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Joseph W. Goodman: Speckle Phenomena in Optics: Theory and Applications

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This is the age of coherent optics, with coherent sources, available from the microwave to the x-ray region of the spectrum, in daily use everywhere. Virtually synonymous with coherence is interference. When a coherent source illuminates an object that is rough on the scale of a wavelength, as most objects are, the interference of the many partial waves in the reflected light, with their random amplitudes and phases, produces the phenomenon known as "speckle": as the name implies, this is a complex pattern of bright and dark areas. Beginning in the nineteen seventies, and continuing unabated up to today, research papers on speckle and its myriad applications have been, and still are, published at an astonishing average rate of more than one a day!

Speckle is here to stay—is it friend or foe? That depends upon how much you know about it, which is where Goodman's book comes in.

Who is this book for? Well, if you want to know not only what optical coherence tomography is and how it works, but also *why* it works, this is the book for you (Chap. 6). If you want to know why your coherent matter-wave Bose-Einstein condensates seem to be developing measles, and what you can do about that, study Chap. 5. If your speckle patterns show what you think are exciting new statistics, and you want to avoid making a fool of yourself in PRL, read Chap. 4 before submitting. This is also the book for you if you want an easily digested short course in statistical optics (for undergraduates use Chaps. 1–3, for graduate students add Chap. 4); if meeting your mortgage payments depends on your getting rid of that pesky clutter in your ground penetrating radar images (read Chap. 7); if the patent office turned down your application for a laser speckle profiler because the examiner couldn't understand your explanation of how it worked (go over Chap. 8); if ... So who is this book for—the simple answer is: who isn't it for?

If you already have Goodman's book on Statistical Optics, and his book on Fourier Optics, and a dozen CDs containing countless original papers on speckle and related phenomena, you might wonder if *you* need this book. Probably not—if you already know and under-

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stand most of the stuff in your collection. But if you don't, and you hope to one day know and understand even just part of that stuff, your best bet is to start with this book.

I knew something about most of the many topics that Goodman discusses, but I cheerfully admit that before reading the book there was an awful lot I didn't know, and even more I didn't understand. One of the great things about *Speckle Phenomena in Optics* is that Goodman carefully explains not only the important what's, but also the why's. If you want to dig deeper, and in many cases you will probably find that you don't need to, there is a bibliography with 183 citations to the most important papers and treatises in the various fields discussed, most citations being introduced in the text with a brief statement of their contents. There are also six appendices containing the heavy math that would otherwise have cluttered up the text, as well as many useful results that would be hard to find elsewhere.

Of course, like any reviewer, I felt I wouldn't be doing my job if I couldn't find something to criticize. Typos are usually good for this, and I did manage to find one in the x-axis label of Fig. 2.4. A more serious criticism is directed at the publisher: the arguments of many exponentials are set in such small type that you might need a magnifying glass to read what is there, as I did. One hopes that this will be corrected in the next edition.

Authors want their books to be timeless, publishers, who have costs to recover, would undoubtedly opt for timely, whereas readers want books that are really useful. *Speckle Phenomena in Optics: Theory and Applications*, with its wonderfully clear first four chapters on fundamentals, and its remaining in-depth four on the most important applications in imaging, holography, metrology, fiber optics, and more, will satisfy everyone.