

IRAF

CCD

2003. 6.

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1.

IRAF CCD
CCD

Unix

가

IRAF

가

IRAF가

- IRAF : NOAO/IRAF V2.12.1-EXPORT (Mar 25, 2002)
- : BOAO 2k CCD (Nov. 7, 2001)
- 2k48515 - 2k48531 : sky flat
- 2k48532 - 2k48538 : bias
- 2k48563 - 2k48567 : IC 1805 (field 1)
- 2k48578 - 2k48582 : IC 1805 (field 5)
-
- P. Massey, 1997 "A User's Guide to CCD Reductions with IRAF" (ccduser3.ps)
- P. Massey & L.E. Davis, 1992 "A User's Guide to Stellar CCD Photometry with IRAF" (daophot2.ps)

2. (pre-processing)

noao.imred.ccdred

2.1. setinstrument

ccdred

setinstrument

ccdred 가

ccdred EXPTIME
(instrument translation file)

EXPOSURE가 ccdred가 EXPTIME

SUBSET 2

2 가 2

object, flat, dark, bias object flat

가 가 SUBSET 2

subsets

ccdred가

boao2k.dat

	boao2k.dat
	subset filter bias zero

SUBSET FILTER

ccdred가 IMAGETYP "zero" "bias"

```

,          IMAGETYP  "bias"          zero
2          boao2k.ss          .      FILTER
          가
2          SUBSET
가      가

```

	boao2k.ss	
	'U'	U
	'B'	B
	'V'	V
	'R'	R
	'I'	I
	'H'	H

```

setinstrument      가      IRAF      ccddb
$      가

```

setinstrument

cc> setinstrument boao2k site="" dir="" ↵

```

          ccdred      가
subsets      'subsets'      'boao2k.ss'      ":q"

```

```

ccdred      ccdred
ccdproc

```

가

```

① fixpix = y (CCD      .)
          "yes"      fixfile
fixfile = 2kbad.map (      CD      BOAO 2k CCD      )

```

```

② oversca=y (      )
          "yes"      biassec      functio      order
. biassec      CCD      .      interac=yes      order
          interac=no

```

ccdproc . BOAO 2k CCD

prescan (20)	image(2048x2048)	physical overscan (20)	logical overscan (112)
-----------------	------------------	------------------------------	------------------------------

biassec logical overscan (30) .
biassec = [2101:2130,1:2048]
[x1:x2,y1:y2] .)
legendre 16
interac = n
funcio = legendre
order = 16

(interac = yes .)
③ trim = y ()
trim trimsec . BOAO 2k CCD
2048x2048 가 trimsec prescan
overscan ,

trimsec = [21:2068,1:2048]
④ zerocor=y (=)
zerocorrection , (median) (mean)
가 1 ADU
zerocor=y ,

```

                                zerocombine
                                Zero
Zero.fits
zero = Zero

⑤ darkcor=n (
                CCD
                darkcor=y
                CCD
                darkcor=y

dark = Dark

                CCD
                darkcor=n
가

⑥ flatcor=y (
                CCD
                CCD

                subset

flatcor=y

flat = Flat*

                "*"
                flatcombine
                subset
                subset

⑦
                , illumcor=n,
fringecon=n, readcon=n, scancon=n

                ccdproc
                ccdproc eparam

:q ↵

                setinstrument
                ccdred
                가
                가

cc> ccdlist *.fits ↵

```

[unknown] [] 가
setinstrument
. ccdlist

가 .

