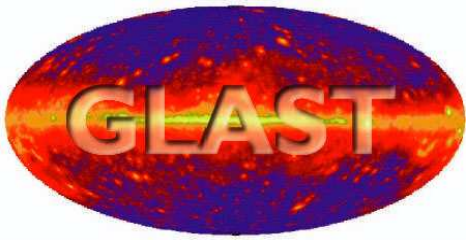

LAT Flight Software

GRBS Manual

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Manual for GRBS, the GRB Simulation Package

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0 Introduction

The GRBS package software consists of a simulated GRB detection algorithm for the SIU and EPUs. The simulation allows for testing of the GRB communications framework.

0.0 Overview

The function of the GRBS package is to simulate GRB detection for test purposes. The GRBS algorithm reports communication detection status, coordinate information, and event data summaries. The GRBS algorithm processes GRB photon candidate events, as well as GBM burst alert telecommand data. An event driven simulation requires the SIU and EPUs in order to simulate a GRB. An SIU only GRB simulation does not require EPU event input, and simply constructs messages for command and telemetry delivery.

1 Package Description

This section describes the CMX package layout for GRBS.

1.0 Shareables

GRBS exports the following shareable libraries.

Module	Description
libgrbs_siu.o	SIU simulated GRB detection
libgrbs_epu.o	EPU simulated GRB detection

1.1 Dependencies

GRBS is dependent on the following FSW packages:

Package	Description
MSG	Message reporting
GRB	GRB interface definition
EDS	Event delivery services
EDS_DB	Event delivery database
PBS	Package basic OS services
VXW	Operating system
GRBS_DB	GRBS database schema
CDM	Database services

Package	Description
EFC	Event filter code
THS	Time hack services

2 Implementation

This section provides an overview of the GRBS software implementation.

2.0 Task Descriptions

The GRB framework and GRBS algorithm software execute in the context of the calling task. This task is currently provided by the LPA package, which instantiates the GRB framework, and facilitates communication between the GRBS algorithm, other FSW packages, the GBM, and the spacecraft.

A portion of the GRBS detection algorithm executes on the EPUs, as an “afterburner” to the gamma filter. The product of this post-processor is exported to the SIU, and intercepted by the GRBS algorithm software.

The primary functions of the GRBS package are:

- Simulate GRB photon candidate summary messages from EPUs
- Simulate attitude coordinates and timing information of candidate photon events
- Simulate GRB alert messages for delivery to external clients
- Simulate spacecraft repointing requests

GRBS filter software executes in the context of the LCBD event task on each EPU and performs the following primary actions:

- Post process events passed in from event handlers
- Identify simulated GRB photon candidates in the event stream
- Simulate GRB summary messages for delivery to the GRBS algorithm executing on the SIU

2.1 GRB Framework

The GRB framework consists of an interface that defines a set of messaging protocols and function callbacks that allow communications between the GRBS algorithm and a driver application. In this instance, the driving application is LPA, the LAT physics acquisition software.

The GRB interface is defined in the GRB package.

2.2 GRBS Event Handler

The GRBS event handler executing on the EPUs acts as a post-processor for event handlers. It is a specialized handler installed by LPA, and operates as an output processor in the EDS framework. If an event handler posts an event to the GRB output stream, the GRBS event handler will evaluate the event and decide whether or not it should be nominated as a GRB photon event. When this occurs, the event content is summarized and placed into a summary structure that is periodically delivered to the GRBS algorithm on the SIU.

2.2.0 GRBS Event Summary Messages

Upon encountering a GRB photon candidate, the GRBS event handler simulates the following event information:

Name	Description
Node	CPU node ID originating the event
ID	The event ID
PPS	The GEM 1-PPS timestamp associated with the event
TRG	Event timestamp
CX	Event X coordinate
CY	Event Y coordinate
CZ	Event Z coordinate
Energy	Event energy

This information is buffered for a configurable amount of events, and forwarded to the GRBS algorithm on the SIU. The SIU GRBS algorithm uses this data to simulate the GRB detection.

