

Road to Magnitude Determination using IRAF/PyRAF (**Part 2**)¹

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¹Proposed workflow

Catatan

Pada tahap ini, semua data, baik bintang standar maupun target sudah harus memiliki magnitudo instrumen. Secara umum, langkah–langkah yang dilakukan adalah sbb:

- Bintang standar
 - ① buat *image set* (.imset) → sembarang editor
 - ② buat *observation file* (.obs) → mknobsfile (bukan mkobsfile)
 - ③ edit file .obs yang dihasilkan: nama bintang harus sesuai dengan katalog yang dipakai (misal katalog landolt)
 - ④ buat *config file* (.cfg) → mkconfig
 - ⑤ lakukan fitting parameter (.ans) → fitparams
- Bintang target
 - ① copy file .cfg dan .ans dari proses di atas ke folder kerja
 - ② edit file .cfg (jika diperlukan) untuk mengatasi jumlah variabel yang lebih banyak daripada jumlah persamaan transformasi
 - ③ buat *image set* (.imset) → sembarang editor
 - ④ buat *observation file* (.obs) → mkobsfile (tanpa huruf n)
 - ⑤ lakukan *invert fit* untuk dapatkan hasil (.ans) → invertfit

Bintang standar

(1) pembuatan .imset untuk bintang standar

buat file dengan sembarang editor dengan format kolom:

nama : filter #1 filter #2 filter #3 dst ...

contoh: bintang standar pada SA 112 dengan urutan filter I, R, V

```
stdstars (-/DATA/2017080203/reduced/std.solved/shortname)
+  stdstars
1 112 : sa112-10-I-193715a.fit sa112-10-R-190538a.fit sa112-10-V-183557a.fit
2 112 : sa112-10-I-202618a.fit sa112-10-R-200835a.fit sa112-10-V-195525a.fit
3 112 : sa112-10-I-211024a.fit sa112-10-R-205429a.fit sa112-10-V-204037a.fit
4 112 : sa112-1-I-191629a.fit sa112-1-R-184944a.fit sa112-1-V-174615a.fit
5 112 : sa112-1-I-192119a.fit sa112-1-R-185501a.fit sa112-1-V-183023a.fit
6 112 : sa112-1-I-193001a.fit sa112-1-R-190019a.fit sa112-1-V-195111a.fit
7 112 : sa112-1-I-201906a.fit sa112-1-R-200423a.fit sa112-1-V-203625a.fit
8 112 : sa112-1-I-210310a.fit sa112-1-R-205016a.fit INDEF
9 112 : sa112-2-I-193109a.fit sa112-2-R-190112a.fit sa112-2-V-183117a.fit
10 112 : sa112-2-I-202014a.fit sa112-2-R-200511a.fit sa112-2-V-195157a.fit
11 112 : sa112-2-I-210417a.fit sa112-2-R-205103a.fit sa112-2-V-203711a.fit
12 112 : sa112-3-I-193154a.fit sa112-3-R-190145a.fit sa112-3-V-183153a.fit
13 112 : sa112-3-I-202100a.fit sa112-3-R-200536a.fit sa112-3-V-195224a.fit
14 112 : sa112-3-I-210503a.fit sa112-3-R-205128a.fit sa112-3-V-203737a.fit
15 112 : sa112-4-I-193239a.fit sa112-4-R-190221a.fit sa112-4-V-183231a.fit
16 112 : sa112-4-I-202145a.fit sa112-4-R-200602a.fit sa112-4-V-195250a.fit
17 112 : sa112-4-I-210549a.fit sa112-4-R-205154a.fit sa112-4-V-203803a.fit
18 112 : sa112-5-I-193325a.fit sa112-5-R-190254a.fit sa112-5-V-183305a.fit
19 112 : sa112-5-I-202231a.fit sa112-5-R-200628a.fit sa112-5-V-195316a.fit
20 112 : sa112-5-I-210634a.fit sa112-5-R-205220a.fit sa112-5-V-203828a.fit
21 112 : sa112-6-I-193411a.fit sa112-6-R-190326a.fit sa112-6-V-183340a.fit
22 112 : sa112-6-I-202316a.fit sa112-6-R-200653a.fit sa112-6-V-195342a.fit
23 112 : sa112-6-I-210720a.fit sa112-6-R-205246a.fit sa112-6-V-203854a.fit
24 112 : sa112-7-I-193457a.fit sa112-7-R-190359a.fit sa112-7-V-183415a.fit
25 112 : sa112-7-I-202401a.fit sa112-7-R-200718a.fit sa112-7-V-195408a.fit
26 112 : sa112-7-I-210805a.fit sa112-7-R-205312a.fit sa112-7-V-203920a.fit
27 112 : sa112-8-I-193543a.fit sa112-8-R-190432a.fit sa112-8-V-183449a.fit
28 112 : sa112-8-I-202447a.fit sa112-8-R-200744a.fit sa112-8-V-195433a.fit
```