2.2 (zerocombine)

가

. zerocombine

cc> epar zerocombine ↵

input = ;

output = Zero ; zerocombine . ccdproc

"zero="

combine = median ;

(mean)

(median)

reject = minmax ;

가

가

"none"

ccdtype=zero ;

process=yes ; no

가

yes

delete=no ;

가

nlow = 0

nhigh = 1 ; nlow nhigh reject minmax

가

:q ↵ ;

cc> zerocombine *.fits ↵

ccdproc interac=no

Zero.fits

interac=yes

가

↵ (Enter) 가


```
rdnoise = 7 ; CCD . BOAO 2k CCD 7 e .
gain = 1.8 ; CCD . BOAO 2k CCD 1.8 e/ADU .
:q ↵ ; .
```

```
cc> epar ccdpro ↵
interac = no ; .
```

```
cc> flatcombine *.fits ↵
```

```
FlatB . , FlatU,
display . I
가 . 가
```

2.4

```
Zero.fits Flat*.fits가
ccdproc .
```

```
cc> ccdpro *.fits ↵
```

```
가 가 ccdlist .
```

```
cc> ccdlist *.fits ↵
```

가 [BOTZF]

[BOTZF] B = badpixel correction, O = overscan correction, T = trimming, Z = zero correction, F = flat correction .

```
가 .
imexamine 가
```

```
cc> imren 2k48563 ic1805f1U30s ↵
```

```
IC 1805 F1 U 30 .
가 , 가 .
가 ,
가
```


3. (cosmic ray)

CCD

(point spread function)

가

noao.crutil.cosmicrays

5x5

7x7

가

cosmicrays

fluxratio

가

threshold

. fluxratio

. fluxratio=2

2%

. threshold

. threshold=25

25

cosmicrays

가

가

가

npasses

fluxratio

cosmicrays

cc> crutil ↩

cr> epar cosmicrays ↩

;

threshold = 25.

fluxratio = 2.

npasses = 5.

window = 5

interactive = yes

train = no

:q ↩

cr> cosmicrays ic1805f1U30s ↩

List of cosmic ray replaced output images (optional) (): ↩

ic1805f1U30s - Review parameters for a particular image? (no|yes|NO|YES) (yes):

↩

5x5

fluxratio

,

‘+’

‘x’

fluxratio=2

```

s :
.

d : '+'      'x'
u : 'x'      '+'
r :
t :   가      y      fluxratio
q :

      surface plot 's'      '+'
      fluxratio      't'
fluxratio      'x'
fluxratio      'q'
;

```

cr> cosmicrays ic1805*.fits ↵

List of cosmic ray replaced output images (optional) (): ↵

ic1805f1B10s - Review parameters for a particular image? (no|yes|NO|YES) (yes):

↵

ic1805f1H60s - Review parameters for a particular image? (no|yes|NO|YES) (yes):

NO ↵

```

      fluxratio
cosmicrays      가

```

4. (PSF photometry)

digiphot.daophot . digiphot.apphot
daophot .

4.0.

가

가

. IRAF

가

4.0.1

noao.observatory .

OBSERVAT

cc> noao ↵

no> observatory set boao ↵

Observatory parameters for Bohyunsan Optical Astronomy Observatory

observatory = boao

timezone = -9

altitude = 1124.

latitude = 36:9.887

longitude = 231:1:24.30

name = 'Bohyunsan Optical Astronomy Observatory'

observatory

BOAO

가

observatory task가 boao

noao\$lib/obsdb.dat

4.0.2

astutil.setairmass

airmass

. lpar setairmass

setairmass

가

. BOAO 2k

CCD

가 setairmass가

. setairmass

no> astutil ↵

as> setairmass ic1805*.fits ↵

4.1.

가 가 .

가
가

가 .
IC 1805 UBVIH α PSF
PSF PSF

4.1.1

가

PSF

CCD

① CCD

: BOAO 2k CCD $24\mu m$

1.8m f/8

0.344"

② CCD

: BOAO 2k CCD

55,000 ADU

③ CCD

: BOAO 2k CCD

7 e,

1.8 e/ADU

4.1.2

PSF

가

I

가

I

가

PSF

가

(:

unlearn

unlearn

unlearn

.)

daofind verbose off

가

da> eparam daophot ↵

verbose = no

:q ↵

① centerpars : ()

가 가

'none'

'centroid'가

PSF

centroid

da> unlearn centerpars ↵

da> eparam centerpars ↵

calgorithm = "none"

:q ↵

② datapars :

CCD

da> unlearn datapars ↵

da> eparam datapars ↵

scale = 1. ;

fwhmpsf = ??? ;

sigma = ??? ;

datamin = ??? ;

datamax = 55000 ; BOAO 2k CCD

ccdread = RDNOISE ;

gain = GAIN ;

exposure = EXPTIME ;

airmass = AIRMASS ;

filter = FILTER ;

obstime = UTMIDDLE ; ()

:w i05s.par ↵ ;

:q ↵

. imexamine imhisto, imstat .