2.3 GRB Simulations

The GRBS simulation was created to aid in diagnostics and testing of LAT, SC, and GBM interfaces. As a default, all simulated LAT detected GRBs use the same GRB coordinates in alert telemetry and GBM telecommand messages. All time values represent the time at which the message was constructed. Remaining fixed values are specified in the table below.

Description	Value
First Location RA	213.9 degrees

Description	Value
First Location DEC	19.2 degrees
First Error RA	0.8333 degrees = 50 arcmin
First Error DEC	1.1667 degrees = 70 arcmin
GRB Classification	1 - GRB Candidate. Closeout messages resulting from LPASTOP or timeout use 0 – GRB Not a candidate.
Gamma count 0	0xfafa
Gamma count 1	0xfbfb, except when running FES simulation, then count of events in EPU summary which triggered alert.
Gamma count 2	0xfcfc
Gamma count 3	0xfdfd
Trigger Parameters 0 -9	1 – 10, repsectively

2.3.0 Commanded LAT GRB Detection

The commanded GRB detection simulation executes only on the SIU and does not requires event input from the EPUs. A simulated LAT detected GRB can be initiated by issuing the LPASETGRB telecommand with the simulation parameters set. 60 seconds after an LPASTART telecommand is successfully processed, the GRB simulation will start. There are 2 detection simulation modes available. For Mode 0, the simulation will declare a suspected GRB 60 seconds after the start of a physics run. At fixed intervals, GRB will issue alert telecommand and telemetry packets and transition from GRB suspect, to GRB confirm, and finally to GRB closeout. For Mode 1, GRB suspected is entered, followed by a GRB closeout.

During a LAT detected GRB simulation, GBM telecommands are acknowledged, but any repoint requests are not honored. If an LPASTOP command is issued, a GRB closeout action will be immediately executed.

Here are a few key points concerning this simulation:

- If the simulation mode is enabled, a LAT detected GRB will be initiated 60 seconds after the LPASTART successfully completes.
- Each LPASETGRB command will activate a single LAT detected GRB simulation ONLY for the subsequent physics run. All remaining physics runs will have the simulation disabled.
- While in simulation mode, all GBM telecommands will be ignored by the GRB software. Note that LIM will still issue acknowledgement of receipt of any such commands.
- While in simulation mode, all EPU GRB summary packets will be discarded, regardless of the enable setting.
- Issuing the LPASTOP command will immediately end the active LAT detected GRB simulation by executing GRB closeout.

GRB Mode 1 Simulation

Action	Description
GRB Suspect	Occurs 60 seconds after LPASTART completion. ALRTTRG telemetry 0x341 is issued, and GFSWLATTRIGGER is send to the GBM. LIM enters ARR mode GRB0 state.
GRB Update	10 ALRTUPDATE telemetry packets are issued at configurable fixed intervals.
GRB Confirm	GRB detection is confirmed, a repoint request issued to SC, via LIM, with a configurable dwell time. The repoint request can be disabled by using repoint dwell value of 0. LIM transitions to GRB1 state.
GRB Closeout	At a fixed interval after GRB confirm is executed, GRB detection is closed out. ALRTCLOSE 0x343 telemetry issued, GFSWLATCLOSEOUT telecommand is sent to the GBM, and LIM transitions to GRB2 state. At the completion of the repoint dwell, LIM will transition for ARR to Normal Physics.

GRB Mode 2 Simulation

Action	Description
GRB Suspect	Occurs 60 seconds after LPASTART completion. ALRTTRG telemetry 0x341 is issued, and GFSWLATTRIGGER is send to the GBM. LIM enters ARR mode GRB0 state.
GRB Closeout	At a fixed interval after GRB confirm is executed, GRB detection is closed out. ALRTCLOSE 0x343 telemetry issued, GFSWLATCLOSEOUT telecommand is sent to the GBM, and LIM transitions to GRB2 state. At the completion of the repoint dwell, LIM will transition from ARR to Normal Physics.

