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Nota di contenuto	About the Author -- Epigraph -- Preface -- Part I Development of Microscopes -- 1 Connections Between Light, Vision, and Microscopes -- 2 Concepts and Criteria of Resolution -- 3 Aberrations and Artifacts Confound Optical Resolution -- 4 Insights in the Development of Light Microscopes -- 5 Ernst Abbe and His Contributions to Optics -- 6 Abbe's Theory of Image Formation in the Microscope -- 7 Helmholtz's Contributions on the Theoretical Limits to the Resolution of the Microscope -- 8 Further Insights to Abbe's Theory of Image Formation in the Microscope Based on Diffraction -- 9 Mathematical Description of Abbe's Theory of Image Formation in the Microscope Based on

Diffraction -- Part II Optical Techniques to Enhance Contrast in the Microscope -- 10 Richard Zsigmondy and Henry Siedentopf's Ultramicroscope -- 11 Light-Sheet Fluorescence Microscopy (LSFM) -- 12 Phase Microscopy to Enhance Contrast -- Part III Far-Field Superresolution Optical Microscopy -- 13 Structured Illumination Microscopy (SIM) -- 14 Stimulated Emission Depletion (STED) Microscopy and Related Techniques -- 15 Localization Microscopy with Active Control -- 16 Coda: Trade-Offs, Cautions, and Limitations of Far-Field Superresolution Optical Microscopes -- Appendix: Annotated Bibliography of Key Publications Relevant to Abbe's Beiträge zur Theorie des Mikroskops 1873 -- Index.

Sommario/riassunto

This book presents a comprehensive and coherent summary of techniques for enhancing the resolution and image contrast provided by far-field optical microscopes. It takes a critical look at the body of knowledge that comprises optical microscopy, compares and contrasts the various instruments, provides a clear discussion of the physical principles that underpin these techniques, and describes advances in science and medicine for which superresolution microscopes are required and are making major contributions. The text fills significant gaps that exist in other works on superresolution imaging, firstly by placing a new emphasis on the specimen, a critical component of the microscope setup, giving equal importance to the enhancement of both resolution and contrast. Secondly, it covers several topics not typically discussed in depth, such as Bessel and Airy beams, the physics of the spiral phase plate, vortex beams and singular optics, photoactivated localization microscopy (PALM), stochastic optical reconstruction microscopy (STORM), structured illumination microscopy (SIM), and light-sheet fluorescence microscopy (LSFM). Several variants of these techniques are critically discussed. Noise, optical aberrations, specimen damage, and artifacts in microscopy are also covered. The importance of validation of superresolution images with electron microscopy is stressed. Additionally, the book includes translations and discussion of seminal papers by Abbe and Helmholtz that proved to be pedagogically relevant as well as historically significant. This book is written for students, researchers, and engineers in the life sciences, medicine, biological engineering, and materials science who plan to work with or already are working with superresolution light microscopes. The volume can serve as a reference for these areas while a selected set of individual chapters can be used as a textbook for a one-semester undergraduate or first-year graduate course on superresolution microscopy. Moreover, the text provides a captivating account of curiosity, skepticism, risk-taking, innovation, and creativity in science and technology. Good scientific practice is emphasized throughout, and the author’s lecture slides on responsible conduct of research are included as an online resource which will be of interest to students, course instructors, and scientists alike.