Preface

Optical components-based instruments play a fundamental role in the scientific and technological advances of our time. We need to consider only a few examples, ranging from the most ordinary to the most complex. All of us have used a camera or a camcorder. The reading of bar codes by optical detection, with the aid of lasers, is commonplace in shops. Likewise, we use optical writing and reading on compact disks. Measurements and controls in industry are always carried out through spectroscopic methods. The telescope is essential in the observation of celestial bodies, and has allowed us to verify hypotheses related to our solar system. The instruments recently sent into space allow us to view our universe at distances that seemed impossible to achieve a few decades ago. The microscope has triggered an equally great revolution in biology and medicine, opening up vast new horizons in these fields, in diagnosis as well as treatment. The camera allowed for far more objective observation of the world than with the naked eye. These brief considerations allow us to understand the immensely important role played by optics in instruments for our view and our current conception of the world. These instruments are absolutely indispensable for a modern and objective view of reality.

In the current work, the basics necessary for the understanding of optics-based instruments and systems are provided, along with some concrete examples of realization and development. The objective is to allow students, scientists and non-specialists in optics to better comprehend the wealth of physical phenomena which govern these instruments and to make optimal use of them. With this goal in mind, we will look at the principles being applied, as well as practical aspects. The description of photographic systems as well as the huge developments in microscopy will illustrate recent evolutions. In this volume we will limit ourselves to ultraviolet, visible and near infrared domains.

An optical instrument is generally made up of several different *optical systems* (for example, the objectives and eyepieces when the detector functions as the eye) or

of other elements such as gratings or interferometers. Images in color are recorded, processed and analyzed. To understand the function of these systems one must first grasp certain essential concepts.

Chapter 1 focuses on the importance of optics in modern devices and instruments.

Chapter 2 reviews the basics of geometric optics, the main approach to optics in instruments.

Chapter 3 is dedicated to elements of photometry and to the consideration of the flux of transported energy. Many instruments use interferometry and diffraction-based techniques. The reader can, if need be, refer to books specialized in "Optical Physics".

The role of the source of light, external or internal to the system, depends strongly on the intended function of the instrument. The most commonly used light sources are summed up in Chapter 4.

Chapter 5 focuses on the characterization of a color, its representation, and its restoration.

Chapter 6 focuses on the methods used to improve the quality of the obtained image thereby obtaining as much information as possible from it.

Chapters 7 and 8 deal with examples of modern industrial systems.

In the final chapter, we will consider the example of the evolution of microscopy, from classic microscopy to modern microscopy.

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