2.3.0.0 LPASETGRB Parameter Settings

This command enables or disables LPA forwarding of messages from the EPU and the GBM, to the GRB detection algorithm. A value of 0 indicates a DISABLED forwarding state, and a value of 1 indicates an ENABLED forwarding state.

The LPAGRBGBMSTATE parameter controls forwarding of GBM telecommands received by the LPA master task on the SIU, to the GRB detection algorithm.

The LPAGRBEPUSTATE parameter controls forwarding of EPU event summary packets received by the LPA master task on the SIU, to the GRB detection algorithm.

The remaining parameters configure a LAT detected GRB simulation. This feature is used for GRB interface diagnostics and testing.

Parameter	Description
LPAGRBGBMSTATE	Enable state of GBM command forwarding
LPAGRBEPUSTATE	Enable state of EPU summary packet forwarding
LPAGRBSIMMODE	0: Mode 0- simulation is disabled. 1: Mode 1 - execute all available detection states: suspect->(update*10)->confirm->closeout. 2: Mode 2 - execute only suspect->closeout.
LPAGRBSIMINTV	time interval in seconds between the GRB detection states for the simulation mode
LPAGRBSIMRPTSEC	GRB repoint request in seconds for the simulation mode. A value of 0 will disable sending of a repoint request

2.3.1 Event Driven LAT GRB Detection

A counting simulation is available that tests the full communications path from the EPUs to the SIU GRB software. The simulation will accept events posted to the LPA GRB output stream which have energy values above the configurable threshold. These events are summarized, and sent to the SIU GRBS simulation. The SIU GRBS simulation will count the number of GRB summary packets and transition, in order, through the GRB detection states.

Event summary packet counts are reset at the start of each physics run. The rate at which the GRB state transition occurs is dependent on the FES trigger rate, and the event handler filter criteria.

This simulation is designed to be used only on the LAT testbed, in conjunction with the FES. This feature is only available in the default simulation implementation and will not be included in flight functionality.

Event Summary Count	Action	Description
0 - 63	GRB inactive	No action
64	GRB Suspect	GRB is suspected. ALRTTRG telemetry 0x341 is issued, and GFSWLATTRIGGER is send to the GBM. LIM enters ARR mode GRB0 state.
127 - 136	GRB Update	GRB is updated. ALRTUPDATE telemetry packets are issued.
138	GRB Confirm	GRB detection is confirmed, a repoint request issued to SC,

Event Summary Count	Action	Description
		via LIM, with the pre - configured dwell time. The repoint request can be disabled by using repoint dwell value of 0. LIM transitions to GRB1 state.
192	GRB Closeout	GRB detection is closed out. ALRTCLOSE 0x343 telemetry issued, GFSWLATCLOSEOUT telecommand is sent to the GBM, and LIM transitions to GRB2 state. At the completion of the repoint dwell, LIM will transition for ARR to Normal Physics.
192 - 256	GRB inactive	Simulation counter resets to 0 at 256.

2.3.2 GBM GRB Detection

Using the GBM interrupt signal, and the GBM burst alert telecommand sequence, the GRBS simulation software will respond to a GBM detected GRB. If a LAT detected GRB is not in progress, the GRBS software will transition through the GRB states, issuing the proper command and telemetry packets. LIM provides confirmation of each of the following steps in the LIM state telemetry packets.

This feature is only available in the default simulation implementation and will not be included in flight functionality.

Action	Description
GBM Interrupt Signal	LIM transitions to ARR mode, GRB0 state.
GBM LFSWCALCINFO Telecommand	If not already in GRB0 state, LIM transitions to GRB0 state.
GBM LFSWCREPREC Telecommand	GRB detection is confirmed. If the command requested a repoint, a repoint request is issued to SC, via LIM, with a configurable dwell time. The repoint request can be disabled by using repoint dwell value of 0. LIM transitions to GRB1 state.
GBM LFSWCLOSEOUT Telecommand	GRB detection is closed out. LIM transitions to GRB2 state. At the completion of the repoint dwell, LIM will transition from ARR to Normal Physics.

