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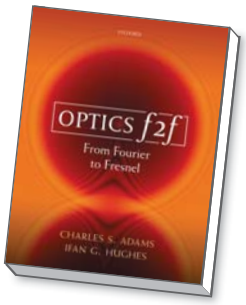
A Fresnel lens in a lighthouse beacon.

Exploring light propagation with Fourier and Fresnel

Standard texts for undergraduate optics courses include *Optics* by Eugene Hecht (5th edition, 2017) and *Introduction to Optics* by Frank Pedrotti, Leno M. Pedrotti, and Leno S. Pedrotti (3rd edition, 2007). Those texts use a traditional approach to teaching optics by starting with geometrical optics and moving to physical optics. Hecht's inclusion of historical details adds richness and humanity to the development of our understanding of light, although the stories frequently interrupt the book's conceptual flow. The Pedrottis skip the history lessons and add an engineering perspective that includes topics such as electro-optics, acousto-optics, and displays and detectors that are not traditionally covered in undergraduate optics courses. Those topics are useful in understanding current applications of optics but are not integrated into a coherent narrative.

In their new textbook, *Optics f2f: From Fourier to Fresnel*, Charles Adams and Ifan Hughes present a different approach to understanding optical phenomena that complements those two more traditional textbooks. Both authors hail from Durham University, where for many years they have been using Fresnel's and Fourier's ideas as a unifying theme in their undergraduate optics courses. The book is the culmination of their compiled notes. Adams, who specializes in quantum optics, received the Institute of Physics' 2014 Thomson Medal and Prize; Hughes, an expert on ultracold atoms, is the co-author, with Thomas Hase, of *Measurements and Their Uncertainties: A Practical Guide to Modern Error Analysis* (2010).



Optics f2f
From Fourier to Fresnel

Charles S. Adams and Ifan G. Hughes
Oxford U. Press, 2019. $39.95 (paper)

Adams and Hughes use the superposition of waves as a foundation for exploring light propagation. They start with Maxwell's equations with single plane and spherical waves and move to situations involving a few waves—topics that also appear in standard texts. But to explore wave optics, Adams and Hughes make the unique choice to use Fresnel's and Fourier's methods of adding many waves. Fresnel's approach considers the superposition of curved wavefronts, while Fourier focuses on the superposition of plane waves. The authors then provide a thorough discussion of Fourier optics, Fraunhofer diffraction, and Fresnel diffraction from a valuable perspective that differs from current optics texts. Adams and Hughes go on to examine contemporary topics, including laser beams and waveguides, tightly focused vector fields, unconventional polarization states, optical phenomena in the time domain, and light-matter interactions.

The book has 13 chapters. Each is made up of short sections of one to a few paragraphs that focus on fundamental ideas. Those sections make it easy for students to zero in on important concepts and equations and for instructors to select the exact material they want to cover. Unfortunately, the conciseness of the text will leave readers who prefer more expansive discussions wanting more. The authors put historical details and parenthetical comments either in separate sections or in boxes on the margins. That approach works well and preserves the flow of the main text. The book is appropriate for upper-level undergraduate optics courses. It would also serve as a handy reference text for graduate-level research students, perhaps as a companion to *Introduction to Modern Optics* by Grant Fowles (2nd edition, 1989).

Optics f2f includes 200 end-of-chapter exercises that help students prove steps that are left out of the in-text derivations, complete interesting new derivations, and develop conceptual understanding of the text topics. Occasionally the authors provide Python coding exercises to help students visualize the evolution of wave phenomena in space or time. The numerical problems are limited. The book provides limited resources for instructors at www.dur.ac.uk/physics/opticsf2f; at the time of writing, the page hosted a PowerPoint presentation containing images of the simulations from chapter 5 and selected solutions to the chapter exercises. Some examples of Python code used to generate figures in the text have been posted at the authors' personal webpage, piphase.wordpress.com.

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