Bintang standar

(2) pembuatan .obs untuk bintang standar

--> epar mknobsfile

The screenshot shows the 'MKNOBFILE' dialog box for the PHOTCAL package. The 'Task' is 'MKNOBFILE'. The 'observations' field is highlighted with a red rectangle and contains the text '112.obs'. Other fields include 'photfiles' (set to '*mag 1'), 'idfilters' (set to 'I, R, V'), 'imsets' (set to '112.imset'), 'wrap' (set to 'Yes'), 'obsparams' (empty), 'obscolumns' (set to '2 3 4 5'), 'minmagerr' (set to '0.001'), 'shifts' (empty), 'apercors' (empty), 'aperture' (set to '1'), 'tolerance' (set to '5.0'), 'allfilters' (set to 'No'), 'verify' (set to 'No'), 'verbose' (set to 'No'), and 'mode' (set to 'al').

Field	Value	Description
photfiles	*mag 1	The input list of APPHOT/DAOPHOT databases
idfilters	I, R, V	The list of filter ids
imsets	112.imset	The input image set file
observations	112.obs	The output observations file
(wrap)	<input checked="" type="radio"/> Yes <input type="radio"/> No	Format output file for easy reading ?
(obsparams)		The input observing parameters file
(obscolumns)	2 3 4 5	The format of obsparams
(minmagerr)	0.001	The minimum error magnitude
(shifts)		The input x and y coordinate shifts file
(apercors)		The input aperture corrections file
(aperture)	1	The aperture number of the extracted magnitude
(tolerance)	5.0	The tolerance in pixels for position matching
(allfilters)	<input type="radio"/> Yes <input checked="" type="radio"/> No	Output only objects matched in all filters
(verify)	<input type="radio"/> Yes <input checked="" type="radio"/> No	Verify interactive user input ?
(verbose)	<input checked="" type="radio"/> Yes <input type="radio"/> No	Print status, warning and error messages ?
(mode)	al	

photfiles: isi dengan .mag hasil fotometri bukan

idfilters: urutan harus sama dengan format dalam .imset

imsets: sesuaikan dengan nama file .imset

observations: nama file keluaran .obs

Bintang standar

(3) edit file .obs bintang standar

Nama bintang sesuai katalog landolt terlihat sbb:

112_595	20:41:18.48	+00:16:28.4	11.352	1.601	1.993
112_704	20:42:02.05	+00:19:07.6	11.452	1.536	1.742
112_223	20:42:14.57	+00:09:00.0	11.424	0.454	0.010
112_250	20:42:26.34	+00:07:41.8	12.095	0.532	-0.025
112_275	20:42:35.42	+00:07:20.8	9.905	1.210	1.299
112_805	20:42:46.73	+00:16:07.9	12.086	0.152	0.150
112_822	20:42:54.92	+00:15:02.6	11.549	1.031	0.883

maka edit nama bintang sesuai dengan bintang yang dipilih.

#	FIELD	FILTER	OTIME	AIRMASS	XCENTER	YCENTER	MAG	MERR
4	112_1	I	19:37:15.0	1.692	1015.311	750.855	15.299	0.003
5	*	R	19:05:38.0	1.438	1015.267	750.848	14.368	0.003
6	*	V	18:35:58.0	1.280	1015.298	750.925	14.818	0.003
7	112_2	I	19:37:15.0	1.692	999.924	657.480	18.026	0.015
8	*	R	19:05:38.0	1.438	999.980	657.409	16.832	0.015
9	*	V	18:35:58.0	1.280	999.925	657.531	16.941	0.014
10	112_3	I	19:37:15.0	1.692	946.718	535.667	17.448	0.010
11	*	R	19:05:38.0	1.438	946.808	535.613	16.204	0.008
12	*	V	18:35:58.0	1.280	946.749	535.698	16.288	0.009
13	112_4	I	19:37:15.0	1.692	697.125	952.321	17.071	0.007
14	*	R	19:05:38.0	1.438	697.094	952.235	16.065	0.008
15	*	V	18:35:58.0	1.280	697.041	952.328	16.427	0.009
16	112_5	I	19:37:15.0	1.692	651.304	867.973	18.506	0.020
17	*	R	19:05:38.0	1.438	651.309	868.017	17.102	0.018
18	*	V	18:35:58.0	1.280	651.249	868.061	16.938	0.014
19	112_6	I	19:37:15.0	1.692	527.182	406.241	16.446	0.005
20	*	R	19:05:38.0	1.438	527.146	406.043	15.768	0.006
21	*	V	18:35:58.0	1.280	527.230	406.059	16.373	0.009
22	112_1	I	20:26:19.0	2.450	1015.314	750.852	15.244	0.003
23	*	R	20:08:35.0	2.097	1015.282	750.825	14.407	0.002

