HSMOOTH
DOCUMENTATION

ZONGE Data Processing
H-field Interpolation Program
version 2.0x

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November, 1992

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HSMOOTH Program Documentation

OVERVIEW

HSMOOTH is a program for interpolating magnetic field magnitudes between setup centers in a CSAMT survey. The program reads a Zonge Engineering .AVG-file and replaces it with a modified .AVG-file holding the interpolated values. The original file is saved with an .AV$ extension.

USAGE

Start the program by typing "HSMOOTH". At the prompt, enter the name of the input .AVG-file. For example, specify the file SAMCSAM.AVG by entering "SAMCSAM".

The second prompt requests the width of the filter. Press RETURN for the default 3-point filter. A 1-point filter will not modify the data. Enter an odd number, to be centered about the station that will be replaced by the weighted average. An even number will be incremented by one. We recommended using the number of E-field dipoles measured per H-field coil (per GDP setup).

For automatic batch file operation, specify the filename and filter width on the command line. For example, the file SAMCSAM.AVG and a filter width of 5 are specified by the command line entry:

```
C:> HSMOOTH SAMCSAM /5
```

Cultural effects like powerline noise may corrupt an H-field setup. A ROBUST option may be selected, which will replace the H-field magnitude at a setup by the median value of the three setups centered upon the present setup. This option is available at the command line, using the /R switch:

```
C:> HSMOOTH TEST /5 /R
```

Both the filter width and robust options may be specified by mode lines that are added to the data file. HSMOOTH does NOT read any .MDE-file at this time, nor is a MODE prompt provided. These modes use the POLES and ROBUST names:

```
$ POLES = 5
$ ROBUST= Yes
```

The program groups the stations in the .AVG-file by looking for repeated H-field magnitude and phase data. All CSAMT stations measured with a single setup (multiple E-field dipoles and one H-field coil) will have the same magnetic field values. HSMOOTH interpolates between setup centers with a weighted-moving-average filter.

CSAMT surveys may be configured to measure components other than Ex,Hy, such as Ey,Hx for vector measurements. The survey may also employ orthogonal transmit dipoles. The AMTAVG program will write the .AVG-file with a column that identifies the component pair, and markers for multiple transmitters will be included. HSMOOTH will write a temporary file for each component pair and transmitter configuration. Each set of data will be filtered separately, and written in sequence to the new file.

HSMOOTH writes a new .AVG-file with modified H-field magnitude values. If the .AVG-file includes resistivity data, these values will be adjusted by the squared ratio of original and filtered H-field magnitudes. The original .AVG-file is renamed with an .AV$ extension.

A .LOG-file will also be written, summarizing the operation of HSMOOTH.

HSMOOTH will give satisfactory results if transmitter currents are accurately recorded. Inaccurate current normalization causes the same perturbations in E- and H-field magnitudes, but HSMOOTH will remove the perturbations from the H-field magnitude values only. The perturbations remaining in the E-field will then show up as apparent resistivity anomalies.

The weights used by HSMOOTH for several filter widths are included below:

filter width	filter weights								
1					1.0				
3				.50	1.0	.50			
5			.33	.67	1.0	.67	.33		
7		.25	50	.75	1.0	.75	.50	.25	
9	.20	.40	.60	.80	1.0	.80	.60	.40	.20

Sample Run, Smooth the H-field Magnitude data in file SAMCSAM.AVG

```
C:> HSMOOTH                                    /* Start the program

ZONGE ENGINEERING: 3322 E. Fort Lowell, Tucson AZ 85716, USA
HSMOOTH 2.00: Smooth H-field Mag data over E-field data.
   MS-DOS version implemented 25 May, 1993

Input filename  [quit]: SAMCSAM                /* Enter the filename

Check data columns . . .
Write component files . . .

Specify the width of the smoothing filter.
A 1-point filter results in no change to the data.
Enter an odd number, to be centered about the station that
will be replaced by the weighted average.  An even number
will incremented by one.  We recommended using the number
of E-field dipoles measured per H-field coil (per GDP setup).

Number of points  [3]: 5                       /* Specify the filter
A  5-pole filter will be used.

Reading data from "ExHy.TMP" . . .
Writing filtered data . . .

Saving original file as SAMCSAM.AV$
Thank You!

C:>
```

