

PHYS 512 Assignment 3

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Problem 1

$$z - z_0 = a((x - x_0)^2 + (y - y_0)^2)$$

To have a linear least squares problem, we need to make sure we are linear in terms of the new model parameters. I can rewrite the above as:

$$z = z_0 + a(x_0^2 + y_0^2) + a(x^2 + y^2) - 2ax_0x - 2ay_0y$$

So now the new parameters are:

$$c_0 = z_0 + a(x_0^2 + y_0^2)$$

$$c_1 = a$$

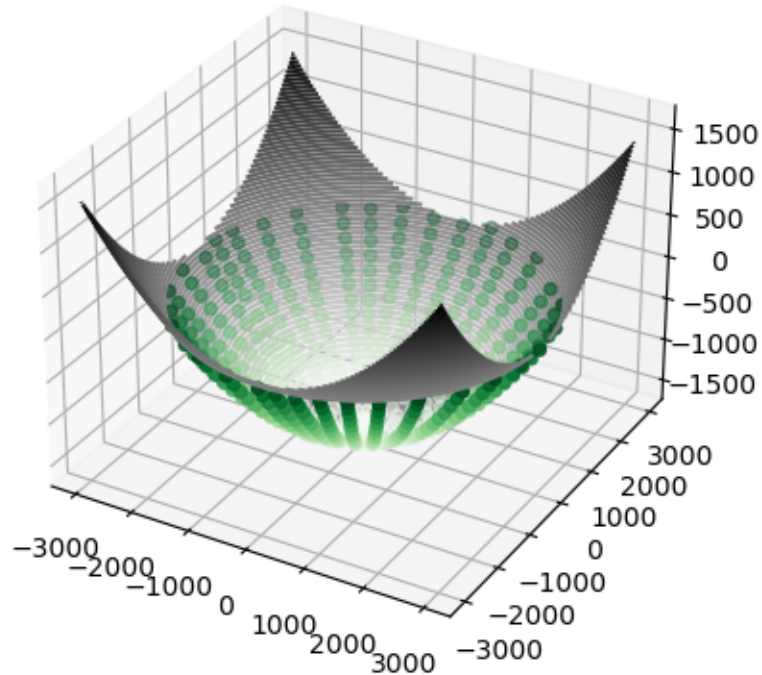
$$c_2 = -2ax_0$$

$$c_3 = 2ay_0$$

Refer to A3_Q1_1.py to get the output:

```
paramter 0 has value -1512.3118166739064 and error 0.3120184362020167
paramter 1 has value 0.00016670445477401347 and error 6.451899757263452e-08
paramter 2 has value 0.00045359902797944066 and error 0.00012506109951270766
paramter 3 has value -0.019411558852635902 and error 0.00011924956427610098
The focal length is 1499.659984125217 with uncertainty 2.321631032757135
```

Note that a is parameter 1. As we can see, the estimated focal length is within the uncertainty of our value. Below I have plotted the model (grey) and the given data values from the text file (greens).



Problem 2

Refer to `A3_Q2_1.py` to get the output:

The chi squared value is 0.0005763944362943763

The data appears to be well fitted until around the 800 marking.