(a) sebelum editing

#	FIELD	FILTER	OTIME	AIRMASS	XCENTER	YCENTER	MAG	MERR
4	112_275	I	19:37:15.0	1.692	1015.311	750.855	15.299	0.003
5	*	R	19:05:38.0	1.438	1015.267	750.848	14.368	0.003
6	*	V	18:35:58.0	1.280	1015.298	750.925	14.818	0.003
7	112_250	I	19:37:15.0	1.692	999.924	657.480	18.026	0.015
8	*	R	19:05:38.0	1.438	999.980	657.409	16.832	0.015
9	*	V	18:35:58.0	1.280	999.925	657.531	16.941	0.014
10	112_223	I	19:37:15.0	1.692	946.718	535.667	17.448	0.010
11	*	R	19:05:38.0	1.438	946.808	535.613	16.204	0.008
12	*	V	18:35:58.0	1.280	946.749	535.698	16.288	0.009
13	112_822	I	19:37:15.0	1.692	697.125	952.321	17.071	0.007
14	*	R	19:05:38.0	1.438	697.094	952.235	16.065	0.008
15	*	V	18:35:58.0	1.280	697.041	952.328	16.427	0.009
16	112_805	I	19:37:15.0	1.692	651.304	867.973	18.506	0.020

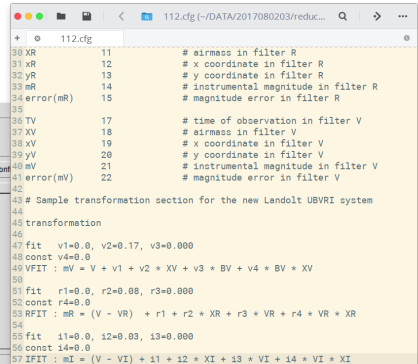
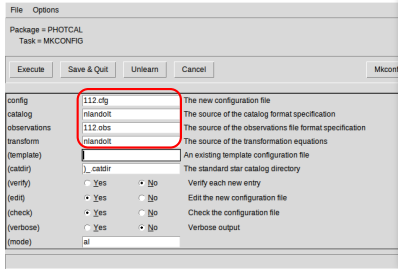
(b) sesudah editing

Bintang standar

(4) pembuatan .cfg bintang standar

--> epar mkconfig

- file .obs yang digunakan adalah file yang sudah diedit pada langkah 3 di atas
- file .cfg yang dihasilkan mengandung persamaan transformasi yang bersesuaian dengan filter yang tersedia



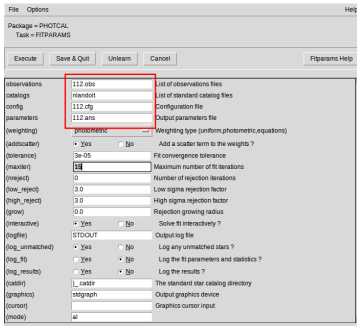
Bintang standar

(5) lakukan fitting parameter

--> epar fitparams

- hasil keluaran (.ans) berupa koefisien transformasi untuk masing-masing filter
- pada file keluaran (lihat gambar kanan), tiga angka pertama pada kotak merah (dari atas ke bawah) memiliki arti:

- 1 koefisien *zero point adjustment*
- 2 koefisien ekstingsi
- 3 koefisien transformasi warna



```
11 msq 0.001216704
12 rms 0.03488129
13 reference mv
14 fitting V+v1+v2*XV+v3*BV+v4*BV*XV
15 weights photometric
16 parameters 4
17 v1 (fit)
18 v2 (fit)
19 v3 (fit)
20 v4 (constant)
21 derivatives 4
22 0.1
23 0.1
24 0.1
25 0.1
26 values 4
27 4.635706
28 0.06089016
29 0.05642562
30 0.
31 errors 4
32 0.009454719
33 0.00407754
34 0.005407352
35 0.
36
37 # Fri 17:43:23 18-Aug-2017
```