Sample Data File

```
\ AMTAVG 7.01: "SAMCSAM.FLD", Dated 91-01-01, Processed 01 Dec 92
$ ASPACE= 183.0m
skp Station Freq  Comp Amps     Emag     Ephz      Hmag     Hphz  Resistivity   Phase  %Emag  sEphz  %Hmag  sHphz   %Rho   sPhz
\=][======][====][===][====][=========][======][=========][======][=========][======][=====][=====][=====][=====][=====][=====]
 2      0.0  8192 ExHy  4.5   1.1731e+3  1491.0  3.5150e-1   722.7  2.7195e+2   768.3    0.4    3.1    1.4   14.7    1.7   16.6
 2      0.0  4096 ExHy  8.    8.5835e+2  2087.0  3.9003e-1  1244.7  2.3648e+2   842.4    0.4    3.1    0.9    7.1    1.4   12.9
 2      0.0  2048 ExHy 15.    6.7279e+2  2450.4  4.4613e-1  1557.8  2.2209e+2   892.6    1.1   11.3    1.2    1.6    0.1    1.1
 2      0.0  1024 ExHy 22.    5.4680e+2  2809.1  5.4905e-1  1884.1  1.9372e+2   925.0    1.0    6.0    1.2    7.5    0.4    3.5
 2      0.0   512 ExHy 27.    4.3143e+2  3087.0  6.6498e-1  2170.8  1.6442e+2   916.3    0.0    1.4    0.1    0.6    0.2    1.8
 2      0.0   256 ExHy 29.    3.6102e+2 -3065.5  8.6567e-1  2361.3  1.3588e+2   856.3    0.0    0.3    0.2    2.1    0.2    1.9
 2      0.0   128 ExHy 30.    3.1513e+2 -3056.5  1.1202e+0  2473.8  1.2365e+2   752.8    0.1    0.6    0.3    3.3    0.3    2.8
 2      0.0    64 ExHy 30.    2.9184e+2 -3073.0  1.3978e+0  2519.9  1.3621e+2   690.3    0.2    4.8    0.5    4.2    0.2    2.0
 2      0.0    32 ExHy 30.    2.3443e+2  3015.3  1.8517e+0  2488.9  1.0018e+2   526.4    0.5    2.1    0.5    4.3    0.2    1.4
 2      0.0    16 ExHy 30.    3.4135e+2  2697.3  2.7474e+0  2616.3  1.9295e+2    81.0    0.5    4.3    0.5    4.9    0.1    1.2
 2      6.0  8192 ExHy  4.5   1.2513e+3 -2111.5  3.6216e-1 -3036.5  2.9142e+2   925.0    1.0   12.0    1.3   12.8    2.4   19.8
 2      6.0  4096 ExHy  8.    8.5772e+2 -1267.2  3.8044e-1 -2183.9  2.4819e+2   916.7    0.2    3.0    0.7    8.3    1.2   12.0
 2      6.0  2048 ExHy 15.    6.4934e+2  -785.8  4.2923e-1 -1762.4  2.2349e+2   976.6    0.1    1.1    0.4    4.3    0.5    3.2
 2      6.0  1024 ExHy 22.    5.0469e+2  -373.3  5.2905e-1 -1355.6  1.7775e+2   982.3    0.1    0.4    0.1    1.7    0.2    2.0
 2      6.0   512 ExHy 27.    3.9387e+2   -73.8  6.4048e-1 -1031.4  1.4772e+2   957.5    0.0    1.5    0.1    0.9    0.2    2.7
 2      6.0   256 ExHy 29.    3.2680e+2    68.6  8.3859e-1  -819.4  1.1865e+2   887.9    0.1    0.4    0.1    0.9    0.3    2.8
 2      6.0   128 ExHy 30.    2.8114e+2    92.6  1.0776e+0  -709.6  1.0635e+2   802.3    0.0    0.3    0.0    0.3    0.1    0.5
 2      6.0    64 ExHy 30.    2.6778e+2    87.0  1.4003e+0  -635.9  1.1428e+2   722.9    0.1    1.1    0.3    2.5    0.2    2.2
