NAME

mbbackangle – Generates tables of the average amplitude or sidescan values in swath sonar data as a function of the grazing angle with the seafloor.

VERSION

Version 5.0

SYNOPSIS

mbbackangle [**–A***kind* **–C –D –F***format* **–G***kind/angle/max/nx/ny* **–I***file* **–N***nangle/anglemax* **–P***pings* **–Q –R***refangle* **–T***topogridfile* **–Z***altitude* **–V –H]**

DESCRIPTION

The program **mbbackangle** reads a swath sonar data file containing beam amplitude and/or sidescan data and generates tables of the average amplitude and/or sidescan values as a function of the grazing angle with the seafloor. These tables can be used by the program **mbprocess** to correct the sidescan or amplitude data for the variation with grazing angle. No assumption is made about the nature of the data or the sonar used to collect it.

The user specifies the angular width of the swath considered and the number of angular bins in that swath; the average amplitude or sidescan value within each bin form the output data. By default, the grazing angle is calculated simply using the acrosstrack distance and depth at the beam or pixel location. If bathymetry is not available, the seafloor is assumed to be flat with a sonar altitude specified by the **–Z** option. If the **–Q** option is used, then the acrosstrack bottom slope at the beam or pixel location is factored into the grazing angle values. For bins outside the nadir region (angles > 15.0 degrees from vertical), the averaging extends over the neighboring bins (three bins averaged for each value). The user also specifies the number of pings to be read to generate each table; the default is 50 pings.

The results are written to a file named by adding a ".sga" suffix to the swath filename for sidescan and ".aga" for amplitude. These files contain a series of amplitude vs. grazing angle tables, each time tagged according to the average time of the pings used to generate that table. The swath file's **mbprocess** parameter file is also modified (or created if necessary) so that sidescan or amplitude correction is enabled.

The correction tables are read and interpolated according to ping time by **mbprocess**. The correction value for each amplitude or sidescan sample is also interpolated using the samples apparent grazing angle. The grazing angle is calculated using a flat bottom assumption by default but, if the **–Q** option is used, will instead be calculated using the acrosstrack slope in the bathymetry (if available) . If the **–T** option is used to specify a topography grid of the area of interest, then the grazing angle is calculated using that grid rather than any bathymetry data within the file being processed.

If the values are in dB, and therefore log scaled, then the corrections are subtracted from the raw values and then the value of the correction table at the reference angle (specified with the **–R** option) is added back in. In the case of linear data, the correction operation is to divide by the correction value and then multiply by the reference value. At present, only SeaBeam 2100 sidescan values are linear; all other amplitude and sidescan data supported by **MB-System** are in dB.

If the **–G** option is used, then **mbbackangle** also generates gridded histograms of the amplitude versus grazing angle values for each swath data file processed. The user specifies the bounds and dimensions of the grids; the **–G** option must be given twice to produce grids of both amplitude and sidescan histograms. In addition to outputting the grids, **mbbackangle** uses **mbm_grdplot** to generate **GMT** shellscripts that, when executed, will generate plots of the gridded histograms overlain with the amplitude versus grazing angle tables in the ".aga" and ".sga" files.

AUTHORSHIP

David W. Caress (caress@mbari.org)
Monterey Bay Aquarium Research Institute
Dale N. Chayes (dale@ldeo.columbia.edu)
Lamont-Doherty Earth Observatory

OPTIONS

−A *kind*
Determines if beam amplitude (*kind* = 1) and/or sidescan (*kind* = 2) data will be processed. Default: both amplitude and sidescan data are processed.

−C Normally, **mbbackangle** produces a table of amplitude vs grazing angle values which is asymmetric about the vertical (zero angle) axis. If **−C** is specified, the amplitude vs grazing angle function will be forced to be symmetric. Generally, it is better to not use this option in **mbbackangle**, and to instead use **mbset** to set symmetric or asymmetric sidescan correction in the **mbprocess** parameter file.

−D This option causes **mbbackangle** to dump the output to stdout rather than to ".sga" or ".aga" files..

−F *format*
Sets the **MBIO** integer format identifier for the input file specified with the **−I** option. By default, **mbbackangle** infers the format from the "*.mbXX" **MB-System** suffix convention.

−G *kind/angle/max/nx/ny*
This option causes **mbbackangle** to output gridded histograms of the amplitude versus grazing angle data for each swath file processed. The program also generates a shellscript to produce a first-cut **GMT** postscript plot of the histogram overlain by the amplitude versus grazing angle tables used by **mbprocess**. The *kind* parameter indicates whether an amplitude (*kind* = 1) or sidescan (*kind* = 2) histogram is desired; the **−G** command must be given twice (once with *kind* = 1 and once with *kind* = 2) to generate both amplitude and sidescan histograms. The histogram grid consists of *nx* bins extending from −*angle* to +*angle* degrees in the x-dimension, and *ny* bins extending from 0.0 to *max* in the y-dimension. The values of the histogram are normalized so that they sum to 1000.0 within each angle bin.

