

Homework One

Joseph Ellis

February 5, 2013

1 PROBLEM NUMBER ONE

1.1 PART 1

This graph represents the focus difference as a function of the object distance from the focal length of the lens. For Figure 1.1, the following values were used in creation of the figure: $f = 100$, and z_i ranges from 105 – 150. The actual units of the values are the same throughout and are not important to the calculations.

1.2 PART 2

For this problem we calculated the depth of the field as a function of image distance from the lens. The values used to create Figure 1.2 are as follows: $z_0 = 100$, $f = 50$, $d = 100$, and the graph below depicts the blur when the image is between 80 and 120. The allowable confusion circle depicted on the graph is equal to 15. The actual units of the values are the same throughout and are not important to the calculations.

1.3 PART 3

In this problem we attempted to recreate the depth of field lines seen on a camera with variable focus. These lines demonstrate the distance that images can be for a given focus distance and object distance available. In Figure 1.3 the diameter of the lens was set to 4 and the allowable blur circle was .02. The focus distances plotted can be seen in the figure, as well as the object distances for which we found the depth of field.

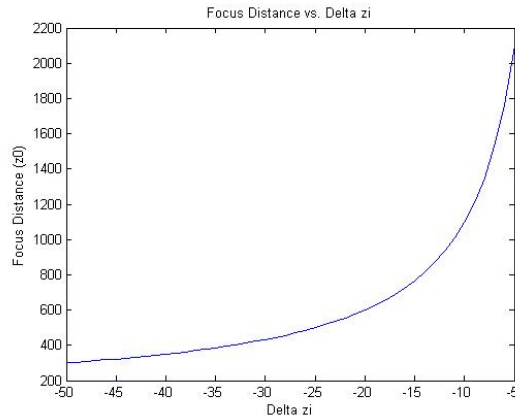


Figure 1.1: Focus Distance vs. $z_i - f$

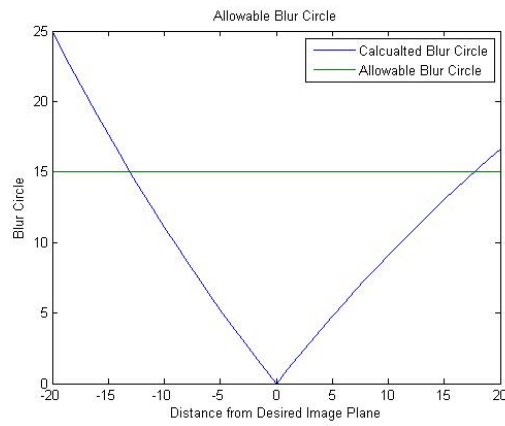


Figure 1.2: Confusion Circle Radius vs. $z_{0prime} - z_0$

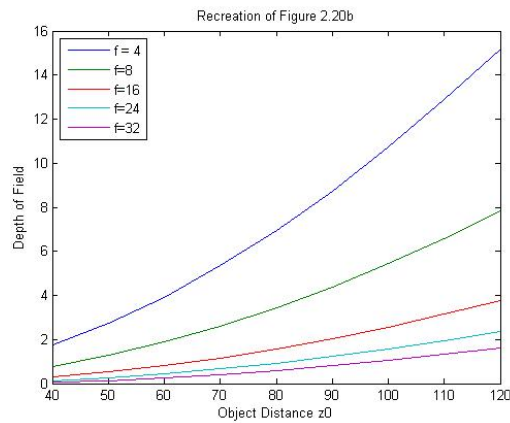


Figure 1.3: Depth of Field vs. Object Distances for a Variety of Focal lengths

2 PROBLEM NUMBER TWO

The derivation of the equation $f^2 = (i - f)(o - f)$ can be seen below.

$$\begin{aligned} f &= \frac{io}{i+o} \\ i - f &= \frac{i}{1} + \frac{io}{i+o} = \frac{(i(i+o) - io)}{i+o} = \frac{i^2}{i+o} \\ o - f &= \frac{o}{1} + \frac{io}{i+o} = \frac{(o(i+o) - io)}{i+o} = \frac{o^2}{i+o} \\ .f^2 &= \left(\frac{io}{i+o}\right)^2 \\ &= \frac{i^2 o^2}{(i+o)^2} \\ &= \frac{(i(i+o) - io)(o(i+o) - io)}{(i+o)^2} \\ &= \frac{(i(i+o) - io)}{i+o} * \frac{(o(i+o) - io)}{i+o} \\ &= (i - f)(o - f) \end{aligned} \tag{2.1}$$

2.1 PROBLEM NUMBER THREE

Please see Matlab Script outputs generated from CVAssignment1.m.

2.2 PROBLEM NUMBER FOUR

This problem was worked out by hand and presented to the Teaching Assistants.

2.3 PROBLEM NUMBER FIVE

This problem was worked out by hand and presented to the Teaching Assistants.