 2      6.0    32 ExHy 30.    2.0597e+2    -8.5  1.8163e+0  -679.5  8.0377e+1   671.0    0.1    1.4    0.2    1.7    0.2    1.9
 2      6.0    16 ExHy 30.    2.6405e+2  -442.2  2.6760e+0  -546.5  1.2170e+2   104.2    0.3    4.6    0.2    2.2    0.5    1.2
 2     12.0  8192 ExHy  4.5   1.5175e+3 -3128.3  3.5544e-1  2424.6  4.4503e+2   730.3    0.6   13.9    2.4   25.7    3.7   36.7
 2     12.0  4096 ExHy  8.    1.0776e+3 -1818.9  3.5323e-1 -2617.0  4.5444e+2   798.1    0.2    3.8    0.5    5.3    1.0    9.6
 2     12.0  2048 ExHy 15.    8.4220e+2 -1080.0  4.0646e-1 -2001.8  4.1928e+2   921.8    0.1    1.0    0.2    1.4    0.3    2.5
 2     12.0  1024 ExHy 22.    6.6369e+2  -532.1  4.9443e-1 -1481.4  3.5192e+2   949.3    0.0    0.3    0.0    1.8    0.2    1.7
 2     12.0   512 ExHy 27.    5.2781e+2  -170.1  6.0843e-1 -1104.1  2.9397e+2   933.9    0.1    2.0    0.3    1.8    0.3    2.4
 2     12.0   256 ExHy 29.    4.4406e+2    -7.6  8.0176e-1  -861.5  2.3966e+2   854.0    0.1    0.2    0.1    0.9    0.1    0.9
 2     12.0   128 ExHy 29.    3.9475e+2    18.2  1.0473e+0  -721.9  2.2197e+2   740.1    0.1    1.4    0.3    2.5    0.4    3.7
 2     12.0    64 ExHy 30.    3.8188e+2    24.0  1.3362e+0  -646.9  2.5524e+2   670.8    0.1    1.2    0.3    2.5    0.5    5.0
 2     12.0    32 ExHy 30.    3.0221e+2  -146.5  1.7584e+0  -676.9  1.8461e+2   530.4    0.3    5.0    0.2    2.3    0.2    3.4
 2     12.0    16 ExHy 30.    4.4644e+2  -491.6  2.6151e+0  -548.9  3.6431e+2    57.3    0.1    1.3    0.2    2.1    0.4    1.9
 2     18.0  8192 ExHy  4.5   1.6965e+3  2432.0  3.1821e-1  1483.5  6.9396e+2   948.4    1.8   18.0    2.8   24.0    4.8   46.8
 2     18.0  4096 ExHy  8.    1.1682e+3 -2162.8  3.4951e-1 -3086.2  5.4546e+2   923.4    1.6   17.2    0.3   20.6    0.5    5.7
 2     18.0  2048 ExHy 15.    8.8357e+2 -1238.2  4.0162e-1 -2206.4  4.7266e+2   968.2    0.0    1.0    0.6    6.4    0.4    5.4
 2     18.0  1024 ExHy 22.    6.8430e+2  -614.6  4.8870e-1 -1614.7  3.8294e+2  1000.1    0.0    0.4    0.4    0.8    0.7    6.2
 2     18.0   512 ExHy 26.    5.3223e+2  -192.5  5.9619e-1 -1180.4  3.1131e+2   987.9    0.2    0.7    0.1    1.5    0.2    2.6
 2     18.0   256 ExHy 28.    4.3459e+2    -1.5  7.7973e-1  -904.0  2.4270e+2   902.4    0.0    0.6    0.1    1.3    0.1    1.4
 2     18.0   128 ExHy 28.    3.8217e+2    43.6  1.0276e+0  -747.1  2.1611e+2   790.8    0.5    2.6    0.7    6.5    0.3    3.0
 2     18.0    64 ExHy 30.    3.6596e+2    60.4  1.2974e+0  -649.7  2.4861e+2   710.1    0.7   10.4    0.9   10.4    0.6    5.7
 2     18.0    32 ExHy 30.    2.7788e+2   -38.6  1.7036e+0  -690.5  1.6629e+2   651.9    0.2    5.4    0.4    4.2    0.2    2.0