−H This "help" flag causes the program to print out a description of its operation and then exit immediately.

−I *filename*
Sets the input filename. If *format* > 0 (set with the **−F** option) then the swath sonar data contained in *infile* is read and processed. If *format* < 0, then *infile* is assumed to be an ascii file containing a list of the input swath sonar data files to be processed and their formats. The program will read and process the data in each one of these files. Each input file will have an associated output file with either the ".sga" or ".aga" suffix. In the *infile* file, each data file should be followed by a data format identifier, e.g.:

    datafile1 11
    datafile2 24

This program uses the **MBIO** library and will read any swath sonar format supported by **MBIO**. A list of the swath sonar data formats currently supported by **MBIO** and their identifier values is given in the **MBIO** manual page. Default: *infile* = "datalist.mb-1".

−N *nangle/angle*
The amplitude vs grazing angle table is calculated by binning the amplitude values according to their grazing angles and averaging the amplitudes within each bin. This option sets the number of grazing angle bins (*nangle*) and the maximum angle considered (*angle*). The grazing angle function will be defined at *nangle* points spaced equally from −*angle* to +*angle*. The *nangle* value should be an odd integer so that the middle bin is centered on the angle 0.0. Default: *nangle* = 81, *angle* = 80.0.

−P *pings*
Sets the number of pings to be read and averaged for each amplitude vs grazing angle table. The output "*.sga" or ".aga" files will generally contain many tables, each with a timestamp corresponding to the average of the ping times used for each table. A table may be output averaged over a lesser number of beams if a time gap is encountered in the data, and also at the end of the file. Default: *pings* = 50.

−Q By default, **mbbackangle** does not use seafloor slopes in calculating the grazing angles for each amplitude beam and sidescan pixel. This option causes the program to calculate acrosstrack slopes from swath bathymetry, if available, and to factor these slopes into the grazing angle calculation for each data point.

−R *refangle* Sets the reference angle that will be used by **mbprocess** in applying the amplitude and/or sidescan correction tables generated by **mbbackangle**. Default: *refangle* = 30.0 degrees.

−T *topogridfile* By default, **mbbackangle** does not use seafloor slopes in calculating the grazing angles for each amplitude beam and sidescan pixel. This option causes the program to calculate acrosstrack slopes using the topography grid *topogridfile*, and to factor these slopes into the grazing angle calculation for each data point.

−V Normally, **mbbackangle** works "silently" without outputting anything to the stderr stream. If the **−V** flag is given, then **mbmask** works in a "verbose" mode and outputs the program version being used and all error status messages.

−Z *depth*
This option specifies a default sonar altitude value in meters to be used whenever bathymetry values are unavailable. A flat seafloor (zero slope) will be assumed wherever the default depth needs to be used (e.g. data files with sidescan but no bathymetry, or the outer parts of swaths where the sidescan may extend further than the bathymetry). If this option is not specified, any amplitude or sidescan values without associated bathymetry information will not be used in calculating the amplitude vs grazing angle table.

EXAMPLE

Suppose one has a Simrad EM300 data file called
0003_20020425_022926.mb57 which contains 131 pings. In order to correct the beam amplitude and sidescan with mbprocess, first use **mbbackangle** to generate the amplitude vs grazing angle tables:

```
mbbackangle −I mbari_1998_988_msn.mb57 \
        -N81/80.0 −P50 \
        -G1/80/60/81/121 \
        -G2/80/60/81/121 \
        -V
```

Here the angle bins will be 2.0 degree wide, the table will extend from −80.0 degees (port) to +80.0 (starboard), and each table will represent the averages over up to 50 pings. The output looks like:

```
Program mbbackangle
Version $Id: mbbackangle.ps 2191 2014-06-05 00:59:01Z caress $
MB-system Version 5.0.4

Pings to average:    50
Number of angle bins: 81
Maximum angle:        80.000000
Default altitude:     0.000000
Working on beam amplitude data...
Working on sidescan data...
Using flat bottom assumption in calculating correction tables...
Outputting gridded histograms of beam amplitude vs grazing angle...
Outputting gridded histograms of sidescan amplitude vs grazing angle...
```

```
processing swath file: mbari_1998_988_msn.mb57 57

7274 records processed
805564 amplitude data processed
146 tables written to mbari_1998_988_msn.mb57.aga
5371412 sidescan data processed
146 tables written to mbari_1998_988_msn.mb57.sga

Plot generation shellscript <mbari_1998_988_msn.mb57_aga.grd.cmd> created.
Plot generation shellscript <mbari_1998_988_msn.mb57_sga.grd.cmd> created.

7274 total records processed
805564 total amplitude data processed
146 total aga tables written
5371412 total sidescan data processed
146 total sga tables written
```