Bintang target

(1) copy file .cfg dan .ans bintang standar

(2) edit .cfg jika diperlukan

jika jumlah variabel lebih banyak dari jumlah persamaan, maka IRAF akan memunculkan pesan kesalahan. Masukkan nilai ke salah satu variabel sebagai konstanta (dalam kasus ini BV atau B-V). Nilai ini bisa diperoleh dari publikasi sebelumnya/katalog untuk bintang target yang ditinjau. Lewati langkah ini jika tidak ada pesan kesalahan.

```
7 fit v1=0.0, v2=0.17, v3=0.000
8 const v4=0.0
9 VFIT : mV = V + v1 + v2 * XV + v3 * BV + v4 * BV * XV
10
11 fit r1=0.0, r2=0.08, r3=0.000
12 const r4=0.0
13 RFIT : mR = (V - VR) + r1 + r2 * XR + r3 * VR + r4 * VR * XR
14
15 fit i1=0.0, i2=0.03, i3=0.000
16 const i4=0.0
17 IFIT : mI = (V - VI) + i1 + i2 * XI + i3 * VI + i4 * VI * XI
```

(c) sebelum editing

```
7 fit v1=0.0, v2=0.17, v3=0.000
8 const v4=0.0
9 VFIT : mV = V + v1 + v2 * XV + v3 * (-0.15) + v4 * (-0.15) * XV
10
11 fit r1=0.0, r2=0.08, r3=0.000
12 const r4=0.0
13 RFIT : mR = (V - VR) + r1 + r2 * XR + r3 * VR + r4 * VR * XR
14
15 fit i1=0.0, i2=0.03, i3=0.000
16 const i4=0.0
17 IFIT : mI = (V - VI) + i1 + i2 * XI + i3 * VI + i4 * VI * XI
```

(d) setelah editing

Bintang target

(3) pembuatan file .imset untuk bintang target

format sama seperti sebelumnya.



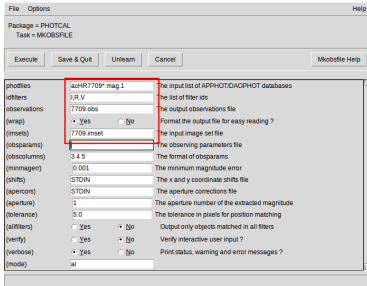
```
+ 112.cfg 112.ans 112.cfg 7709.imset
1 7709 : acHR7709-10-I-01.fts acHR7709-10-R-01.fts acHR7709-10-V-01.fts
2 7709 : acHR7709-10-I-02.fts acHR7709-10-R-02.fts acHR7709-10-V-02.fts
3 7709 : acHR7709-1-I-01.fts acHR7709-10-R-03.fts acHR7709-10-V-03.fts
4 7709 : acHR7709-1-I-02.fts acHR7709-1-R-01.fts acHR7709-1-V-01.fts
5 7709 : acHR7709-1-I-03.fts acHR7709-1-R-02.fts acHR7709-1-V-02.fts
6 7709 : acHR7709-1-I-05.fts acHR7709-1-R-03.fts acHR7709-1-V-03.fts
7 7709 : acHR7709-2-I-01.fts acHR7709-1-R-04.fts acHR7709-1-V-04.fts
8 7709 : acHR7709-2-I-03.fts acHR7709-1-R-05.fts acHR7709-1-V-05.fts
9 7709 : acHR7709-3-I-01.fts acHR7709-2-R-01.fts acHR7709-2-V-01.fts
10 7709 : acHR7709-3-I-03.fts acHR7709-2-R-02.fts acHR7709-2-V-02.fts
11 7709 : acHR7709-4-I-01.fts acHR7709-2-R-03.fts acHR7709-2-V-03.fts
12 7709 : acHR7709-4-I-03.fts acHR7709-3-R-01.fts acHR7709-3-V-01.fts
13 7709 : acHR7709-5-I-01.fts acHR7709-3-R-02.fts acHR7709-3-V-02.fts
14 7709 : acHR7709-5-I-03.fts acHR7709-3-R-03.fts acHR7709-3-V-03.fts
15 7709 : acHR7709-6-I-01.fts acHR7709-4-R-01.fts acHR7709-4-V-01.fts
16 7709 : acHR7709-6-I-03.fts acHR7709-4-R-02.fts acHR7709-4-V-02.fts
17 7709 : acHR7709-7-I-01.fts acHR7709-4-R-03.fts acHR7709-4-V-03.fts
18 7709 : acHR7709-7-I-03.fts acHR7709-5-R-01.fts acHR7709-5-V-01.fts
19 7709 : acHR7709-8-I-01.fts acHR7709-5-R-02.fts acHR7709-5-V-02.fts
20 7709 : acHR7709-8-I-03.fts acHR7709-5-R-03.fts acHR7709-5-V-03.fts
21 7709 : acHR7709-9-I-01.fts acHR7709-6-R-01.fts acHR7709-6-V-01.fts
22 7709 : acHR7709-9-I-03.fts acHR7709-6-R-02.fts acHR7709-6-V-02.fts
```