FWHM . ds9

imexamine

```

        .
        'r'
        . ,

da> display ic1805f1I05s 1 fil+ ↵
da> imexamine ↵
ds9      ..... r
        (
13.40 14.60 14417 72.97 602.7 7 3.00 3.92 4.47

        가      FWHM      가
        FWHM      가
        5~6      FWHM      FWHM
        datamin

```

```

da> imhisto ic1805f1I05s[601:700,1631:1730] z1=30 z2=120 ↵

```

```

        가      가      10
        datamin = 55

```

```

da> imstat ic1805f1I05s[601:700,1631:1730] lower=60 upper=85 ↵
#      IMAGE      NPIX      MEAN      STDDEV      MIN      MAX
ic1805f1I05s[601:700,1631:1730] 8480 72.98 6.291 60. 85.

, sigma = 6.3
      FWHM, datamin, sigma      PSF

```

③ daopars : PSF

```

da> unlearn daopars ↵
da> eparam daopars ↵
functio = penny1 ; PSF      penny1      penny2
        가      penny
        Gaussian,      Lorentz

```

```

    가 gauss, lorentz, moffat15, moffat25, penny1,
    penny2, auto . " ,
    daophot 가 . auto

varorder = 2 ; PSF , 2 PSF

psfrad = ??? ; . (3~4) * FWHM .
fitrad = ??? ; . 1 * FWHM .
recenter = yes ; .
fitsky = yes ; .
groupsky = no ; group .

sannulu = 2 ; .
wsannul = 10 ; .
:w i05s.dao.par ↵ ; daopars
:q ↵

④ findpars ; daofind
. 4σ . , threshold =
4 . daophot .

⑤ fitskypars ;
. 14" . 7"
BOAO 2k CCD 20.36
. 25
가 100 5 가
가 100

da> unlearn fitskypars ↵
da> eparam fitskypars ↵
salgorithm = mode ; (mode) .
annulus = 25 ;
dannulus = 5 ;
:q ↵

⑥ photpars ;
가 zmag=25
가

```

4.1.3 PSF

①

daofind 가 . daofind

```
da> daofind ic1805f1l05s i05s.coo ↵
```

```
<image name>.coo.1
                                i05s.coo
```

Enter

daofind tvmark

```
da> display ic1805f1l05s 1 fil+ ↵
```

```
da> tvmark 1 i05s.coo mark=circle radii=3 color=205
```

tvmark mark=circle

eparam

tvmark color

202 = black	203 = white	204 = red
205 = green	206 = blue	207 = yellow
208 = cyan	209 = magenta	210 = coral
211 = maroon	212 = orange	213 = khaki
214 = orchid	215 = turquoise	216 = violet
217 = wheat	255 = black	

②

scaling factor \cdot PSF \cdot 1 * FWHM

```
da> phot ic1805f1i05s i05s.coo ic1805f1i05s.ap aper=4.3 ↵
```

ic1805f1i05s.ap가

③ PSF

PSF CCD ,

PSF . PSF

PSF

psf . psf PSF
PSF 가 PSF 가

a) PSF

PSF 가

psf

da> display ic1805f1i05s 1 fil+ ↵

da> psf ic1805f1i05s ic1805f1i05s.ap "" psf.1 pst.1 psg.1 interac+ ↵

ic1805f1i05s : PSF

ic1805f1i05s.ap :

“ ” : PSF , “ ”

psf.1 : PSF (psf.1.fits),

. PSF .

pst.1 : PSF

psg.1 : PSF PSF

interac+ : .

PSF .

- ‘a’ .

