

Handin 2

Marcus Malmquist, marmalm, 941022

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1 Task 1

The beam waist is located at $z = 0$ because that is how I define it. The beam width at $z = z_1$ (which is located at $z = -0.81$) is $296\text{ }\mu\text{m}$.

2 Task 2

The beam width was numerically calculated to be 9.6 mm which is roughly 30 times larger than there theoretical value. The theoretical value is more likely to be correct as it is theoretical (and if not it would just be rubbish). The simulation uses approximations (particularly when calculating the integral) which probaby has a substantial impact on the result.

3 Task 3

It is possible for a more incorrect and random starting field to converge into a the fundamental mode as seen in Figure 1

4 Task 4

The hair appears to turn the fundamental mode into a (0,1)-mode as can be seen in Figure 2 although it does not quite converge after 300 iterations.

5 Task 5

Then hair appears to turn the fundamental mode into a (0,1)-mode as can be seen in Figure 3. Item should be noted that it actually converges and it does so very quickly compared to the setup in Section 4.

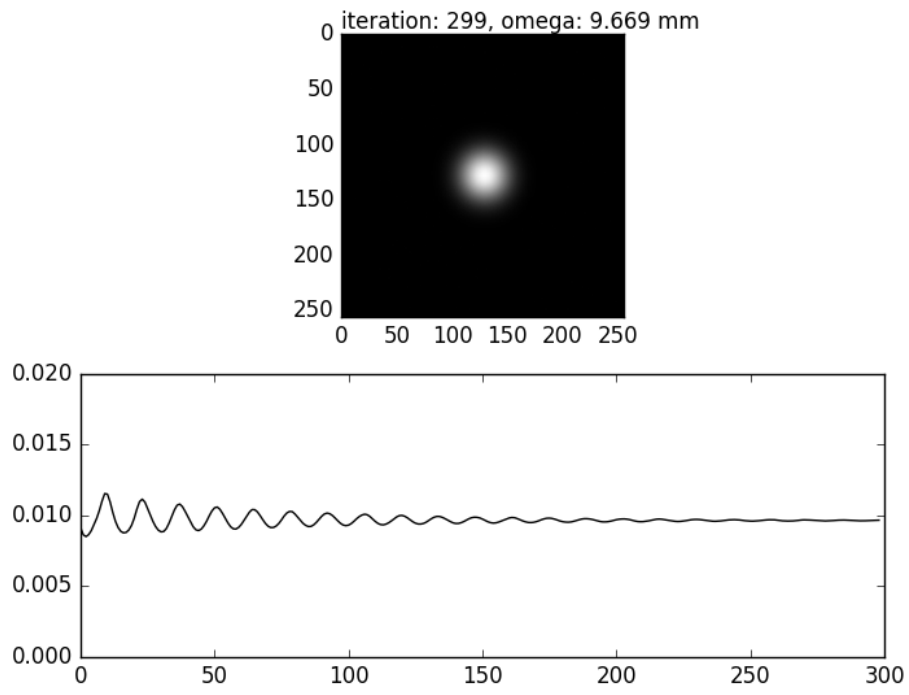


Figure 1: The gaussian beam after 300 iterations (top image) and the e^{-2} radius (bottom graph)

