Assignment1 Report -Mars Module

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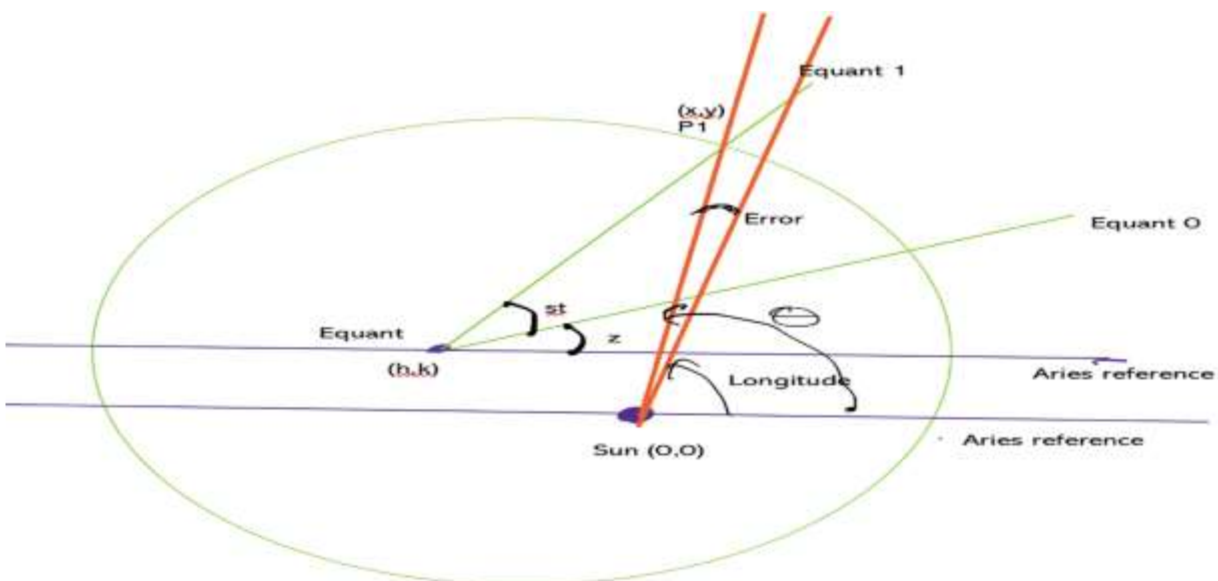


Implementation:

1) Opposition data is loaded and from the date we have obtained Heliocentric longitude by using the following: ZodiacIndex*30 + Degree + Minute/60 + Seconds/3600 (degrees)
2) The opposition parameter has 12x2 dimensions. Each Row has 2 elements
   1)Times: days commenced for each opposition
   2)Longitudinal angles: for each opposition

Q1)

1) Using times and other parameters we first compute the Point of Intersection of dotted line from equant (e1, e2) onto the circle for each time in times.
2) These point of intersection are converted to polar co-ordinates to get the angle subtended by sun-arise.
3) Longitudinal angle is subtracted from the angle we got in previous step to get angular error. We find angular error for each opposition.
4) Finally obtained angular errors and maximum angular error is returned.

Results on parameters

C	R	Z	E1	E2	S	Max Error
28	7.5	73	0.5994	89	0.52	13.23
170	9.0	54	1.400	120.000	0.524	7.30

Q2)

We are given radius of circular orbit r units in sun-centric distance, and angular velocity s in degrees/day. The input given to the *BestOrbitInnerParameter* are r =8.5 and s=0.52.

Straregry: first we do a coarse grid search to find those parameters which lead to least MaxAngularError. Then a find grid search is done around the parameters obtained in previous step, to find the overall least max angular error.

Step1 : Coarse grid search
The range of parameters are decided as follows

C ranges from (50,150) with step size=10
Z ranges from (50,150) with step size=10
e2 ranges from (50,150) with step size=10
e1 ranges from (50,150) with step size=10
for the above parameters, the least max angular error found was 13.1459 degrees for parameters c=200, e1=1.5, e2=110, z=70

step2: **Fine grid search** For the parameters obtained above a grid search is done around those parameters.
For parameters c=135, e1=0.9, e2= 106, z=73, the least max angular error was found to be 12.0394

Q3:

In this question we are given a radius of circular orbit r in units in sun-centric distance and we need to return best s which gives least maximum angular error.

We give r=8 as input to o bestS function.