- .

- ‘s’ 가 ‘w’

- .

- ‘a’ PSF

- .

- ‘d’ .

- PSF 가 ‘d’

- PSF ‘w’ PSF

- cursor가 ‘q’

- xgterm ‘q’ psf .

b) PSF

PSF allstar . PSF

PSF (psg.1) .

PSF가 .

PSF ,

```

                                . PSF
                                PSF
                                PSF
                                .

```

da> allstar ic1805f1i05s psg.1 psf.1 als.1 rjt.1 sub.1 ↵

```

,
psg.1 :
psf.1 : PSF
als.1 :
rjt.1 :
sub.1.fits :

```

```

PSF PSF pst.1 tvmark
txdump

```

da> txdump pst.1 xc,yc yes > pst.1.coo ↵
da> display sub.1 1 fil+ ↵
da> tvmark 1 pst.1.coo rad=15 color=204 ↵

```

15 PSF 가
,
pst.1

```

da> vi pst.1 ↵

```

(ic1805f1i05s; )
ic1805f1i05s.ap 가
tvmark

```

da> tvmark 1 extra.coo int+ ↵

```

- 가 'a' 가
- 'q'

```

da> phot ic1805f1i05s extra.coo extra.ap aper=4.3 ↵

da> vi ic1805f1i05s.ap ↵

```

:$ ;
:r extra.ap ; extra.ap
75dd ; exrta.ap 75 (comment)
:wq ;

```

da> prenum ic1805f1i05s.ap ↵

c) *PSF*

PSF PSF
PSF
substar

da> substar ic1805f1i05s als.1 pst.1 psf.1 sub1 ↵

als.1 : PSF PSF
pst.1 : PSF (),
psf.1 : PSF
sub1 :

PSF 가

d) *PSF*

a) PSF
PSF 가 , PSF

da> psf sub1 ic1805f1i05s.ap pst.1 psf.2 pst.2 psg.2 interac- ↵

b) - d) allstar PSF 가
PSF 가 PSF
PSF가 PSF , psf.n ic1805f1i05s.psf, pst.n
ic1805f1i05s.pst, psg.n ic1805f1i05s.psg

e) (*aperture correction*)

PSF 가 가
(amplitude)
(zero point)
, PSF

1 * FWHM

$$m = A \exp \left[\frac{(x - x_c)^2}{2\sigma_x^2} + \frac{(y - y_c)^2}{2\sigma_y^2} \right]$$

A

7"

가 .
PSF 7" PSF
PSF
PSF 가
PSF
PSF

```

da> psort pst.n mag ↵ ; PSF
da> txdump als.n xc,yc mag<maglimit > apc.coo ↵
      ; PSF
      ; maglimit = PSF 가
da> phot ic1805f1i05s.sub apc.coo ic1805f1i05s.apc aper=4.3,20.36 ↵
      ; PSF
      ; 1 * FWHM 7" (= 20.36 ) 가
      ic1805f1i05s.apc
      .
      , psf.n, pst.n, psg.n, sub.n.fits,
subn.fits, als.*, rjt.*, apc.coo

```

e) PSF
PSF

```

da> allstar ic1805f1i05s ic1805f1i05s.ap ic1805f1i05s.psf als1.dat rjt1.dat sub1 ↵
      ; als1.dat rjt1.dat , sub1.fits가
da> display sub1 1 fil+ ↵
      ; 가?
da> tvn 1 rem.coo int+ ↵
      ;
da> phot sub1 rem.coo rem.ap aper=4.3 ↵
      ;
da> peak sub1 rem.ap ic1805f1i05s.psf rem.pk rem.rj ↵
      ; PSF peak
      ; peak allstar PSF
      scaling . peak
da> vi als1.dat ↵ ; als1.dat rem.pk 가

```

```

:$ ↵      ;      .
:r rem.pk ↵ ; rem.pk      .
:38dd      ; rem.pk      38 (comment)      .
:wq ↵      ;      .
da> allstar ic1805f1i05s als1.dat ic1805f1i05s.psf als2.dat rjt2.dat sub2 ↵
      ; als1.dat      .
      ; sub2      .
      ;      .

      alsn.dat
      .

