

Reviewer: Tom Stephens

Software Component: ObservationSim/OrbSim

Summary of Tests Performed:

I created a new source of each of the sources available to obsSim documented either in the Doxygen documentation for the package or on Seth's confluence wiki page. I then ran a series of simulations with each of those sources individually, and then combined as a single simulation. I also ran a single day's simulation with the 3EC sources and the Egert background model as a MapSpectrum and the as a MapSource source. For all of these simulations I recorded the elapsed time and any problems I noted.

User Interface/Documentation:

- 1) The Source Model definition tool (U7) would be very useful in GUI form. Creating the sources by hand was frustrating, especially since there was no way when editing the XML file to know what the parameters were for. I had to keep flipping back and forth between the scattered documentation and the file I was editing.
- 2) What does the `<use_spectrum frame="galaxy"/>` line do in a spectrum source? There doesn't seem to be any documentation.
- 3) The documentation could be improved significantly in several ways.
 1. Clear documentation on structure of xml source description files was needed. There were several different examples that were not all quite the same.
 2. Most importantly, there should be a central document containing descriptions of all of the sources, details about the source, description of all the parameters and an example of the XML file entry for that source. Right now the documentation is scattered and/or not to be found at all. I know there is overlap with the flux package but I couldn't find any documentation on the flux sources. If it is there, it is not obvious.
 3. What are the liteNN parameters in the parameter file for GalPulsars? Light curve information?

Tool Behavior:

- 1) The PulsarSpectrum source spews forth a lot of junk that doesn't need to be printed. Using the example crab source from Seth's page, it generated 256kB of text for a 1 day simulation.
- 2) The PulsarSpectrum also generates a pulsar.root file, that I didn't see mentioned in the description. What is it and what is its format?
- 3) When the simulation runs with the GalPulsar source, it starts using the ethernet connection transferring ~370KB/s up and back. Is it talking to itself or somewhere else? This is throttling the performance of the simulation. With all the other sources, the simulation is using 99% of the CPU. With this source it is only using ~50-55% of the CPU.

This seems to be an artifact of my system set-up. The software is installed on a disk mounted by nfs to the computer I am running the process on. It seems that the GalPulsar source is continuously reading/writing to the disk in the installation location and thus is using up the ethernet bandwidth. When I run the program on my laptop, which has everything on a local disk, I don't see the ethernet being used at all and the source runs much faster.

- 4) I tried the GalPulsar with the Vela source (with the flux still low by an order of

magnitude) and it ran fine and took about 6 seconds to simulate a day's worth of data. However, when I changed the parameters, it wandered off and started taking forever. The changes I made were the following:

1. Moved position from $(l,b) = (263.55,-2.79)$ to $(l,b) = (174.5,-10.91)$ in the anti-center region.
2. Changed period from $8.932876E-02$ to $4.932876E-01$.
3. Changed flux from $9.28E-07$ to $2.28E-06$.
4. Raised upper energy limit from $1.00E02$ to $1.50E02$
5. Changed spectral index from $6.20E-01$ to $7.10E-01$
6. Everything else left alone.

It has been running for ~12 CPU minutes so far and has not finished. Maybe there is something unphysical about my parameters that is causing it to go crazy? Just changing the flux and position didn't cause a problem. It is something about the other parameters.

- 5) GRBmanager also prints a lot of information to the screen as it is working. There is also a `grb_generated.txt` file created but the columns are undocumented. This is very slow compared to some of the others.
- 6) Putting all the sources into a single simulation takes longer than having them individually run by a factor of 2. When I included the sources with the diffuse background and the 3EC sources, it slowed it down by a factor of ~13. I expected some slow-down but the amount was surprisingly large.
- 7) If you enter a relative path to the script in the bin directory of the installation, the software runs. However if you try to execute it using it's absolute path, I get the following error:

```
/glast02/users/tstephen/STtest/bin/obsSim: line 114: /  
glast02/users/tstephen/observationSim/v5r1p3/rh9_gcc32/obsSim.exe: No  
such file or directory
```

In this case the path to the executable seems to have lost the /STtest part. This even happens if you are in the bin directory itself.
- 8) Tried to use all sources and got a segfault when the GRBmanager tried to load.
- 9) A few of the columns in the resultant FT1 file are not filled in, most notably the EARTH_AZIMUTH and EVENT_ID columns.

Future Development

- 1) ** Proper handling of the CALIB_VERSION vector. We used the values in this column as a hack in DC1 to specify which of the background cuts the events had passed in the reconstruction. We need to specify this properly and update the tools to handle it correctly.
- 2) It would be useful be able to specify a ROI to generate the events it. If I'm looking at a specific region in the galactic plane and have to include the diffuse emission, it would be much faster if only the events that fall in the ROI were computed. I don't know how easy this would be to implement however.

Testing Results

The following table lists the sources I used for testing. The XML source file is included after the table.