Bintang target

(4) pembuatan file .obs bintang target

--> epar mkobsfile

Urutan filter harus sama dengan file .imset



(e) parameter mkobsfile

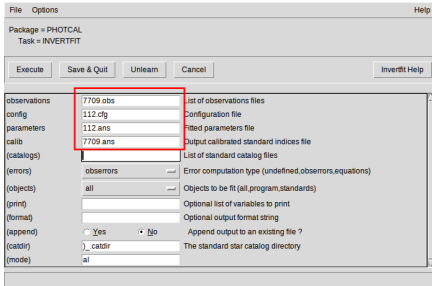
#	FIELD	FILTER	OTIME	AIRMASS	XCENTER	YCENTER	MAG	MERR
1								
2								
3								
4	7709	I	20:30:51.0	2.219	1000.134	654.794	13.262	0.003
5	*	R	20:57:40.0	2.895	1000.508	654.650	11.659	0.003
6	*	V	18:42:10.0	1.242	1000.638	654.530	11.454	0.003
7	7709	I	19:41:45.0	1.593	1000.186	654.770	13.152	0.003
8	*	R	19:08:44.0	1.366	1000.520	654.762	11.512	0.003
9	*	V	20:43:46.0	2.495	1000.844	654.427	11.369	0.003
10	7709	I	19:23:17.0	1.454	1000.283	654.875	13.121	0.003
11	*	R	20:11:44.0	1.913	1000.610	654.889	11.586	0.003
12	*	V	19:58:38.0	1.755	1000.314	654.973	11.273	0.003
13	7709	I	19:48:08.0	1.579	1000.311	654.887	13.172	0.003
14	*	R	18:56:38.0	1.304	1000.772	654.742	11.554	0.003
15	*	V	18:25:13.0	1.181	1000.074	655.037	11.124	0.003
16	7709	I	20:29:13.0	2.189	1000.199	654.968	13.204	0.003
17	*	R	19:07:42.0	1.360	1000.663	654.701	11.514	0.003
18	*	V	18:39:45.0	1.232	1000.506	655.176	11.231	0.002
19	7709	I	19:18:05.0	1.420	1000.332	655.009	13.134	0.008
20	*	R	20:10:46.0	1.908	1000.442	654.928	11.526	0.003
21	*	V	19:57:37.0	1.743	1000.770	654.831	11.210	0.002
22	7709	I	20:29:24.0	2.192	1000.295	655.254	13.288	0.003

(f) isi file .obs bintang target

Bintang target

(5) melakukan inverse fitting untuk mendapatkan magnitudo standar bintang target

--> epar invertfit



The screenshot shows the terminal output of the INVERTFIT process. The output is a table with 7 columns: object id, V, error(V), VR, error(VR), VI, and error(VI). The table contains 10 rows of data, with the first row being the column headers and the subsequent 9 rows being the data for the target star 7709.

10 # Columns:	11 # 1	12 # 2	13 # 3	14 # 4	15 # 5	16 # 6	17 # 7
	object id	V	error(V)	VR	error(VR)	VI	error(VI)
20	7709	6.751	0.003	0.196	0.005	0.060	0.004
21	7709	6.590	0.003	0.111	0.005	0.020	0.004
22	7709	6.539	0.003	-0.012	0.005	0.002	0.004
23	7709	6.425	0.003	-0.135	0.005	-0.164	0.004
24	7709	6.529	0.002	0.037	0.004	-0.103	0.004
25	7709	6.477	0.002	-0.015	0.004	-0.072	0.008
26	7709	6.525	0.003	-0.118	0.005	-0.189	0.004
27	7709	6.441	0.002	-0.193	0.004	-0.159	0.004
28	7709	6.534	0.002	0.049	0.004	-0.151	0.004
29	7709	6.571	0.003	-0.007	0.005	-0.065	0.004
30	7709	6.577	0.002	0.011	0.004	-0.122	0.004