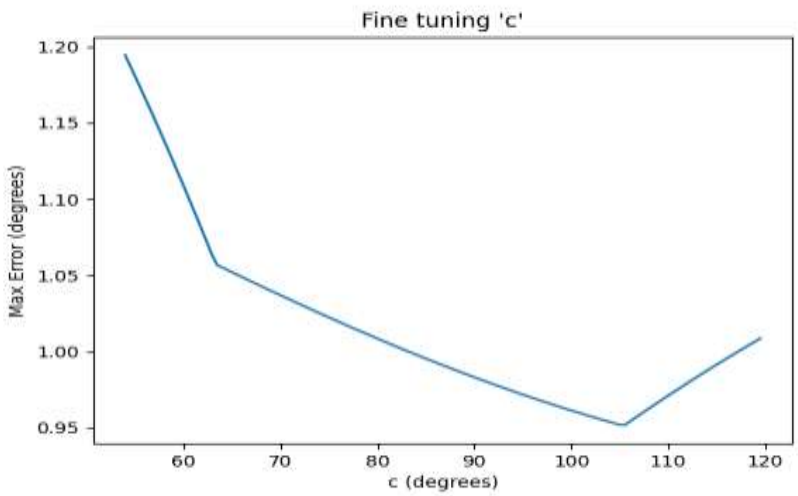
Strategy: the range of s is taken from 350/687 to 370/687. For each s we do 1) Coarse Grid Search, 2) Fine Grid Search.

Coarse Grid Search : Here the range of parameters decided for c, e1, e2, z as same as in Q2.

Fine Grid Search: a fine grid search is done around the parameters obtained from previous step.

Execution time = 1:02:53.728141

Optimal parameters obtained after searching over specified range of s. the least max angular error of 1.194329 degrees was obtained r=8 (given), c=54 e1=1.5, e2=92, z=57, s=0.5240176472489083 further fine tuning was made around c to reduce the error further. At c=105.5 degrees max error got reduced to 0.9517921305329082 from 1.94329 degrees.



Next even more small steps were taken around e1 to check if it produces least max angular error, which indeed produced. For e1= 1.409399999999955, the max error got reduced to 0:8710408305034889 from 0.9517921305329082 degrees.

Q4)

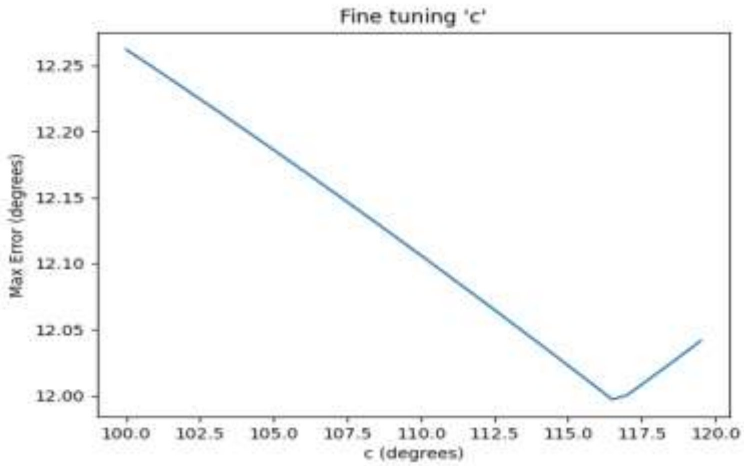
In this question we are given angular velocity s degrees/day and we need to return r which gives the least maximum angular error.

The input give to the bestR is 0.52. Here range for r is taken from 1 to 5 with step size of 0.2. for each value of r in the specifies range we do Coarse Grid search and Fine Grid Search.

Coarse Grid search: Here the range of parameters decided for c, e1, e2, z as same as in Q2**.** We find those parameters which leads to max angular error**.**

Fine Grid Search: A fine grid search is done around the parameters obtained from previous step. With parameters s= 0:52(given), c = 117, e1 =0.6, e2 = 105, z = 72, r = 4:3999, the optimal parameters obtained after searching over specified range of r, the least max angular error of 12.000176 was obtained.

Conclusion: This module provided a good practice on python programming. I was able to learn how to analyze the data. Here I started with a broad set of values of parameters to get the least max angular error. Once I got those parameters I did fine search around those parameters and the error got reduced even further.



Further fine tuning was made around c to reduce max error further, but the error did not reduce by large margin.
For c=116.5. max error got reduced to 11:99694671956815 from 12:000176279434513 degrees.

Q5)

In this question we are given the opposition data and we need to find out the optimal parameters which would give us the least maximum angular error.

Strategy :

Coarse Grid search: Here the range of parameters decided for c, e1, e2, z as same as in Q2**.** We find those parameters which leads to max angular error**.**

The results on coarse grid search:

r	s	c	e1	e2	z	MaxError(degrees)	Execution time
2.2	0.524017	60	0.3	90	60	3.470986	7:58:32.225407

Fine Grid Search: A fine grid search is done around the parameters obtained from previous step.

r	s	c	e1	e2	z	MaxError(degrees)	Execution time
4.9	0.524017	64	0.9	94	57	1.525212	0:09:59.186319