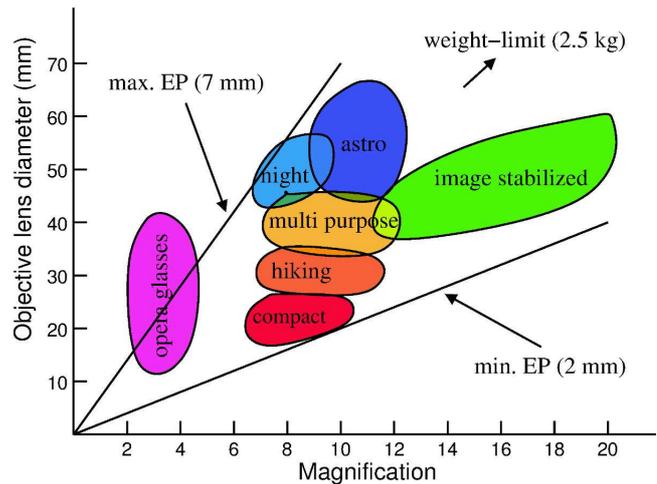


# 1 Introduction

This book covers the technology, performance and application of handheld binoculars. The author follows genuine interdisciplinary approaches, attempting to build bridges between widely separated fields like technical optics, physiology of the eye, and human perception. *The first paradigm of this book is thus:* binocular observation is best interpreted as a technically supported perception process, hence a prime example for a man-machine interaction.

Handheld binoculars span a magnification range between 2x and 20x, as well as objective lens diameters between 15mm–70mm. These parameter ranges aren't accidental: Limiting factors are the diameter of the eye pupil, which – depending on ambient light – varies in size between 2mm and 7mm, and the human muscular system, which is posing limits to magnification (about 12x) and weight (about 2.5kg) of a device that can be handheld without substantial loss in resolution, due to muscle tremor and fatigue. Image stabilization techniques enable the user to extend the magnification range into values of up to 20x.

This book begins with a relaxed and un-formal discussion of binoculars, their origin and evolution, as well as their typical technical characteristics and quirks. To the reader who is less familiar with these instruments, this part offers a welcome warm up and helpful background, before he is going to dive into the following, rather technical chapters. A deeper understanding of the function of binoculars would be impossible without knowledge about the physics and technology of optical imaging. This is offered in Chapter 3, in which, however, no attempt is made to provide an exhaustive discussion of technical optics. Instead, following the paradigm of our interdisciplinary approach, a rather intuitive



## 1.1

### Handheld binoculars and their common fields of application.

presentation of the process of image formation and the associated errors, based on simple but solvable ray-tracing exercises, is carried out.

In the following two chapters about the telescope and various technical solutions to the problem of image erection, the basic components of binoculars are discussed in great detail. Issues that are absent in common textbooks, such as the depth of field or the p-coating of roof prisms, are addressed as well as the newly invented Perger-prism (a contribution to this book by its inventor, Dr. Andreas Perger), or the recently developed high-transmission glasses by Schott. In Chapter 6, the synthesis of the previous technical chapters is carried out. All components of a binocular are analyzed in terms of their mutual interactions, and simple analytical formula allow the reader to arrive at approximate numbers for