Geometry file format description

The geometry file is a text format file that describes the system parameters of the used system. It includes the geometry of the frame, the placement of the instruments, the transmitter waveform, time gate specifications, and so on. Everything needed to allow accurate modeling of the system in the inversion.

The geometry file consists of a [General] section and one or more [Channel#] sections. Within each section, related entries have been grouped together, often using a comment line to describe the group. This is not required, the entries just need to be within the right section, but it does improve the readability of the geometry file. Comment lines are indicated with a "/".

Below we will go through an example SkyTEM skb geometry file using tables to explain the different keywords within each group. The type can be a string or a specific number of integers or reals. The description details how the keyword is used. The last column shows if the keyword is required (Req.), optional (Opt.) or special enough to be detailed in the description (Spec.).

In general, we use SI-units for the keyword values. The unit for the different keyword values are stated in brackets [].

1. [General] section – Device positions.

Keyword	Type	Description	
Description	String	Line that can be used to describe the geometry file.	Opt.
GPSPosition1	3 Reals	Position of the 1st GPS device on the frame. All device positions are described in X, Y and Z [m] with origin at the center of the transmitter coil and with z positive downward.	Req.
GPSPosition2	3 Reals	Position of the 2nd GPS device on the frame.	Opt.
GPSDifferentialPosition1	3 Reals	If a differential version of GPS1 has been used, the device position of GPS1 must be repeated with the GPSDifferentialPosition1 keyword.	Opt.
GPSDifferentialPosition2	3 Reals	If instead a differential version of GPS2 has been used, the device position of GPS2 must be repeated with the GPSDifferentialPosition2 keyword. This will normally not be done to more than one GPS device.	Opt.
AltimeterPosition1	3 Reals	Position of the 1st altimeter on the frame.	Req.
AltimeterPosition2	3 Reals	Position of the 2nd altimeter on the frame.	Opt.
InclinometerPosition1	3 Reals	Position of the 1st Inclinometer on the frame.	Req.
InclinometerPosition2	3 Reals	Position of the 2nd Inclinometer on the frame.	Opt.
RxCoilPosition1	3 Reals	Position of the Z receiver coil on the frame (It is always 1st).	Req.
RxCoilPosition2	3 Reals	Position of the X receiver coil on the frame.	Opt.

2. [General] section – Transmitter loop definitions.

Keyword	Type	Description	
LoopType	Real	LoopType used by AarhusInv when inverting the data. This can be either 72 or 73 for the SkyTEM system. Both describe a segmented loop detailed with the TxLoopArea and TxLoopPoint entries below. The difference is that the 73 variant uses the inverse Laplace transform instead of the Fourie transform that has been used with the legacy 72 variant. For inversions using system response, the 73 version must be used. For inversions using waveform and filters it doesn't matter and the either can be used.	Req.
TxLoopArea	Real	Area of the Tx-loop [m^2]. This area must match the area of the polygon described by the TxLoopPoint entries below.	Req.
TxLoopPoint1 .. TxLoopPointN	2 Reals	X and Y [m] coordinates for the N corners of the loop. Counterclockwise order. The last point connects back to the first point.	Req.
NumberOfTurnsLM	Integer	Number of Tx-loop turns used for low moment.	Spec.
NumberOfTurnsHM	Integer	Number of Tx-loop turns used for high moment.	Spec.
NumberOfTurns	Integer	Number of Tx-loop turns used. If there is only one moment, this version must be used. If both moments are present, both the low moment and high moment versions must be used instead. This must be identical to the setup of WaveformPoint.	Spec.

3. [General] section – Low pass filter characteristics of the receiver coil(s).

Keyword	Type	Description	
RxCoilLPFilter1	2 Reals	Low pass filter characteristics of the Z receiver coil. The first value is the order of the filter. A value of -1 is used for no filter and a value of 0.99 is used for a Gaussian. filter. The second value is the cut-off frequency [Hz]. For more about the effect of the filters see the article "Christiansen, A. V., E. Auken, and A. Viezzoli, 2011, Quantification of modeling errors in airborne TEM caused by inaccurate system description, Geophysics, 76, 1, F43-F52". (http://www.hgg.geo.au.dk/Papers_EndNote/3986773044/CHRISTIANSEN2011.pdf)	Req.
RxCoilLPFilter2	2 Reals	Low pass filter characteristics of the X receiver coil.	Opt.

4. [General] section – Front gate delay.

Keyword	Type	Description	
FrontGateDelay	Real	Instrument related time shift [s]. See note on timings. (http://www.ags-cloud.dk/Wiki/tiki-index.php?page=W_GeometryFileFormat)	Req.

5. [General] section – Power line monitor description.

Keyword	Type	Description	
GateNoForPowerLineMonitor	Integer	Gate number for power line monitor. By default, the last low moment gate will be used to calculate the power line monitor value. This is done using the individual raw SkyTEM skb shots, that are stacked to form the raw data during the import.	Spec.
FreqForPowerLineMonitor	Real	Frequency used for the power line monitor. By default, 50 [Hz] will be used, but it should set based on the frequency of the power lines in the area and can be changed to 60 [Hz] if needed.	Spec.