2.4 GRB Alert Reporting

Upon encountering one of several GRB detection states, the GRBS algorithm will issue alert messages destined for LPA, LIM, the spacecraft, or the GBM. The content of these messages is defined in the LAT to GBM ICD. The formatting of these messages is handled by the LPA software.

2.5 GBM Message Handling

Upon detection of a GRB by the GBM, a series of telecommand packets will be forwarded to the GRBS detection algorithm. The algorithm will analyze the data contained in these packets, and decide on a course of action. If the GRBS algorithm confirms that the GRB is genuine, it will proceed with the alert process. This could result in a LAT mode change, reconfiguration of event handling software, and issuing of a spacecraft repoint request.

3 Configuration

This section describes the process of configuration for the GRBS package. GRBS is configured by default at initialization by reading in CDM database files from the file system. Further configuration is accomplished by processing telecommands and applying the settings dynamically.

3.0 GRBS_DB Configuration

The GRBS configuration parameters are defined in a CDM database file. The schema for these files resides in the GRBS_DB package. There can be multiple instances of the GRBS_DB schema. The database instances are identified by their instance IDs. These instance IDs are to be used in telecommand parameters when accessing or updating the configuration values. Please refer to GRBS_DB_siu_schema.h and GRBS_DB_epu_schema.h in the GRBS_DB package.

Table 1 GRBS_DB Siu Schema

Parameter	Description
repoint_time	The default GRB repoint request time in seconds. This is the default time requested by GRB to the spacecraft to remain in a repoint.
close_timeout	The GRB inactivity timeout in seconds. Sets the elapsed time for which no GRB activity, after which the GRB closeout action is executed.
gbm_timeout	The GBM inactivity timeout in seconds. Sets the elapsed time for which no GBM telecommands, after which the GRB closeout action is executed.

Table 2 GRBS_DB Epu Schema

Parameter	Description

Parameter	Description
photon_energy	GRB energy threshold in Mev. Photons with energies above this threshold will be evaluated as candidate events.

4 Programming

The GRBS package provides several public control interfaces that are used to initialize and start the software.

4.0 GRBS Control Routines

The following callbacks are exported by the GRBS packages for initialization and control of the GRBS detection algorithm.

Callback	Description
GRBS_simConfig	Configures the SIU only GRB simulation
GRBS_simDetect	Initiates the SIU only GRB simulation
GRBS_simReset	Resets the SIU only GRB simulation

Refer to GRBS_pubdefs.h for the full callback signature for each function

5 Command and Telemetry

This section covers the command and telemetry interfaces of the GRBS package.

5.0 Telecommands

GRBS generates command content defined for the GBM, and delivered by LPA. For details on structure and content of these packets, refer to the LAT Telecommand and Telemetry document, and the LAT GBM Interface Control document.

Command	APID	Function Code	Description
LFSWCALCINFO	0x660	1	GBM GRB Calculated Information
LFSWCREPREC	0x660	2	GBM GRB Candidate Repoint Recommendation
LFSWCLOSEOUT	0x660	3	GBM GRB Closeout
GFSWLATTRIGGER	0x6f1	1	LAT Detected GRB Alert
GFSWLATCLOSEOUT	0x6f1	3	LAT Detected GRB Closeout

5.1 Telemetry

This section describes the telemetry interface for the GRBS package. GRBS generates content for alert telemetry packets, which are delivered by LPA. For details on the size and structure of these packets, refer to the LAT Telecommand and Telemetry document, and the LAT GBM Interface Control document.

5.1.0 Packet Descriptions

Name	APID	Description
ALRTTRG	0x341	GRB Trigger Alert Telemetry
ALRTUPDATE	0x341	GRB Update Alert Telemetry
ALRTCLOSE	0x343	GRB Closeout Alert Telemetry