

Final Documentation Draft

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1 Introduction

Starting with an image of at most three suns on a fiducial grid, we find the centers of the suns and their relative position to the fiducials (which provide a physical distance calibration). The program deems suns too close to the edge or suns partially cut off as unfit for centering.

2 Introduction cont.

2.1 Program List

1. `defparams`
Reads in parameter table
2. `defsysvarthresh`
Sets thresholds
3. `idsuns`
Identifies shapes in image. For each shape, calculate average value/max and assign region number depending on how bright it is
4. `everysun`
For each shape, find center
5. `quickmask`
Using a mask of pixel values above a threshold, find center of mass of mask
6. `picksun`
Determine if center is too close to edge of image; if so, mark as a partial sun and refrain from further analysis
7. `centroidwholesuns`
Depending on which suns are partial, only limb-fit the whole suns
8. `fourpixfit`
Fit line to a four pixel limb-profile centered around where it crosses a threshold
9. `makeslimlimbstrips`
Make limb strips 4 pixels long
10. `makestrips`
Make strips centered around solar center
11. `para_fid`
Find fiducials in each limb-fitted sun, also use parabolic peak-fitting to calculate sub-pixel positions of fiducials

Has to be a cleaner way of doing this

1. Load Image
2. Read parameters from pblock.txt
3. Sort image and cut off top .1% of pixels (top 1% was actually too much)
4. Smooth, take deriv, smooth again, take deriv again of sorted array, find peaks that correspond to difference solar regions and their thresholds
5. Mask image above thresholds to find centers of every shape, regardless of partial or not
6. If center of shape is within a certain distance to edge of image, mark as partial and cease further analysis

Table 1. Final data structure of solar region

Name	Type	Value	Notes
XPOS	FLOAT	210.522	Rough calculation using a simple masking method
YPOS	FLOAT	166.702	"
REG	INT	1	Region ID #: 1 is 100%, 2 is 50%, 3 is 25%
THRESH	FLOAT	106.000	Threshold calculated from sorting array and taking derivatives.
			Used in both finding rough X-Y center as well as the threshold for limb-fitting.
PARTIAL	FLOAT	0.	Flag that determines if the solar region is cut off on the edge or not.
			0 means that it is not cut off
XSTRIPS	STRUCTURE	-> WHOLEXSTRIPS Array[5]	Structure containing the strips of whole solar data
YSTRIPS	STRUCTURE	-> WHOLEYSTRIPS Array[5]	bound by a cropped region chosen by XPOS and YPOS
LIMBXSTRIPS	STRUCTURE	-> LIMBXSTRIPS Array[5]	"
			LIMBSTRIPS contains a pair of arrays, ENDPOINTS and STARTPOINTS that mark the limbs of each strip of data from X/YSTRIPS
LIMBYSTRIPS	STRUCTURE	-> LIMBYSTRIPS Array[5]	"
LIMBXPOS	FLOAT	210.710	Center calculated from LIMBXSTRIPS
LIMBYPOS	FLOAT	167.172	"
NPIX	FLOAT	26680.0	Number of pixels above threshold

7. Crop remaining whole suns

8. Extract 5 strips centered around cropped solar center for both X and Y direction

9. Extract a pair of limb strips for each long strip

10. Applt linear fit to limb profile

11. Mark position where fit crosses threshold

12. Use new threshold-crossing position to calculate chord lengths

13. Average midpoints of chords to find limb-fitted centers

14. Analyze the cropped image for fiducials

15. Using the fiducial positions, we compare the solar positions we calculated to a position defined by the physical setup.

This is the form of the fiducial structure containing the positions and sub-pixel positions of fiducials for each solar region.

```

1 >> help.*(bbb[0])
2 ** Structure <260a348>, 2 tags, length=180, data length=178, refs=1:
3   REG          INT          1
4   FIDARR       STRUCT  -> FIDPOS Array[11]
5 >> help.*(bbb[0])). fidarr ./ str
6 ** Structure FIDPOS, 4 tags, length=16, data length=16:
7   X            FLOAT       50.0000
8   Y            FLOAT       132.000
9   SUBX         FLOAT       50.8438
10  SUBY         FLOAT       133.291

```

3 Setting Up Parameters

Before we analyze the solar image, we load a parameter table and assign values.

```

1 scan_width 10      ; Distance to next chord when picking chords to limb-fit
2 sundiam 70        ; Approx Solar diameter, deprecated
3 nstrips 5         ; Number of pairs of solar chords to limb-fit per direction
4 ministrip_length 4 ; Length of limb profile to linear fit
5 crop_box 120      ; Half-width of box used to find fiducials in

```

```

6 elim_perc 1 ; Percentage of highest pixels to eliminate when finding threshold
7 n_smooth 900 ; Elements to smooth by when finding threshold
8 soldiskr 60 ; Deprecated
9 border_pad 50 ; If solar center is within this value of border, marked as a partial sun
10 triangle_size .25 ; Percentage of image height to use for triangle sides for making clipped-bottom-corner
    mask
11 fid_smooth_thresh -150 ; Threshold to determine row/column positions of fiducials
12 onedsumthresh 80 ; Once looking at fiducial candidates, look at 1D sum of smaller fiducial crop and
    threshold difference of smoothed array - original array by this
13 disk_brightness 15 ; Arbitrary pixel brightness to eliminate bright fiducial candidates which are on the
    solar disk but are not on a fiducial
14 fid_crop_box 15 ; Half-width of box used to analyze fiducials
15 fid_smooth_candidates 15 ; Smoothing parameter for 1D sums of fiducial candidates

```