 2     18.0    16 ExHy 30.    3.7603e+2  -491.6  2.5579e+0  -558.1  2.7013e+2    66.5    0.3    1.8    0.3    2.2    0.0    0.4
 2     24.0  8192 ExHy  4.    2.0018e+3  1453.4  2.8862e-1   672.6  1.1744e+3   780.8    0.5    6.7    3.1   31.1    3.7   36.6
 2     24.0  4096 ExHy  8.    1.4450e+3 -2661.4  3.3326e-1  2765.7  9.1792e+2   856.0    0.5    4.2    1.2   13.7    2.2   22.2
 2     24.0  2048 ExHy 15.    1.1192e+3 -1485.7  3.7744e-1 -2406.8  8.5868e+2   921.1    0.2    1.1    0.4    4.3    0.6    6.3
 2     24.0  1024 ExHy 22.    8.6714e+2  -712.8  4.4784e-1 -1683.9  7.3225e+2   971.2    0.0    0.2    0.1    3.4    0.3    3.8
 2     24.0   512 ExHy 26.    6.6926e+2  -240.2  5.4469e-1 -1212.4  5.8973e+2   972.2    0.0    0.1    0.2    1.9    0.3    3.4
 2     24.0   256 ExHy 28.    5.1201e+2   -28.6  6.6927e-1  -921.4  4.5725e+2   892.8    0.0    0.2    0.2    2.4    0.5    4.7
 2     24.0   128 ExHy 28.    4.9467e+2    26.6  9.7175e-1  -771.2  4.0490e+2   797.8    0.0    0.8    0.2    1.6    0.3    3.0
 2     24.0    64 ExHy 28.    5.0064e+2    42.6  1.3067e+0  -657.9  4.5872e+2   700.5    0.5    2.5    0.3    2.8    1.0    9.8
 2     24.0    32 ExHy 28.    3.7409e+2   -33.2  1.6845e+0  -676.6  3.0825e+2   643.4    0.3    4.1    0.4    4.5    0.2    2.0
 2     24.0    16 ExHy 28.    5.1261e+2  -515.1  2.5315e+0  -562.5  5.1254e+2    47.4    0.2    2.1    0.2    2.1    0.1    1.4
 2     30.0  8192 ExHy  4.5   1.0969e+3 -1667.4  2.9457e-1 -2325.8  3.3851e+2   658.4    1.9   15.6    6.9   69.6   11.6  108.7
 2     30.0  4096 ExHy  8.    7.8682e+2 -1051.9  2.9363e-1 -1843.0  3.5059e+2   791.1    0.1    0.8    0.7    8.2    1.2   11.6
 2     30.0  2048 ExHy 15.    6.1638e+2  -662.2  3.2983e-1 -1574.8  3.4105e+2   912.7    0.1    0.8    0.7   10.1    1.8   16.8
 2     30.0  1024 ExHy 22.    4.7630e+2  -287.8  3.9858e-1 -1263.9  2.7891e+2   976.0    0.1    0.5    0.2    5.8    0.5    5.5
 2     30.0   512 ExHy 28.    3.6720e+2   -16.6  4.7574e-1 -1008.9  2.3272e+2   992.4    0.2    1.4    0.3    4.1    0.3    3.7
 2     30.0   256 ExHy 30.    3.0297e+2    93.6  6.4638e-1  -821.1  1.7164e+2   914.7    0.1    0.9    0.1    1.5    0.3    2.9
 2     30.0   128 ExHy 30.    2.6245e+2    97.7  8.5108e-1  -715.2  1.4859e+2   812.9    0.2    0.8    0.3    2.6    0.3    2.8
 2     30.0    64 ExHy 30.    2.5341e+2    83.7  1.0888e+0  -632.8  1.6928e+2   716.5    0.1    1.7    0.7    6.1    0.6    5.9
 2     30.0    32 ExHy 30.    1.8666e+2    38.9  1.3951e+0  -653.1  1.1188e+2   691.9    0.3    1.1    0.7    6.5    0.7    7.9
 2     30.0    16 ExHy 30.    2.4393e+2  -518.6  2.0950e+0  -565.6  1.6947e+2    47.0    0.4    3.7    0.6    5.0    0.5    2.5
```