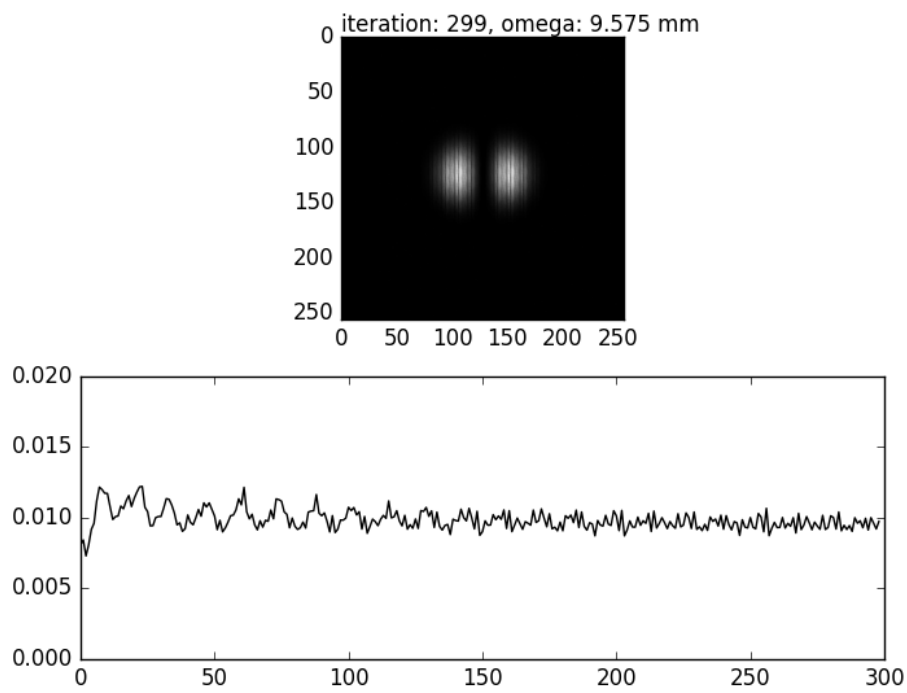


Figure 2: The gaussian beam after 300 iterations (top image) and the e^{-2} radius (bottom graph). The bottom graph should only be used to judge whether or not the beam has converged.

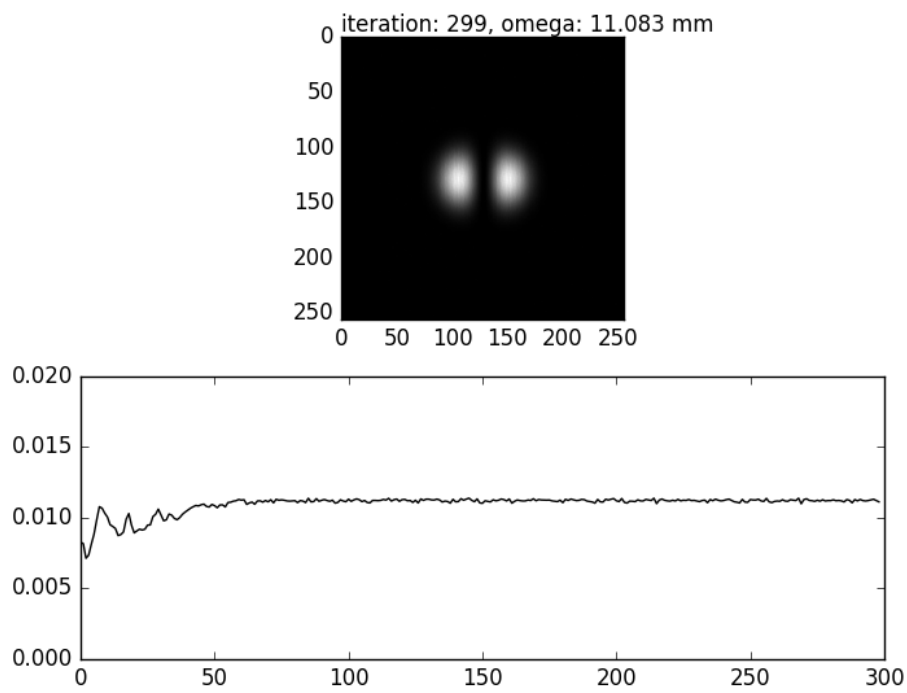


Figure 3: The gaussian beam after 300 iterations (top image) and the e^{-2} radius (bottom graph). The bottom graph should only be used to judge whether or not the beam has converged.

