ctools - Feature #2207

Add RING background method to ctskymap

10/09/2017 03:26 PM - Knödlseder Jürgen

Status:	Closed	**Start date:**	10/09/2017
Priority:	Normal	**Due date:**	
Assigned To:	Cardenzana Josh	**% Done:**	100%
Category:		**Estimated time:**	0.00 hour
Target version:	1.5.0		

Description

Add ring background method to ctskymap for background subtraction. Add RING option, loop over all sky regions ("pixels") and determine background in a ring, scale by background rate, and subtract

Inputs:

- Source integration radius
- Ring radii (inner & outer), ON region solidangle is 1/7 of OFF region solidangle in H.E.S.S
- Optional exclusion regions

History

#1 - 10/09/2017 03:38 PM - Knödlseder Jürgen

- Assigned To set to Cardenzana Josh

#2 - 10/09/2017 04:12 PM - Cardenzana Josh

- Checklist set to [ ] Add 'RING' option for background subtraction in ctskymap.par, [ ] Update tests, [ ] Implement ring background subtraction method in ctskymap, [ ] Add parameters to define the integration regions for the ROI and background ring

#3 - 10/13/2017 10:57 AM - Cardenzana Josh

- Checklist changed from [ ] Add 'RING' option for background subtraction in ctskymap.par to [x] Add 'RING' option for background subtraction in ctskymap.par

#4 - 10/13/2017 10:57 AM - Cardenzana Josh

- Checklist changed from [ ] Update tests to [x] Update tests

#5 - 10/13/2017 10:57 AM - Cardenzana Josh

- Checklist changed from [ ] Implement ring background subtraction method in ctskymap to [x] Implement ring background subtraction method in ctskymap

#6 - 10/13/2017 10:57 AM - Cardenzana Josh

- Checklist changed from [ ] Add parameters to define the integration regions for the ROI and background ring to [x] Add parameters to define the integration regions for the ROI and background ring

#7 - 10/16/2017 04:09 PM - Cardenzana Josh

- File Significance_Dist.png added

- File ctskymap_RING_bkg_counts.png added

- File ctskymap_RING_bkg_signif.png added

Attached below is a sample image for the ring background subtraction method. The method follows the prescription outlined in Li & Ma (1983) Eq. 17 for computing the bin-by-bin significance. The number of signal events in each bin is computed as "Non - (alpha * Noff)" where Non is the integrated counts inside the ROI radius centered on the bin being analyzed and Noff is the number of events in the ring centered on the bin being analyzed.

There are now 5 new parameters to control this method

- roiradius: Controls the integration region radius (default = 0)
- inradius: Controls the inner radius of the background ring (default = 0.6)
- outradius: Controls the outer radius of the background ring (default = 0.8)
- regfile: User provided exclusion region file either as a list of DS9 circle regions, or a skymap with all bins to be excluded set to 0 and bins to be included set to 1 (default is no file)

The bin-by-bin sensitivity is computed as:
(background sensitivity) * (livetime) * (bin solid angle)
where the background sensitivity is computed via the background IRF.

As a test the method was run in 2 different configurations on a generated sample of 16 Crab observations displayed in the image below:

- Left: No exclusions
- Right: Exclusion over the Crab source

As expected, when not using any exclusion on the source a deficit ring appears, due to over subtraction from the non-excluded source. Here are the associated significance maps:

A quick check of the distribution of significance values for all bins outside the exclusion region in the right map provides the following normalized distribution:

A Gaussian with mean=0 sigma=1 is overplotted. The agreement of the Gaussian with the distributions shows the results are reasonable.

