Using MEGAlib with Real Measurements

Version of 4 April 2018

1. Overview

MEGAlib was originally designed for the MEGA Compton and pair telescope prototype, so using it with real measurements is as staright forward as using it with simulations. You need two things to use MEGAlib with measurements, an evta-file (which is very similar to the sim file) and a geometry file with the detectors at the correct position.

2. The evta file format

If you use MEGAlib's calibration framework Fretalon, you will automatically get the right evta format. However, if you use your own calibration tools, you have to convert your data into the evta file format. Here is how a typical start of an evta file looks like:

Attention 1: This is the format of MEGAlib 2.99 (experimental branch) / 3.x

Attention 2: Do NOT name this file "sim" file. If Revan reads a sim file, it starts the detect effects engine and noises the data. If Revan reads an evta file, it does not start the detector effects engine, and not noise the data since it assumes the data are real measurements.

```
Version 200
Type EVTA

SE
ID 1
TI 1465776080.278382500
GX 169.27901 -8.0520075
GZ 252.52139 39.753109
HX 303.49681 0.62073623
HZ 82.847332 89.181876
HT 3;-4.4184;-7.02935;-5.1143287;71.886297;0.05773502;0.05773502;0.03690222;0.6632136
HT 3;-4.8184;-6.02935;-5.1999273;70.696487;0.05773502;0.05773502;0.05418522;0.7177678
SE
ID 2
...
```

The various elements in the evta file are:

Key:	Type
Parameters:	1: File type
Description:	The unique type of this file. In case of a evta file "EVTA".

Key:	Version
Parameters:	1: integer
Description:	The version of the evta file format

Key:	SE
Parameters:	-
Description:	"Start Event": Marks the beginning of a new event

Key:	ID
Parameters:	1: ID of event
Description:	Represents a unique ID of the event

Key:	TI
Parameters:	1: Time in seconds
Description:	Observation time of the event

The EVTA file formats differ mostly be the amount of information contained in the HT, the hit, keyword:

Version:	100
Key:	HT
Parameters:	1: Detector ID (see table of detector IDs)
	2: x position of the interaction in detector coordinates in cm
	3: y position of the interaction in detector coordinates in cm
	4: z position of the interaction in detector coordinates in cm
	5: Energy deposition uncertainty in keV
Description:	The hit information in the active detector material. The position must be within an active detector in the geometry file!

Version:	101
Key:	HT
Parameters:	1: Detector ID (see table of detector IDs)
	2: x position of the interaction in detector coordinates in cm
	3: y position of the interaction in detector coordinates in cm
	4: z position of the interaction in detector coordinates in cm
	5: Energy deposition uncertainty in keV
	6: Time hit was measured in seconds
Description:	The hit information in the active detector material. The position must be within an active detector in the geometry file!

Key:	EN
Parameters:	-
Description:	"End": Marks the end of the event block. No events are allowed beyond this keyword.

Version:	200
Key:	HT

Parameters:	1: Detector ID (see table of detector IDs)
	2: x position of the interaction in detector coordinates in cm
	3: y position of the interaction in detector coordinates in cm
	4: z position of the interaction in detector coordinates in cm
	5: Energy deposition uncertainty in keV
	6: x position uncertainty of the interaction in detector coordinates in cm
	7: y position uncertainty of interaction in detector coordinates in cm
	8: z position uncertainty of interaction in detector coordinates in cm
	9: Energy deposition uncertainty in keV
Description:	The hit information in the active detector material. The position must be within an active detector in the geometry file!

Version:	201
Key:	HT
Parameters:	1: Detector ID (see table of detector IDs)
	2: x position of the interaction in detector coordinates in cm
	3: y position of the interaction in detector coordinates in cm
	4: z position of the interaction in detector coordinates in cm
	5: Energy deposition uncertainty in keV
	6: Time, the hit was measured in seconds
	7: x position uncertainty of the interaction in detector coordinates in cm
	8: y position uncertainty of interaction in detector coordinates in cm
	9: z position uncertainty of interaction in detector coordinates in cm
	10: Energy deposition uncertainty in keV
	11: Time uncertainty in seconds
Description:	The hit information in the active detector material. The position must be within an active detector in the geometry file!

Since a real detector might be rotated in the world coordinate system, MEGAlib allows to define those rotations. For satellites, the keywords GX, GZ (Galactic coordinates) and HX, HZ (Horizon coordinates) are relevant, for terrestrial applications, the RX & RZ are relevant and describe the detector orientation in the world coordinate system.

Key:	RX & RZ
Parameters:	1: x-value [cm] of the detector orientation vector 2: y-value [cm] of the detector orientation vector 3: z-value [cm] of the detector orientation vector
Description:	Describes the x and z-axis of the orientation of the detector in Cartesian coordinates. Use either (RX & RZ) or (GX & GZ), not both!

Key:	GX & GZ
Parameters:	1: longitude [deg] of the detector orientation vector in Galactic coordinates 2: latitude [deg] of the detector orientation vector in Galactic coordinates
Description:	Describes the x and z-axis of the orientation of the detector in Galactic coordinates. Use either (RX & RZ) or (GX & GZ), not both!

Key:	HX & HZ
Parameters:	1: longitude [deg] of the detector orientation vector in Galactic coordinates 2: latitude [deg] of the detector orientation vector in Galactic coordinates
Description:	Describes the x and z-axis of the orientation of the detector in a Horizon coordinates system. HX and HZ are different from (RX & RZ) and (GX & GZ), because they are not used for imaging, but for the Earth horizon cut.

ID	Description
1	2D Strip detector (no depth resolution)
2	MEGA style calorimeter – many scintillator bars in one enclosing volume
3	3D Strip detector with depth resolution
4	Universal detector without any position resolution (e.g. calorimeter)
5	**Not fully implemented**: Drift chamber
6	**Not fully implemented**: 3D Strip detector with depth resolution and limited directional resolution
7	Anger camera
8	3D Voxel detector

Table: List of detector IDs – the definition is identical to the definition throughout MEGAlib