6. [General] section – Calculate raw data.

Keyword	Type	Description	
CalculateRawDataSTD	Integer	Calculate raw data STD. By default, the raw data STDs will be calculated. This is done using the individual raw SkyTEM skb shots, that are staked to form the raw data during the import. Changing the value from 1 to 0 will disable this. It will also change the calculation of the averages from a weighted average to a simple average. This will be further detailed in a later document.	Spec.

7. [General] section – Waveform definitions.

Keyword	Type	Description	
WaveformLMPoint01 … WaveformLMPointN	2 Reals	Time [s] and normalized amplitude [0;1] for each of the N low moment waveform points. The waveform must start and end at 0 amplitude.	Spec.
WaveformHMPoint01 … WaveformHMPointN	2 Reals	Time [s] and normalized amplitude [0;1] for each of the N high moment waveform points. The number can be different from what is used for low moment. The waveform must start and end at 0 amplitude.	Spec.
WaveformPoint01 … WaveformPointN	2 Reals	Time [s] and normalized amplitude [0;1] for each of the N high moment waveform points. The waveform must start and end at 0 amplitude. If there is only one moment, this version must be used. If both moments are present, both the low moment and high moment versions must be used instead. This must be identical to the setup for NumberOfTurns	Spec.

8. [General] section – Gate time definitions.

Keyword	Type	Description	
GateTimeLM01 .. GateTimeLMN	3 Reals	Center [s], Open [s] and Close [s] times for each of the N low moment gates. MeaTimeDelay should be zero for low moment when this is used.	Spec.
GateTimeHM01 .. GateTimeHMN	3 Reals	Center [s], Open [s] and Close [s] times for each of the N high moment gates. MeaTimeDelay should be zero for high moment when this is used.	Spec.
GateTime01 .. GateTimeN	3 Reals	Center [s], Open [s] and Close [s] times for each of the N gate. The gate times can either be defined with separate gate tables for each moment or with a single gate table. When a single gate table is used, the high moment will usually have a positive MeaTimeDelay that shift the gate times for that moment. See note on timings. (http://www.ags-cloud.dk/Wiki/tiki-ndex.php?page=W_GeometryFileFormat)	Spec.

9. [Channel#] sections – There is one channel description for each moment.

Keyword	Type	Description	
RxCoilNumber	Integer	Receiver coil number. Connects the channel to its RxCoilPosition and RxCoilLPFilter.	Req.
GateTimeShift	Real	Calibration time shift of gatetimes [s]. This must be set to 0 when using system response convolution.	Req.
GateFactor	Real	Calibration factor shift of dB/dt values [factor].	Req.
SystemResponseConvolution	Integer	System response convolution. By default, this is not used. This is equivalent to a value of 0. A value of 1 will enable this. See the system response modeling guide for other things that need to be changed when doing so. (http://www.ags-cloud.dk/Wiki/W_SystemResponse)	Spec.
RemoveInitialGates	Integer	Automatic disable time gate 1 to RemoveInitialGates in the processing.	Req.
PrimaryfieldDampingFactor	Real	Primary field damping factor used in the modeling of the data. This cannot be set to 0. For more about the effect of this damping factor on the filters see the article “Christiansen, A. V., E. Auken, and A. Viezzoli, 2011, Quantification of modeling errors in airborne TEM caused by inaccurate system description, Geophysics, 76, 1, F43-F52”. (http://www.hgg.geo.au.dk/Papers_EndNote/3986773044/CHRISTIANSEN2011.pdf)	Req.
UniformDataSTD	Real	Relative uniform STD for all dB/dt gates. 0.03 = 3%	Req.
MeaTimeDelay	Real	Instrument related time shift [s]. See note on timings. (http://www.ags-cloud.dk/Wiki/tiki-index.php?page=W_GeometryFileFormat)	Spec.
SignPattern	Integers	Sign pattern described with +/-1 integers.	Spec.

		By default, this is not used. It is however required when using system response convolution.	
NoGates	Integer	Number of gates used. From 1 to NoGates.	Req.
RepFreq	Real	Repetition frequency.	
FrontGateTime	Real	Front gate time. A negative front gate time is used when there is no front gate.	Req
TiBLowPassFilter	2 Reals	TiB low pass filter characteristics. The first value is the order of the filter. A value of -1 is used for no filter. The second value is the cut-off frequency [Hz].	Req
TransmitterMoment	String	Transmitter moment. This can be LM, HM or Noise.	Req.
TxAppoximateCurrent	Real	Approximate transmitter current. This must be within 25% of the actual current, else soundings with extreme values will be removed during the processing.	Req
ReceiverPolarizationXYZ	String	Receiver polarization. This can be X, Y or Z.	Req.
GateConstants	NoGates Reals	Gate constants [V/m^2]. If used a value must be added to each gate. The value can be 0.	Opt.
GateFactors	NoGates Reals	Gate factors [factor]. If used a value must be added to each gate. The value can be 1.	Opt.
GateSTDs	NoGates Reals	Gate STDs [factor]. If used a value must be added to each gate. The value can be 1.	Opt.