Pull branches:
CTools: Josh Cardenznaa / ctools: 2207-ctskymap_RING_bkgsubtract

FitsFiles/ctskymap_withexcl_runavg_signif.fits minus exclusions
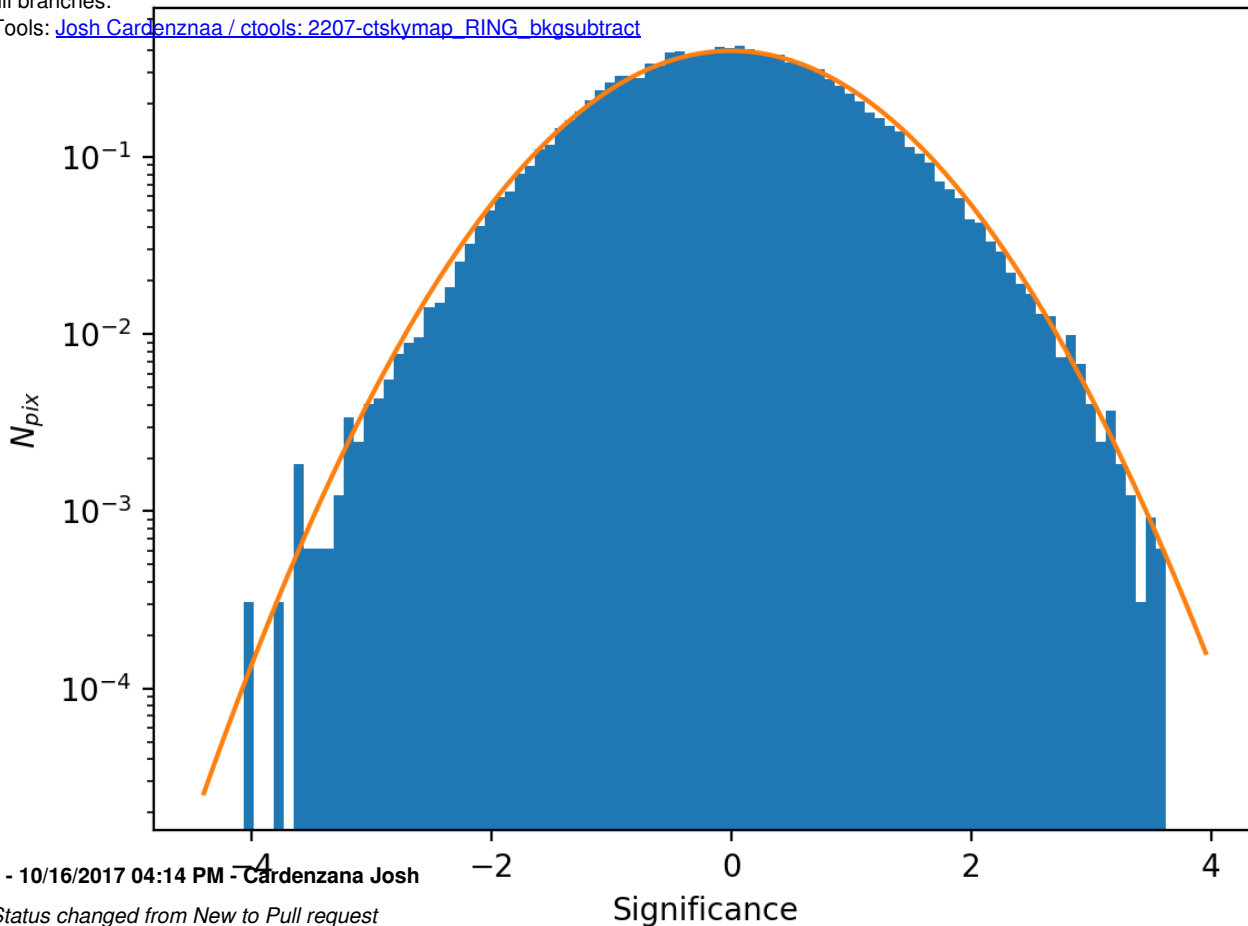
#8 - 10/16/2017 04:14 PM - Cardenzana Josh

- Status changed from New to Pull request

Forgot to specify this as a pull request.

#9 - 10/16/2017 11:10 PM - Knödlseder Jürgen

- Status changed from Pull request to Closed

- Target version set to 1.5.0

I merged the code into devel.

The biggest modification I made was a change of the pixel values for the exclusion map. In fact, in csphagen an exclusion is specified by a non-zero pixel value, while you used a zero pixel value for that. I hence defined **a non-zero pixel as a pixel to be excluded** in ctskymap.

We should probably add a test of the exclusion region to the unit tests so that we are sure of that logic.

Files

Significance_Dist.png	62.3 KB	10/16/2017	Cardenzana Josh
ctskymap_RING_bkg_counts.png	600 KB	10/16/2017	Cardenzana Josh
ctskymap_RING_bkg_signif.png	785 KB	10/16/2017	Cardenzana Josh