Table 1 - New Sources

<i>ID</i>	<i>Type</i>	<i>RA</i>	<i>DEC</i>	<i>index</i>	<i>flux</i>	<i>Comment</i>
1	TransientTemplate	83.5	31.4	2.1	10	200s burst @ 1000s
2	PulsarSpectrum	88.07	27.72	-	1.3E-6	1.5s period
3	GalPulsars	72.72	27.19	-	-	
4	GRBmanager	73.6	17.89	-	-	tstart=1500s, interval=10000s
5	PeriodicSource	80.7	17.19	1.9	0.02	10000s period
6	Pulsar	88.24	17.02	2		
7	SimpleTransient	93.33	15.96	2.4	1	1100s burst @ 1000s
8	GaussianSource	93.51	27.19	2.7	0.1	

```
<source_library title="test_sources">
  <source name="tom_gaussian_source">
    <spectrum escale="MeV">
      <SpectrumClass name="GaussianSource"
        params="0.1, 2.7,93.51, 27.19, 2.2, 0.7, 45,
30., 3e5"/>
      <use_spectrum frame="galaxy"/>
    </spectrum>
  </source>

  <source name="tom_periodic_source">
    <spectrum escale="MeV">
      <SpectrumClass name="PeriodicSource"
        params="0.02, 1.9, 1e4, .35, 0.16, 30, 3e5"/>
      <celestial_dir ra="80.7" dec="17.19"/>
    </spectrum>
  </source>

  <source name="tom_simple_transient">
    <spectrum escale="MeV">
      <SpectrumClass name="SimpleTransient"
        params="1., 2.4, 1e3, 2e3, 30., 2e5"/>
      <celestial_dir ra="93.33" dec="15.96"/>
    </spectrum>
  </source>

  <source name="tom_transient_template">
    <spectrum escale="MeV">
      <SpectrumClass name="TransientTemplate"
        params="10., 2.1, 1e3, 1.2e3, TransTemplate.dat"/>
      <celestial_dir ra="83.5" dec="31.4"/>
    </spectrum>
  </source>
</source_library>
```

```
</source>

<source name="tom_pulsar_spectrum" >
  <spectrum escale="MeV">
    <SpectrumClass name="PulsarSpectrum" params=" 1,2.3e-
6,0.033,422e-15,2,1e6,30e6,-1.9,0.29"/>
    <celestial_dir ra="88.07" dec="27.72"/>
  </spectrum>
</source>

<source name="tom_pulsar_spectrum2" >
  <spectrum escale="MeV">
    <SpectrumClass name="PulsarSpectrum" params=" 1,1.3e-
6,1.5,842e-15,2,1e6,30e6,-1.9,0.29"/>
    <celestial_dir ra="88.07" dec="27.72"/>
  </spectrum>
</source>

<source name="tom_gal_pulsars">
  <spectrum escale="GeV">
    <SpectrumClass name="GalPulsars" params="pulsar2.txt"/>
    <use_spectrum frame="galaxy"/>
  </spectrum>
</source>

<source name="tom_grb_manager">
  <spectrum escale="MeV">
    <SpectrumClass name="GRBmanager" params="1500,10000"/>
    <celestial_dir ra="73.6" dec="17.89"/>
  </spectrum>
</source>

<source name="tom_pulsar">
  <spectrum escale="MeV">
    <SpectrumClass name="Pulsar"
    params="1e-2,2.,0.833,0,1.0e-10,PulseTemplate.dat"/>
    <celestial_dir ra="88.34" dec="17.02"/>
  </spectrum>
</source>

</source_library>
```

Timing Info

The time in the following table is the CPU time needed to complete the simulation. The speedup is the speedup of real time, ie 86400 seconds divided by the time needed to complete the simulation.

Time (s)	Speed Up	Description
205.5	420.4	1 day's simulation – default source_names.txt w/ extragalactic & all 3EC
1904.2	45.4	1 day's simulation – extragalactic, galdiffusemap20, all 3EC – generated 114837 events
423.7	199.7	1 day's simulation – replaced galdiffusemap30 with galdiffuse(a new mapSource source) – generated 288688 events (factor of 2.5 more events) 4.4x faster --> 11x speedup
10331.76	8.36	1 day's simulation as above but with some additional sources added. The sources were the same as the All line in the following table.

These tests were done with a 200000s simulation. The % CPU Usage column is not very meaningful for the short simulations since a large fraction of the Clock Time column was accumulated while I typed in the parameters. However, for the 3 longer simulations, it is a meaningful measurement.

<i>Source</i>	<i>Clock Time (s)</i>	<i>CPU time (s)</i>	<i># Events</i>	<i>CPU time/event (ms)</i>	<i>% CPU Usage</i>
TransientTemplate	3.96	1.30	190	6.84	34.50
PulsarSpectrum	360.39	354.85	593	598.40	98.50
GalPulsars	77.18	25.74	424	60.71	52.70
GRBmanager	52.77	49.32	46	1072.17	93.90
PeriodicSource	3.79	1.65	218	7.57	48.50
Pulsar	2.88	1.24	127	9.76	47.9
SimpleTransient	3.21	1.18	83	14.22	41.70
GaussianSource	4.15	2.47	512	4.82	62.10
Sum of the above columns excepting GRBmanager	452.65	387.19	2020	191.67	85.50
All except GRBmanager	799.93	736.56	1982	381.72	94.1