GammaLib - Action #3391

Implement analytical gradients for radial disk model

10/15/2020 12:27 AM - Knödlseder Jürgen

Status:	In Progress	**Start date:**	10/15/2020
Priority:	Normal	**Due date:**	
Assigned To:	Knödlseder Jürgen	**% Done:**	20%
Category:		**Estimated time:**	0.00 hour
Target version:			

Description

History

#1 - 10/19/2020 05:09 PM - Knödlseder Jürgen

- Status changed from New to In Progress

- Assigned To set to Knödlseder Jürgen

Code version	CPU	Iterations	logL	Speed-up	Comments
Reference	35.21	2	156240.662	-	-
Implementing #3203	14.81	2	156240.662	2.4	identical results

#2 - 10/20/2020 10:51 AM - Knödlseder Jürgen

- % Done changed from 0 to 20

I implemented an analytical radius gradient for the radial disk model. The table below compares the fit results to the reference results obtained with the unmodified code. Unfortunately, this implementation leads to some convergence problems during the fit and results in inaccurate errors (see below).

Quantity	Reference value	New value
Iterations	2	13
logL	156240.662	156240.584
RA	83.633218 +/- 0.000585	83.633219 +/- 0.000586
DEC	22.015370 +/- 0.000540	22.015371 +/- 0.000541
Radius	0.200600 +/- 0.000519	0.200808 +/- 1783.490243
Prefactor	5.652e-16 +/- 2.655e-18	5.654e-16 +/- 1.004e-11
Index	2.473765 +/- 0.004081	2.473796 +/- 0.004080

