**Automated Airgun Processing output definitions**

*Aaron Thode*

*SIO/UCSD*

The output file from autonomated airgun processing has the form

SXYYN0TYYYYMMDDT000000.txt

Where “X” is site number, “YY” is two-digit representation of the year of measurement, “N” is letter designating a DASAR at Site X, “YYYY” is the four-digit representation of the year of measurement, “MM” is the two-digit month, and “DD” is the two-digit day.

Thus “S307A0T20070919T000000.txt” is a file containing the airgun results from 2007, Site 3, DASAR A on Sept. 19.

The output file contains one header text line, followed by data in 14 columns, each column described in turn below. If the data are band limited then the frequency range used is also displayed in the header. The description of each column provides units and, if appropriate, a mathematical symbol that will be used at the end of the document to illustrate relationships. Symbols in capital letters represent a quantity expressed in dB units; lower-case letters represent a quantity in linear units.

(1) Date Time: Date and local AK time of pulse detection in the form ‘2007-09-19 00:00:06’, where the time is expressed as a 24-hr clock.

(2) airgun interval (s): Interval in seconds between the detected pulse and the next pulse from the same source.

(3) peak pressure (dB re 1 uPa): The peak pressure attained by the pulse in the time domain.

(4) signal rms S+N (dB re 1uPa): The rms pressure of the signal, computed without subtracting a background noise estimate. Symbol: *Prms,S+N* for dB units, and *prms,S+N* for linear units.

(5) signal SEL S+N (dB re 1uPa^2-s): The sound exposure level (SEL) of the signal, computed without subtracting a background noise estimate.

Symbol: *SEL,S+N,* for dB units, and *sel,S+N* for linear units.

For a bandlimited pulse *x(t)* measured over a pulse duration *tpulse*:



*SELS+N* =10log10(*selS+N)*

(6) signal rms S only (dB re 1uPa): The rms pressure of the signal, computed after subtracting a background noise estimate. Symbol: *Prms,S,* for dB units, and *prms,S* for linear units.

(7) signal SEL S only (dB re 1uPa^2-s): The sound exposure level (SEL) of the signal, computed after subtracting a background noise estimate.

Symbol: *SEL,S,* for dB units, and *sel,S* for linear units.

(8) signal duration (s): The duration of a pulse estimated by taking the 5% and 95% levels of the “normalized cumulative energy flux function” (see Appendix) derived from the bandlimited signal. Symbol: *tpulse.*

(9) noise rms (dB re 1uPa): The rms level of a bandlimited noise sample made just before the onset of a pulse. Symbol: *Prms,N,* for dB units, and *prms,N* for linear units.

(10) noise duration (s): The length of the time sample used to estimate *prms,N*.  Smaller values of “noise duration” indicate non-stationary (less stable with time) background noise. This column is *NOT* used to derive the next column….

(11) noise SEL (dB re 1uPa^2-Hz): The SEL of a sample of background noise measured over a duration equal to the pulse duration. Symbol: *SELN* for dB units, *selN* for linear units. This quantity is important because it relates *selS+N* to *selS*:



Note that these equations are only valid in *linear* units. Also note that it is physically possible for *selS* to be smaller than *selN* for weak pulses.

(12) peak frequency (Hz): Frequency at which the power spectral density of the bandlimited pulse attains its maximum.

(13) number of clips: An integer stating how many samples of the *raw,* data were within three samples of 65536 or within three samples of zero. The raw samples are data samples before equalization, filtering, and scaling. I'd recommend removing associated values from consideration if values are greater than 5.

(14) bearing (degrees) : The azimuth of the pulse in degrees from true north.

Some relationships between the columns are blow. The quantity ‘X’ can represent ‘S+N’, ‘S’, or ‘N’:

*SELX* =10log10(*selX);*

*Prms,X* =20log10(*prms,X);*







Appendix: Normalized cumulative energy flux function

A “cumulative energy flux function” is defined as

 (3)

The “normalized cumulative energy flux function” is

 (4)

If *Cnorm(t0.05)*=0.05 and *Cnorm(t0.95)*=0.95, then the airgun pulse duration *tpulse* is defined as *t0.95*- *t0.05*, that is, the time interval in s between the arrival of 5% and 95% of the total pulse sound exposure.