Preface

This book concerns light as a *moving energy*: the main feature of a *light source* is its power (energy emitted per unit time); the prominent and distinctive characteristic of light (if *quasi-monochromatic*), observed compulsorily on a surface, is its intensity (energy reaching a unit surface per unit time) and for *natural* light is its spectral intensity (energy hitting a unit surface per unit time and per unit frequency). Throughout each chapter these are the dominant and recurring arguments. The emphasis on light (see Appendix 1) as moving energy grants continuity, either it must be considered a wave or the *moving entity* called photon. In addition deliberately no mention has been made to old and new optical technologies. These references seem misleading for students because technologies are a very serious matter (reserved to engineering universities and treated in different textbooks) and cannot be deceptively used as attracting argument to study and understand the basic concepts of Optics.

In the mid-1950s, as a student, and in the first years of 1960s, as a professor, we used a slide rule (an unknown instrument to the present-day students) to do simple calculations. Then cumbersome and enormous calculators (mainframes and minicomputers) appeared and were used as a little more sophisticated tool of calculus and for simpler tasks pocket calculators. Later in 1980s the Personal Computers begin to appear and in 1990s Internet. These are now standard and *universal utilities*. Nevertheless textbooks propose scientific problems for students as if the only available calculus instrument is a pocket calculator.

In this book MATLAB (a trademak of MathWorks) is used. Someone can rightly use another equivalent program: it is a choice the author has to do. But MATLAB or an equivalent program *is a must*. Without this tool the book wouldn't appear as it is. In many circumstances it has been an unyielding and implacable corrector of some substantial or material mistakes or oversights.

With this tool finding roots of equations, solving differential equations, determining the value of an integral with integrand function of real or complex arguments, mastering matrix calculus, plotting and other current subjects of numerical mathematics become a real affordable task for a student.

As example, relevant to our book, consider the *reference to untraceable tables* to find values of the Bessel (1784-1846) integrals used by Airy (1801-1892) to define diffraction for a circular aperture or values of Fresnel (1788-1827) integrals used by Cornu (1841-1902) to plot in a complex plane a spiral. Both arguments seem *nebulous* to students. These eminent scientists excellently used the available tools of their times. Now we have the chance to do a better choice.

In the book appear *only the results* of a long list of MATLAB scripts. Their presence in the book would double the number of pages and confuse, with necessary links, the linear sequence of the content. However readers can refer to scripts using a complementary virtual booklet (www.optics-as.com) that will also include corrections, to unavoidable errors present in this book, supplementary problems, and readers' suggestions.

Usually a list of problems is included at the end of each chapter of a Physics textbook and answers are given to some of them. This position is an indicator of their ancillary condition versus academic lessons. In science the experimental observation is the starting point for theory; so in the educational process the problems would introduce professorial lectures. The book is an attempt to give prior focus to problems in order to seize and firmly hold the basic concepts underlying them. Therefore a teacher,

using this textbook, can explain and extend the contents of introductions to the main laws present in each chapter (adding some demonstrations, if necessary) meanwhile the problems are discussed and resolved.

Who are we indebted to? Mainly to a long list of students we have encountered in the last forty years and of scientists (their names are the titles of a large number of problems) who, investigating Optics in the last three centuries, have given us a wealth of knowledge about light.

Special thanks must be expressed to Professor Mauro Castellani for his invaluable help to accomplish this project.