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2020-10-20T08:28:09: +==================================+
2020-10-20T08:28:09: | Maximum likelihood optimisation |
2020-10-20T08:28:09: +==================================+
2020-10-20T08:28:12:  >Iteration   0: -logL=-156234.420, Lambda=1.0e-03
2020-10-20T08:28:15:  >Iteration   1: -logL=-156240.244, Lambda=1.0e-03, delta=5.824, step=1.0e+00, max(|grad|)=-1931.641974 [Radius:2]
2020-10-20T08:28:18:  >Iteration   2: -logL=-156240.583, Lambda=1.0e-04, delta=0.339, step=1.0e+00, max(|grad|)=-833.416297 [Radius:2]
2020-10-20T08:28:21:  >Iteration   3: -logL=-156240.609, Lambda=1.0e-05, delta=0.026, step=1.0e+00, max(|grad|)=-359.991341 [Radius:2]
2020-10-20T08:28:24:   Iteration   4: -logL=-156240.598, Lambda=1.0e-06, delta=-0.011, step=1.0e+00, max(|grad|)=-155.656673 [Radius:2] (stalled)
2020-10-20T08:28:27:   Iteration   5: -logL=-156240.589, Lambda=1.0e-05, delta=-0.009, step=1.0e+00, max(|grad|)=-67.334496 [Radius:2] (stalled)
2020-10-20T08:28:30:   Iteration   6: -logL=-156240.584, Lambda=1.0e-04, delta=-0.005, step=1.0e+00, max(|grad|)=-29.138564 [Radius:2] (stalled)
2020-10-20T08:28:33:   Iteration   7: -logL=-156240.584, Lambda=1.0e-03, delta=-0.002, step=1.0e+00, max(|grad|)=-12.618171 [Radius:2] (stalled)
2020-10-20T08:28:36:   Iteration   8: -logL=-156240.584, Lambda=1.0e-02, delta=-0.002, step=1.0e+00, max(|grad|)=-12.689130 [Radius:2] (stalled)
2020-10-20T08:28:39:   Iteration   9: -logL=-156240.584, Lambda=1.0e-01, delta=-0.002, step=1.0e+00, max(|grad|)=-13.366271 [Radius:2] (stalled)
2020-10-20T08:28:42:   Iteration  10: -logL=-156240.584, Lambda=1.0e+00, delta=-0.001, step=1.0e+00, max(|grad|)=-17.959582 [Radius:2] (stalled)
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2020-10-20T08:28:45:   Iteration  11: -logL=-156240.584, Lambda=1.0e+01, delta=-0.000, step=1.0e+00, max(|grad|)=-26.278080 [Radius:2] (stalled)
2020-10-20T08:28:49:   Iteration  12: -logL=-156240.584, Lambda=1.0e+02, delta=-0.000, step=1.0e+00, max(|grad|)=-28.799630 [Radius:2] (stalled)
2020-10-20T08:28:52:   Iteration  13: -logL=-156240.584, Lambda=1.0e+03, delta=-0.000, step=1.0e+00, max(|grad|)=-29.104049 [Radius:2] (stalled)
2020-10-20T08:28:55:  Non-Positive definite curvature matrix encountered.
2020-10-20T08:28:55:  Load diagonal elements with 1e-10. Fit errors may be inaccurate.
2020-10-20T08:28:55:
2020-10-20T08:28:55: +=========================================+
2020-10-20T08:28:55: | Maximum likelihood optimisation results |
2020-10-20T08:28:55: +=========================================+
2020-10-20T08:28:55: === GOptimizerLM ===
2020-10-20T08:28:55:  Optimized function value ..: -156240.584
2020-10-20T08:28:55:  Absolute precision ........: 0.005
2020-10-20T08:28:55:  Acceptable value decrease .: 2
2020-10-20T08:28:55:  Optimization status .......: errors are inaccurate
2020-10-20T08:28:55:  Number of parameters ......: 11
2020-10-20T08:28:55:  Number of free parameters .: 7
2020-10-20T08:28:55:  Number of iterations ......: 13
2020-10-20T08:28:55:  Lambda ....................: 10000
2020-10-20T08:28:55:  Maximum log likelihood ....: 156240.584
2020-10-20T08:28:55:  Observed events  (Nobs) ...: 784398.000
2020-10-20T08:28:55:  Predicted events (Npred) ..: 784402.066 (Nobs - Npred = -4.06633628881536)
2020-10-20T08:28:55: === GModels ===
2020-10-20T08:28:55:  Number of models ..........: 2
2020-10-20T08:28:55:  Number of parameters ......: 11
2020-10-20T08:28:55: === GModelSky ===
2020-10-20T08:28:55:  Name ......................: Crab
2020-10-20T08:28:55:  Instruments ................: all
2020-10-20T08:28:55:  Observation identifiers ...: all
2020-10-20T08:28:55:  Model type ................: ExtendedSource
2020-10-20T08:28:55:  Model components ..........: "RadialDisk" * "PowerLaw" * "Constant"
2020-10-20T08:28:55:  Number of parameters ......: 7
2020-10-20T08:28:55:  Number of spatial par's ...: 3
2020-10-20T08:28:55:   RA ........................: 83.6332186394091 +/- 0.000586190731955529 [-360,360] deg (free,scale=1)
2020-10-20T08:28:55:   DEC .......................: 22.0153707022781 +/- 0.000540656938785219 [-90,90] deg (free,scale=1)
2020-10-20T08:28:55:   Radius ....................: 0.200807514288527 +/- 1783.490242605 [0.01,10] deg (free,scale=1,gradient)
2020-10-20T08:28:55:  Number of spectral par's ..: 3
2020-10-20T08:28:55:   Prefactor .................: 5.65413711056141e-16 +/- 1.00435365485205e-11 [1e-23,1e-13] ph/cm2/s/MeV
 (free,scale=1e-16,gradient)
2020-10-20T08:28:55:   Index .....................: -2.47379598694615 +/- 0.00407993123134148 [-5,-0]  (free,scale=-1,gradient)
2020-10-20T08:28:55:   PivotEnergy ...............: 300000 [10000,1000000000] MeV (fixed,scale=1000000,gradient)
2020-10-20T08:28:55:  Number of temporal par's ..: 1
2020-10-20T08:28:55:   Normalization ............: 1 (relative value) (fixed,scale=1,gradient)
2020-10-20T08:28:55:  Number of scale par's .....: 0
2020-10-20T08:28:55: === GCTAModelCubeBackground ===
2020-10-20T08:28:55:  Name ......................: BackgroundModel
2020-10-20T08:28:55:  Instruments ................: CTA, HESS, MAGIC, VERITAS
2020-10-20T08:28:55:  Observation identifiers ...: all
2020-10-20T08:28:55:  Model type ................: "PowerLaw" * "Constant"
2020-10-20T08:28:55:  Number of parameters ......: 4
2020-10-20T08:28:55:  Number of spectral par's ..: 3
2020-10-20T08:28:55:   Prefactor .................: 0.997042263510008 +/- 0.00227681856003367 [0.01,100] ph/cm2/s/MeV (free,scale=1,gradient)
2020-10-20T08:28:55:   Index .....................: -0.00241102099135354 +/- 0.00131525623970631 [-5,5]  (free,scale=1,gradient)
2020-10-20T08:28:55:   PivotEnergy ...............: 1000000 MeV (fixed,scale=1000000,gradient)
2020-10-20T08:28:55:  Number of temporal par's ..: 1
2020-10-20T08:28:55:   Normalization ............: 1 (relative value) (fixed,scale=1,gradient)
2020-10-20T08:28:55:
2020-10-20T08:28:55: +===============+
2020-10-20T08:28:55: | Save results |
2020-10-20T08:28:55: +===============+
2020-10-20T08:28:55:  Model definition file .....: crab_results_3391_radius.xml
2020-10-20T08:28:55:  Covariance matrix file ....: NONE
2020-10-20T08:28:55:
2020-10-20T08:28:55: Application "ctlike" terminated after 46 wall clock seconds, consuming 45.2125 seconds of CPU time.
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#3 - 03/14/2022 12:26 PM - Knödlseder Jürgen

- Target version deleted (2.0.0)