```

e)

pexamine 가 .
가 .

da> pexamine alsn.dat out.dat ic1805f1i05s ↵

- hotkey

```

e :      .
q :      .
x :      x-y      . x-y      y      merr, sharpness, chi
      .      x      mag      .
h :      .
d :      .
u :      .
f :      .
^ :      y      가      .
v :      y      가      .
( :      x      가      .
) :      x      가      .
s :      surface plot      . x-y      가      x
      .
r :      radial plot      .
c :      contour plot      .
m :      . imexamine      m      .

pexamine      가      (mag)      (merr)
가      .      merr > 0.3      .      , y      0.3      's'
      .      merr > 0.3      x      .      가      가      's'

```

가 's' 'd' saturation 'f' 'x'

:ycol chi ↵

y chi . chi χ^2 가 가 . χ^2
 $\chi^2 > 2$
 가 surface plot
 가

:ycol sharpness ↵

sharpness ± 1.5
 가
 가 가
 out.dat txdump subimage
 tvmark 가?
 out.dat e) rem.coo
 out.dat ic1805f1i05s.als

da> rename out.dat ic1805f1i05s.als ↵ ;
 da> psort ic1805f1i05s.als yc ↵ ; y
 da> psort ic1805f1i05s.apc yc ↵ ; y

e)

ic1805f1i05s.fits : 가
 ic1805f1i05s.psf.fits : PSF
 ic1805f1i05s.pst : PSF PSF
 ic1805f1i05s.psg : PSF
 ic1805f1i05s.als : PSF
 ic1805f1i05s.apc : PSF

②

```
imexamine imhisto imstat ic1805V05s fwhm, sigma, datamin
. datapars
. ( , v05s.par )
FWHM daopars psfrad fitrad
v05s.dao.par .
```

③ PSF

```
I PSF .
```

5.

5.1

```
PSF txdump . PSF
ID, XC, YC, MAG, MERR,
IFILTER, XAIRMASS, OTIME 가
txdump .
```

5.2

```
PSF .
IRAF photcal .
```


A1.

Landolt

5-6 가 .

phot . PSF

datapars, fitskypars

datamin, fwhm, sigma .

centerpars calgorithm "centroid" . centroid

가

cbox FWHM 2

sa100I05s.fits

da> display sa100I05s 1 fil+ ↵

da> phot sa100I05s "" sa100i05s.ap aper=20.36 int+ ↵

;

가

. aperture photpars.aperture

da> display sa100I05s 1 fil+ ↵

da> tvmark 1 sa100I05s.coo.1 int+ ↵

; 'a'

; 'q'

sa100i05s.coo가

da> phot sa100I05s sa100I05s.coo.1 sa100i05s.ap aper=20.36 ↵

A2. photcal -

가

()

()

IRAF

photcal .

photcal

A2.1

. Landolt

IRAF

```

: photcal$catalogs
: README
Landolt      : landolt.dat  (Landolt, A.U. 1983, AJ 88, 439)
              nlandolt.dat (Landolt, A.U. 1992, AJ 104, 430)

```

```

Landolt
photcal.mkcatalog

```

ph> mkcatalog std.cat ↵

```

;
[a-z,A-Z,0-9,+,-,_,]
[a-z,A-Z,0-9]
, V-I
<EOF>
가
<EOF>
가 vi 가 가
std.cat
fstad.cat.dat

```

A2.2

```

mkcatalog
가
가 , 가
SA100 B V U imset

```

100 : sa100V05s.fits sa100B10s.fits

```

photcal.mknobsfile

```

ph> eparam mknobsfile ↵

```

photfile = *mag* ;
idfilter = U,B,V,I,H ;
imsets = imset ; imset

```

```

observat = ssobs      ;

                ssobs      SA100      ,      ,      ,
,      .      fssobs.dat
                ssobs      .

ssobs      INDEF      .      INDEF
      . mknoobsfile      toleran      10      ,      15
      .

ssobs      ssobs
      가
      fssobs.dat      . (      ,
mU, mB, mV,      XU, XB, XV )

```

A2.3.

