3.6 Imaging Brighter: Increasing Contrast -- 5.3.7 Imaging Faster in 3D: Increasing Volumetric Temporal Resolution -- 5.3.8 Imaging Bigger: Increasing Sample Volume -- 5.3.9 Imaging Smaller: Increasing Spatial Resolution -- 5.3.10 Imaging More: Increasing Throughput -- 5.4 Summary -- References -- Chapter 6 Commercial and OpenSource Systems -- 6.1 Introduction -- 6.1.0 Questions? Answers? -- 6.2 Commercial Systems -- 6.2.1 Carl Zeiss Lightsheet Z.1: Market Introduction and Experiences

-- 6.2.1.1 Introduction -- 6.2.2 ALPHA3: Light Sheet Fluorescence Microscope -- 6.2.2.1 Digital Light Sheet Generator -- 6.2.2.2 Modular and Flexible Light Sheet Setup -- 6.2.3 Illumination Unit(s) -- 6.2.3.1 Sample Chamber and Holders -- 6.2.3.2 Detection Unit -- 6.2.3.3 Software -- 6.2.3.4 HighSpeed 3D Acquisition -- 6.2.3.5 Applications -- 6.2.3.6 Summary -- 6.2.4 Leica TCS SP8 DLS: Turning Light Sheet Microscopy Vertically -- 6.2.4.1 Light Path -- 6.2.4.2 Sample Preparation for the Leica TCS SP8 DLS -- 6.2.4.3 Convenient Software Tools to Manage Large Data Amounts -- 6.2.4.4 Technical Specifications -- 6.2.4.5 Applications -- 6.2.4.6 Imaging with Low Light Intensities -- 6.2.4.7 Imaging of Cleared Tissue. 6.2.4.8 Imaging of Fast Dynamic Processes -- 6.2.4.9 High Throughput by Multiposition Experiments and Imaging of Larger Specimens -- 6.2.4.10 Advanced Applications by Combined Imaging Methods -- 6.2.4.11 Summary -- 6.2.5 The Large Selective Plane Illuminator (LSPI): A Versatile Illumination Module for Large Photosensitive Samples -- 6.2.5.1 Introduction -- 6.2.5.2 Design -- 6.2.5.3 Light Sheet Properties and Resolution -- 6.2.5.4 Sample Preparation -- 6.2.5.5 Application 1: Fluorescence Imaging in Live Coral Samples -- 6.2.5.6 Application 2: Fluorescence Imaging in Other Live and Fixed Samples -- 6.2.5.7 Application 3: Reflectance Imaging -- 6.2.5.8 Software, Image Processing, and Data Management -- 6.2.5.9 Price Range -- 6.2.5.10 Acknowledgment -- 6.2.6 LUXENDO's Modular Light Sheet Solutions Adapt Specifically to a Broad Spectrum of Diverse Samples and Applications -- 6.2.6.1 Introduction -- 6.2.6.2 Multiple View Selective Plane Illumination Microscope (MuVi SPIM) -- 6.2.6.3 Clearing -- 6.2.6.4 Inverted View Selective Plane Illumination Microscope (InVi SPIM) -- 6.2.6.5 Quantitative View Selective Plane Illumination Microscope (QuVi SPIM) -- 6.2.6.6 Conclusion -- 6.2.6.7 Acknowledgments -- 6.3 OpenSource Systems -- 6.3.1 OpenSPIM: The Do It Yourself (DIY) Selective Plane Illumination Microscopy (SPIM) Approach -- 6.3.1.1 Introduction -- 6.3.1.2 The Principle of DIY SPIM -- 6.3.1.3 Of the Diversity of Biological Applications Using DIY SPIM Microscopy -- 6.3.1.4 Community -- 6.3.2 eduSPIM: Light Sheet Fluorescence Microscopy in the Museum -- 6.3.2.1 Introduction -- 6.3.2.2 Optical Design -- 6.3.2.3 Control Software and User Interface -- 6.3.2.4 Sample Choice and Sample Mounting -- 6.3.2.5 Outreach and Discussion -- 6.3.2.6 Acknowledgments -- References -- Further Reading -- Publications with Lightsheet Z.1.

Chapter 7 Image Processing and Analysis of Light Sheet Microscopy Data -- 7.1 Introduction -- 7.2 Multiview SPIM Reconstruction -- 7.2.1 Multiview Registration -- 7.2.2 Multiview Fusion -- 7.3 Processing of Data from Other Light Sheet Microscopy Implementations -- 7.4 Big Image Data Management and Visualization -- 7.4.1 Hierarchical Data Format -- 7.4.2 Parallel Processing -- 7.4.3 Big Data Visualization -- 7.5 Analysis of Light Sheet Microscopy Datasets -- 7.5.1 Image Dimensionality Reduction for Better Analysis -- 7.5.2 Segmentation and Tracking in Light Sheet Data -- 7.5.3 Atlas Registration -- 7.6 Conclusion -- References -- Chapter 8 Imaging Molecular Dynamics Using a Light Sheet Microscope -- 8.1 Introduction -- 8.2 Fluorescence Techniques Using Light Sheet Illumination -- 8.2.1 Fluorescence Correlation Spectroscopy -- 8.2.2 Fluorescence Recovery After Photobleaching -- 8.2.3 SingleParticle Tracking -- 8.2.4 Förster Resonance Energy Transfer -- 8.2.5 Fluorescence Anisotropy Imaging -- 8.2.6 Fluorescence Lifetime Imaging Microscopy -- 8.3 Instrumentation -- 8.3.1 Light Sheet Microscope Configurations -- 8.3.2 Objectives and Cameras -- 8.4 Considerations for Acquisition Parameters -- 8.4.1 Light Sheet Thickness Versus Field of View -- 8.4.2

Field of View Versus Frame Rate -- 8.4.3 Pixel Size Versus Spatial Resolution -- 8.4.4 Pixel Size Versus Field of View and Frame Rate -- 8.4.5 Data Rate -- 8.4.6 Synchronous Versus Asynchronous ReadOut -- 8.4.7 Photobleaching and Phototoxicity -- 8.5 Applications of Fluorescence Techniques Performed Using Light Sheet Microscopes -- 8.5.1 Fluorescence Correlation Spectroscopy -- 8.5.2 Fluorescence Recovery After Photobleaching -- 8.5.3 SingleParticle Tracking -- 8.5.4 Förster Resonance Energy Transfer -- 8.5.5 Fluorescence Anisotropy Imaging -- 8.5.6 Fluorescence Lifetime Imaging Microscopy.
8.6 Concluding Remarks.

Sommario/riassunto

This book provides an in-depth exploration of light sheet fluorescence microscopy (LSFM), a revolutionary imaging technique that enhances resolution and minimizes phototoxic effects by illuminating specimens with a thin sheet of light. The text covers various aspects of LSFM, including illumination techniques, sample mounting, detection methods, and microscope configurations. It discusses both commercial and open-source systems as well as image processing and data analysis. Additionally, the book explores the application of LSFM in diverse fields such as biology and drug development, making it a valuable resource for scientists and researchers seeking to understand and apply this advanced microscopy technology. The intended audience includes professionals in biological sciences and microscopy technology.