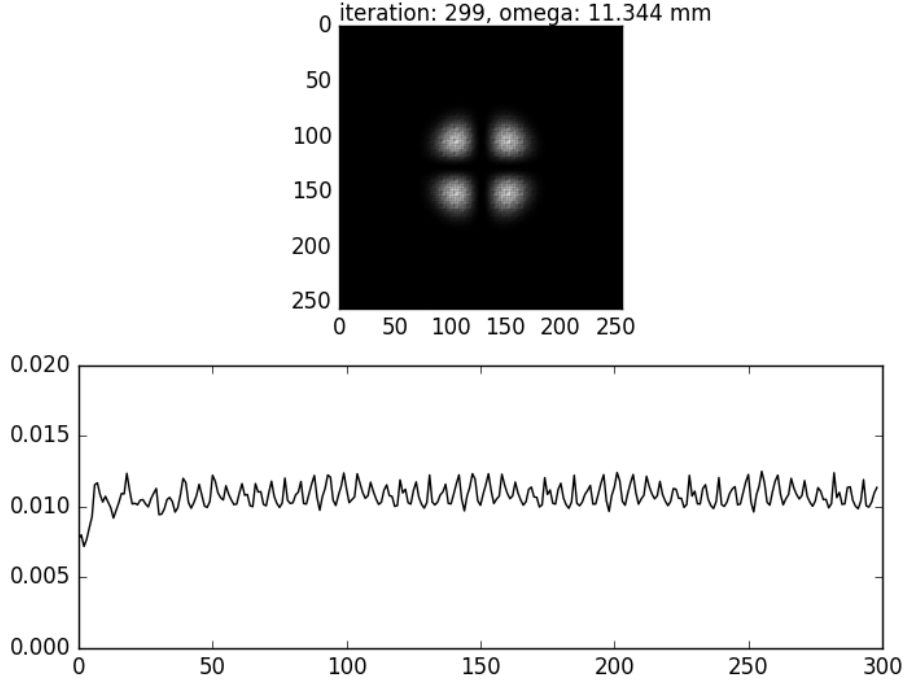


Figure 4: The gaussian beam after 300 iterations (top image) and the e^{-2} radius (bottom graph). The bottom graph should only be used to judge whether or not the beam has converged.

6 Task 6

The hairs appears to turn the fundamental mode into a (1,1)-mode as can be seen in Figure 4 although it does not quite converge after 300 iterations.

7 Task 7

7.1 a

Since we plot the intensity we lose information about the phase, which can cause the field (which has a phase) to look different when compared to the previous roundtrip.

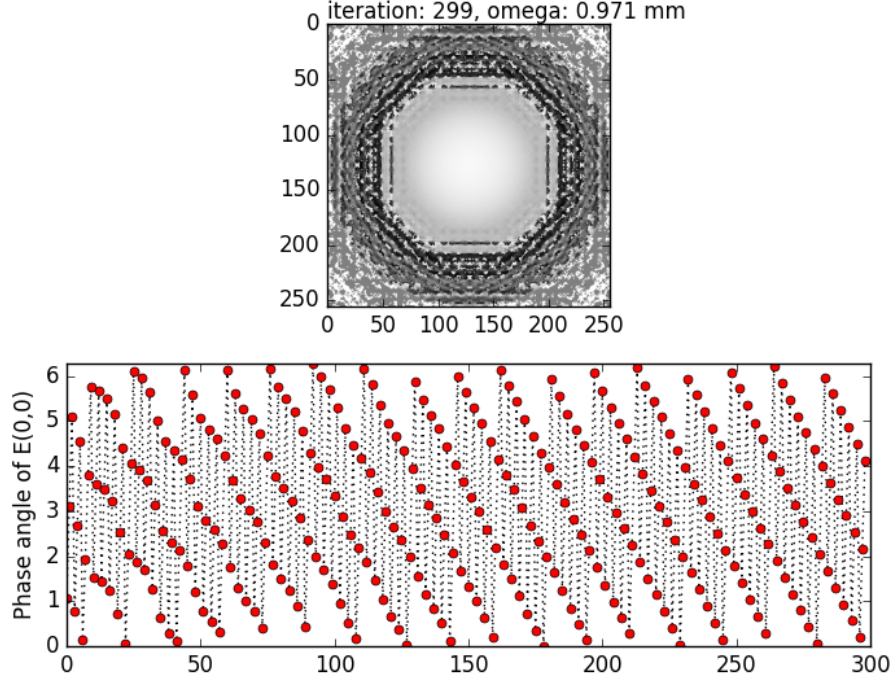


Figure 5: The normalized phase of the gaussian beam after 300 iterations (top image) and the phase of $E(0,0)$ at the left mirror (bottom graph).

7.2 b

Then graph in Figure 5 confirms that the distance traveled in one roundtrip is not a multiple of λ . From the figure it seems that once the beam has converged the phase changes by just over 4π after three roundtrips.

7.3 c

In order to make the phase of the field equal for two consecutive roundtrips one can change the distance between the mirrors slightly in order to make the distance traveled in one roundtrip be a multiple of λ .