가

$$\begin{aligned}
 v &= V + K_V X + \eta_V (B - V) + \zeta_V \\
 b &= B + K_B X + \eta_B (B - V) + \zeta_B \\
 u &= U + K_U X + \eta_B (U - B) + \zeta_U
 \end{aligned}$$

```

mkconfig
v1, v2, v3

```

ph> mkconfig ↵

The new configuration file: boao.cfg ↵

The source of the catalog format specification (STDIN): std.cat ↵

The source of the observations file format specification (STDIN): ssobs ↵

The source of the transformation equations (STDIN): ↵

ENTER THE TRANSFORMATION EQUATIONS

Enter the label and functional form for EQUATION 1

Enter label (e.g. VFIT) (label, ?=help, <EOF>=quit entry): VFIT ↵

Enter equation (equation, equation \ =continue, ?=help, <EOF>=quit entry):

mV = V + v1*XV + v2*BV + v3 ↵

Enter initial values for the parameters to be fit in EQUATION 1

Enter parameter 1 (name value, ?=help, <EOF>=quit entry):v1 0 ↵

Enter parameter 2 (name value, ?=help, <EOF>=quit entry):v2 0 ↵

Enter parameter 3 (name value, ?=help, <EOF>=quit entry):^D

Enter initial values for the parameters to be held constant in EQUATION 1

Enter parameter1 and value (name value, ?=help, <EOF>=quit entry):v3 0 ↵

Enter parameter2 and value (name value, ?=help, <EOF>=quit entry):^D

Enter initial values for the parameters to be fit in EQUATION 1

....

```

vi          가  boao.cfg
.           compilation      Warnings = 0, Errors = 0

```

A2.4.

photcal.fitparams .

ph> fitparams ssobs boao.cfg boao.ans ↵

```

                                     가
.
.      'd'      'f'
.      . X      Y      'w'      'x'      'y'
.      'vshow'
가      -
.      'g'      'k'      "Set graph axis types"      'g'
.      X      Y      BV,residuals      'k'      B-V
.      B-V      가
.      ,
.
.
.

```

boao.ans .

A2.5.

PSF

가 . ,

a)

(V)

imexamine

b)

*.apc 가 .

가 (1*FWHM 20.36)

. 20.36

가

c)

photcal.mkobsfile

`ph> mkobsfile ic1805f1v05s.als,ic1805i05s.als,ic1805b10s.als,ic1805u30s.als` ↵

The list of filter ids : V,I,B,U ↵

The output observations file: `ic1805f1obs` ↵Enter name of image set 1 (name, <EOF>=quit entry) : `f1s` ↵Enter image name 1 (name, <CR>=INDEF) : `ic1805f1V05s` ↵Enter image name 2 (name, <CR>=INDEF) : `ic1805f1I05s` ↵Enter image name 3 (name, <CR>=INDEF) : `ic1805f1B05s` ↵Enter image name 4 (name, <CR>=INDEF) : `ic1805f1U05s` ↵Enter name of image set 2 (name, <EOF>=quit entry) : `^D`

Image set 1 (f1s): Enter the shifts in x and y

Image ic1805f1V05s (xshift yshift, <CR>=0.0 0.0, <EOF>=quit entry): ↵

Image ic1805f1I05s (xshift yshift, <CR>=0.0 0.0, <EOF>=quit entry): `-3.0 2.1` ↵

....

Image set 1 (f1s): Enter the aperture correction

Image ic1805f1V05s (magnitude, <CR>=0.0, <EOF>=quit entry) : `-0.112` ↵

...

Observations file: ic1805f1obs

Image set: f1s 2434 stars written to the observations file

d)

photcal.inverfit

inverfit

evalfit

ph> inverfit ic1805f1obs boao.cfg boao.ans ic1805f1_all.dat ↵

ic1805f1_all.dat

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