The output files include the amplitude versus grazing angle tables in mbari_1998_988_msn.mb57.aga and mbari_1998_988_msn.mb57.sga, the gridded histogram files mbari_1998_988_msn.mb57_aga.grd and mbari_1998_988_msn.mb57_sga.grd, and the plotting shellscripts mbari_1998_988_msn.mb57_aga.grd.cmd and mbari_1998_988_msn.mb57_sga.grd.cmd. The **mbprocess** parameter file mbari_1998_988_msn.mb57.par has also been either created (if necessary) or modified to enable sidescan correction using the ".sga" tables. The first of the six tables in mbari_1998_988_msn.mb57.sga looks like:

```
## Sidescan correction table files generated by program mbbackangle
## Version $Id: mbbackangle.ps 2191 2014-06-05 00:59:01Z caress $
## MB-system Version 5.0.4
## Table file format: 1.0.0
## Run by user <caress> on cpu <hess> at <Fri Oct  1 11:18:30 2004>
## Input swath file:      mbari_1998_988_msn.mb57
## Input swath format:    57
## Output table file:     mbari_1998_988_msn.mb57.sga
## Pings to average:      50
## Number of angle bins:  81
## Maximum angle:         80.000000
## Default altitude:      0.000000
## Data type:             sidescan
# table: 0
# nping: 50
# time:  1998/06/10 14:55:24.979779    897490524.979780
# nangles: 81
-80.0000     0.0000     0.0000
-78.0000     0.0000     0.0000
-76.0000     0.0000     0.0000
-74.0000     0.0000     0.0000
-72.0000     0.0000     0.0000
-70.0000     0.0000     0.0000
-68.0000     0.0000     0.0000
-66.0000     0.0000     0.0000
-64.0000    33.4828     7.5915
-62.0000    32.4068     5.4016
-60.0000    31.9667     5.3320
-58.0000    31.7880     5.1880
-56.0000    31.6249     5.0681
```

-54.0000	31.6362	4.9521
-52.0000	31.5590	5.0482
-50.0000	31.3955	5.1242
-48.0000	31.0372	5.2364
-46.0000	30.9569	5.1092
-44.0000	30.8126	4.9848
-42.0000	30.3497	4.9611
-40.0000	29.7660	4.9479
-38.0000	29.2746	4.9727
-36.0000	29.1929	4.9734
-34.0000	29.1729	4.9893
-32.0000	28.7375	5.0295
-30.0000	28.6560	5.0031
-28.0000	28.0609	5.1757
-26.0000	27.3652	5.2692
-24.0000	26.2536	5.1193
-22.0000	25.2113	4.8437
-20.0000	24.9033	4.5717
-18.0000	24.4118	4.5952
-16.0000	24.4341	4.5824
-14.0000	24.3251	4.7864
-12.0000	23.6965	4.1409
-10.0000	24.1326	3.7653
-8.0000	26.1912	4.2246
-6.0000	27.9516	4.5724
-4.0000	31.1992	5.6401
-2.0000	29.2624	5.8076
0.0000	27.4466	4.3310
2.0000	24.9780	4.1345
4.0000	24.2328	4.0980
6.0000	23.3917	4.6856
8.0000	24.0867	4.5882
10.0000	23.2293	4.6383
12.0000	24.1375	4.5005
14.0000	25.1402	4.6843
16.0000	25.1948	4.9131
18.0000	25.0986	5.0503
20.0000	25.0798	5.0769
22.0000	25.0582	5.1801
24.0000	25.6108	5.1108
26.0000	25.8393	5.0068
28.0000	26.3232	4.9469
30.0000	26.4346	5.0686
32.0000	26.6474	5.1690
34.0000	27.0092	5.2098
36.0000	27.1987	5.1664
38.0000	27.3710	5.2504
40.0000	27.1160	5.1788
42.0000	27.0691	5.1418
44.0000	27.2547	4.8907
46.0000	27.7406	4.9654
48.0000	28.1568	4.9277
50.0000	28.4015	4.9687
52.0000	28.4042	4.9034

```
54.0000   28.3741    4.9500
56.0000   28.5195    4.9799
58.0000   28.6455    5.0142
60.0000   28.9284    4.9876
62.0000   28.9028    5.0380
64.0000    0.0000    0.0000
66.0000    0.0000    0.0000
68.0000    0.0000    0.0000
70.0000    0.0000    0.0000
72.0000    0.0000    0.0000
74.0000    0.0000    0.0000
76.0000    0.0000    0.0000
78.0000    0.0000    0.0000
80.0000    0.0000    0.0000
#
#
```

SEE ALSO

mbsystem(1), **mbprocess**(1), **mbset**(1), **mbfilter**(1)

BUGS

None worth bragging about.