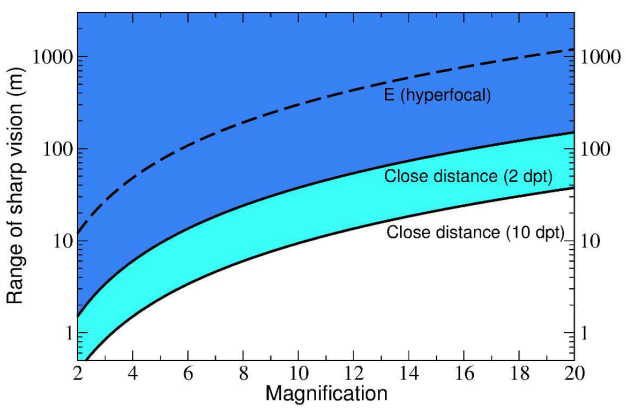
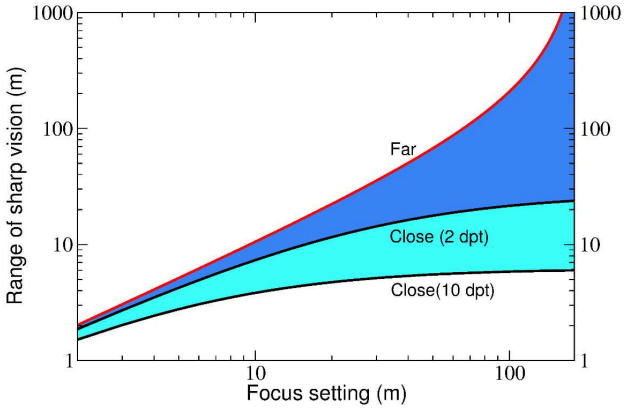


10.16

In-focus areas of binoculars that are focused onto the hyperfocal distance (dashed curve), as a function of magnification. All objects between the minimum distance and infinity appear in focus, and the former depends on the accommodation width of the observer, as demonstrated for a young observer with $\delta_{\text{akk}} = 10\text{dpt}$ and an elder observer with $\delta_{\text{akk}} = 2\text{dpt}$. Further assumed is an effective exit pupil of $d' = 3\text{mm}$ diameter.



10.17

Ranges of objects that appear sharp, as a function of the instrument's distance setting, at 8x magnification. The far distance limit (red curve) does not depend on the accommodation width of the observer, while the close distance point varies significantly with δ_{acc} (i.e. observer's age). The hyperfocal distance, beyond which the depth of field extends to infinity, is at 192m.

Finally, we have to generalize these arguments to any distance setting of the binocular – the user will obviously focus onto an object of arbitrary distance, with dramatic consequences for the respective ranges of distances that are in focus. Actually, this generalization is easier than it seems: Whenever a binocular's focus is set to a certain distance, then the virtual images of objects at the same distance are at infinity. Due to the tolerable circle of confusion, there exists a certain margin »beyond infinity« which still appears sharp, and the accommodation width of the eye is unaffected by the distance setting, thus adding a certain range of distances in front of that object that can be accommodated on. Using the depth scale m^2, we then simply have to translate the virtual distances into object space. This leads to the range of

$$\frac{m^2}{\delta_{\text{acc}} + \dfrac{m^2}{E_{\text{foc}}} + \dfrac{1}{d'}} < E < \frac{m^2}{\dfrac{m^2}{E_{\text{fok}}} - \dfrac{1}{d'}} \,, \quad (10.40)$$

in which objects appear in focus, if the binocular is focused on the distance E_{foc}. Figure 10.17 displays the ranges of objects in focus, calculated for a magnification of 8x and an effective exit pupil of $d' = 3\text{mm}$, as a function of E_{foc}. At close distances, the depth of field is turning very narrow, and once again, the minimum distance depends strongly on the accommodation range of the observer. The far distance (red curve) does not depend on δ_{acc}, and runs toward infinity when the binocular's distance setting approaches the hyperfocal distance.