Locus Algorithm

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26 April, 2019

Example Implementation of the Locus Algorithm

To illustrate the workings of the Locus Algorithm, a worked example is given here. The star with SDSS ID 1237680117417115655 (RA = 346.65 and DEC = -5.04) is used as the example. This star has SDSS magnitudes as given in the table below.

Band	SDSS_Magnitude
u	17.20
g	15.38
r	14.65
i	14.40
z	14.28

The telescope system considered has parameters given in the table below:

Parameters	Values
Field of View in minutes	10.00
Resolution Limit in minutes	0.18
Dynamic Range in magnitudes	2.00

Within this field of view, SDSS records 1345 separate objects. Of these, a total of 15 pass the filters that limit colour difference between the target and the reference to be less than 0.1 mags and for the purpose of dynamic range the difference in r band magnitude between the target and the potential reference to be less than 2. Next, potential reference stars are checked for crowding. If there is another object in SDSS that is 5 magnitudes greater than the potential reference or brighter within the resolution limit of the telescope system (11 arc seconds), then this potential reference will be removed from consideration. After this check, there remains 14 potential references. After checking different fields of view, a pointing with RA = 346.65 and DEC = -5.12 included both the target and 7 reference stars. These numbers are presented in the table below.

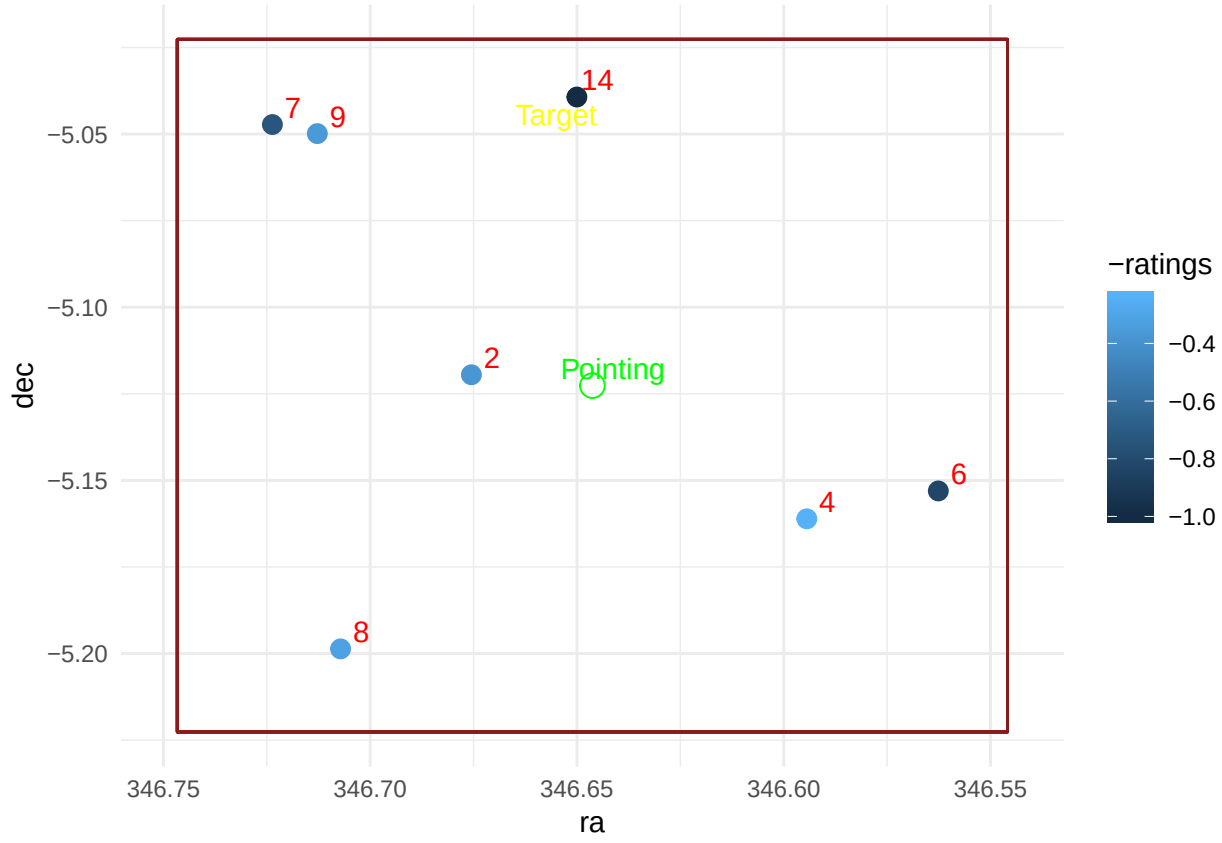
filters	numbers
Objects Potentially in the Field of View	1345
Correct Colour and Magnitude	15
Not Crowded	14
In Final Field of View	7

The SQL query to download potential reference stars from SDSS is given below. This SQL query is run on the CAS database, release DR15, of SDSS. Note the flags to give clean photometry (Aguado et al. (2018))

```
SELECT objID, ra, dec, psfmag_u, psfmag_g, psfmag_r, psfmag_i, psfmag_z
FROM photoObj
WHERE (ra between ( 346.48270496969 ) AND ( 346.817331746246 )
OR ra BETWEEN ( 706.48270496969 ) AND ( 706.817331746246 )
OR ra BETWEEN ( -13.5172950303096 ) AND ( -13.1826682537544 ))
AND dec BETWEEN ( -5.20597532982638 ) AND ( -4.87264199649304 )
AND psfmag_r BETWEEN 12.64849 AND 16.64849
AND (psfmag_g - psfmag_r) BETWEEN ( 0.633989999999999 ) AND ( 0.833989999999999 )
AND (psfmag_r - psfmag_i) BETWEEN ( 0.149080000000001 ) AND ( 0.349080000000001 )
AND clean = 1
AND (calibStatus_r & 1) != 0
```

A table with the reference stars in the final field of view is given below:

objID	ra	dec	psfmag_u	psfmag_g	psfmag_r	psfmag_i	psfmag_z	ratings
1237680117417050120	346.563	-5.153	18.460	16.498	15.771	15.533	15.397	0.830
1237680117417050133	346.594	-5.161	16.702	14.825	14.068	13.887	13.648	0.241
1237680117417115655	346.650	-5.039	17.199	15.382	14.648	14.399	14.281	1.000
1237680117417115762	346.676	-5.120	18.920	17.022	16.282	15.974	15.851	0.380
1237680065348435996	346.707	-5.199	16.704	14.699	13.905	13.676	13.515	0.322
1237680117417115683	346.713	-5.050	17.585	15.782	15.109	14.867	14.798	0.361
1237680117417115692	346.724	-5.047	18.362	16.576	15.843	15.568	15.464	0.734



References

Aguado, D. S., Romina Ahumada, Andres Almeida, Scott F. Anderson, Brett H. Andrews, Borja Anguiano, Erik Aquino Ortiz, et al. 2018. "The Fifteenth Data Release of the Sloan Digital Sky Surveys: First Release of MaNGA Derived Quantities, Data Visualization Tools and Stellar Library," December. https://doi.org/10.3847/1538-4365/aaf651.